WESTERN SOCIETY OF WEED SCIENCE

1995 RESEARCH PROGRESS REPORT

ISSN-0090-8142

RED LION HOTEL
SACRAMENTO, CALIFORNIA
MARCH 13-16, 1995

FORWARD

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Stephen D. Miller
Editor, Research Progress Report
Western Society of Weed Science;
1995

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PROJECT 1

WEEDS OF RANGE AND FOREST

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<u>Red alder seed germination control using pre-plant broadcast herbicide applications: Plantation age six status report</u>. Paul F. Figueroa. Red alder is a major hardwood competitor to conifers in the Pacific Northwest. It is a prolific seeder that seeds in from adjacent natural stands and rapidly develops from seed forming an overtopping canopy that suppresses conifer growth. Current standard control methods allow alder to develop until densities exceed a competition threshold (usually between plantation ages' six and ten years).

Many common aerial herbicide control applications use either 2,4-D or a combination of 2,4-D plus triclopyr for spring-foliar conifer release treatments. The spring-foliar release window is narrow since it is between the time red alder leaves have developed to at least 75% of their previous years full size, and Douglas-fir terminal bud expansion is less than 1.5 inches (on less than 5% of the trees). This is the time Douglas-fir has the lowest risk of herbicide injury and when the alder is most sensitive. If triclopyr is selected as the herbicide for release treatment it cannot be used if there has been any Douglas-fir bud expansion. This herbicide treatment guide results in an operational window that can range from a few days to several weeks depending on the herbicide used, climatic and yearly growing conditions. If treatment is not made there can be lower conifer growth rates in subsequent years and a greater risk for reduced long-term growth.

An alternative alder control strategy is to prevent red alder seed from germinating through the use of soil-active herbicides. This approach could potentially eliminate or reduce future need for conifer release treatments. A research test was established to evaluate several soil active herbicides and their ability to prevent alder seed from germinating and developing into conifer competitors. The study was established in an area where there was a high probability of alder seed germination.

The test was established in Weyerhaeuser Company's Southwest Washington Region on a site that had been burned as a site preparation treatment (1988). Alder seed germination was assessed on 48 0.03 acre plots that were treated with imazapyr, asulam, atrazine, and sulfometuron. Treatments were applied as pre-plant and pre-plant plus repeat broadcast application treatments. Treatment blocks were established to correspond to seeding distances from a mature alder stand. These blocks represented zones of 50 to 100, 100 to 150, 150 to 200, and 200 to 250 feet from the seed source. Pre-plant herbicide treatments were initially applied three weeks prior to planting 2+0 Douglas-fir seedlings (3/6/89). Follow-up release treatments were done in March 1990 and February 1991. Table 1 shows the treatments tested in this study.

<u>Table 1</u>. Spring applied herbicide treatments.

Treatment	Timing
Check	no herbicide treatment
Asulam (1.7 lb)	year 0 only (Aug 1989)
Imazapyr (0.15 lb)	year 0, year 0+1, year 0+1+2
Atrazine (4.0 lb)	year 0, year 0+1, year 0+1+2
Atrazine (4.0 lb) plus asulam (1.7 lb)	year 0+1+2 plus year 0, in August 1989
Sulfometuron (2 oz)	year 0, year 0+1, year 0+1+2

There was a treatment effect on seed germination and alder height patterns for age 5 and 6 years. Three years of imazapyr had lower germination and alder height than either the 1 and 1+2 imazapyr treatments for each zone. A similar trend was seen for atrazine and sulfometuron treatments (Figures 1, 2, 3, 4). However, sulfometuron had lower density and shorter alder heights than either atrazine or imazapyr treatments.

Red alder seed germination by the sixth year after treatment began to show different patterns. As shown in Table 2, there appeared to be a more random (or normal) seed germination pattern developing at age 6. It is highly unlikely that there could be any herbicide residual that would inhibit seed germination during the sixth year.

At plantation age 6, red alder seedling density differences could be related to chance, but it appears applications of sulfometuron were effective at preventing alder seed from germinating. Visual observations indicate a generally higher degree of vegetation control, and increase in Douglas-fir growth on sulfometuron treated plots (compared to the non-treated check and the atrazine and imazapyr plots). This suggest there are other positive gains from sulfometuron in addition to controlling red alder germination.

It was noted that by age 6 only the sulfometuron 0+1 and sulfometuron 0+1+2 treatments maintained alder stocking and height below a level that would mandate broadcast aerial herbicide application in order to maintain conifer growth and survival. Additional larger scale operational applications are ongoing to validate these data across a broad range of soils and site conditions. (Weyerhaeuser Company, 505 North Pearl Street, Centralia, WA 98531).

Table 2. Red alder density and predominant mean height for ages 4, 5, and 6 by treatment for the 50 - 100 feet zone from the alder seed source.

Treatment	Red Alder Density			Red Alder Height		
	age 4	age 5	age 6	age 4	age 5	age 6
	(tpa)	(tpa)	(tpa)	(feet)	(feet)	(feet)
Check	2267	2533	3400	6.4	10.0	16.5
Asulam	4000	6133	10733	5.0	7.3	16.7
Atrazine 0	667	2000	5133	2.6	6.6	10.3
Atrazine 0+1	367	600	1000	3.3	6.0	10.7
Atrazine 0+1+2	67	500	2700	1.4	3.9	8.1
Atrazine/Asulam	100	167	1600	1.0	3.2	5.4
Imazapyr 0	2133	2533	3567	7.0	7.3	17.0
Imazapyr 0+1	1000	1933	4167	6.7	9.1	16.4
Imazapyr 0+1+2	567	733	3367	2.5	4.2	11.5
Sulfometuron 0	33	400	2867	0.4	1.0	6.2
Sulfometuron 0+1	0	67	800	0	0.1	1.6
Sulfometuron 0+1+2	0	0	400	0	0	0.8

Ryderwood, 9100 Road herbicide screening trial. Red alder seedling density and height five and six years after Douglas-fir plantation establishment. Asulam applied at 1.7 lb, imazapyr at 0.15 lb, atrazine at 4.0 lb, and sulfometuron at 2 oz.

Figure 1. Age 5 red alder density by treatment and by distance from the seed source.

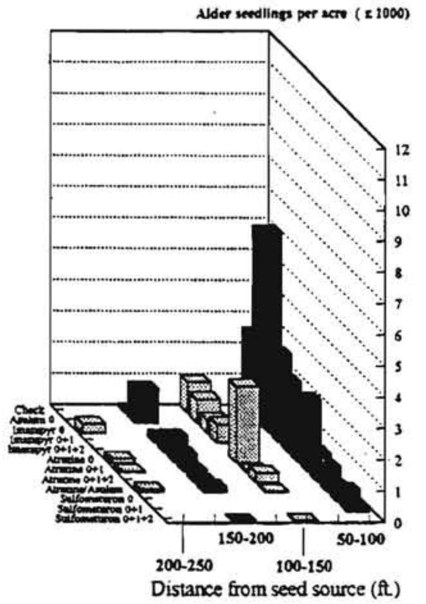


Figure 2. Age 6 red alder density by treatment and by distance from the seed source.

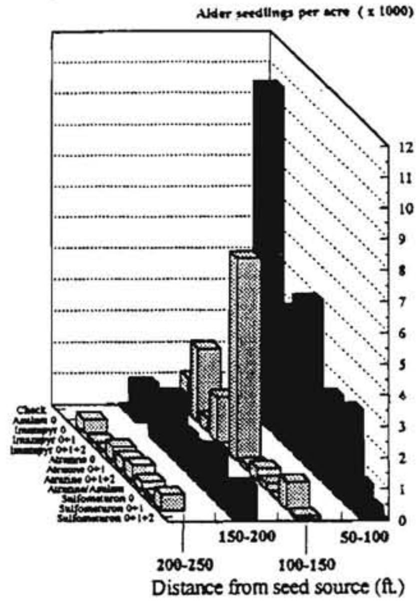


Figure 3. Age 5 red alder mean height in the 50 to 100 ft. zone from the seed source by treatment.

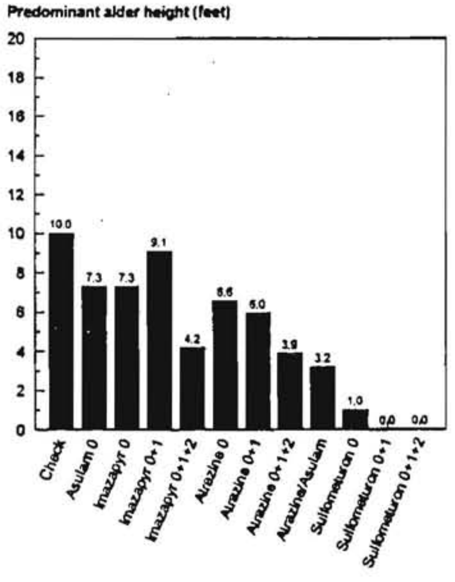
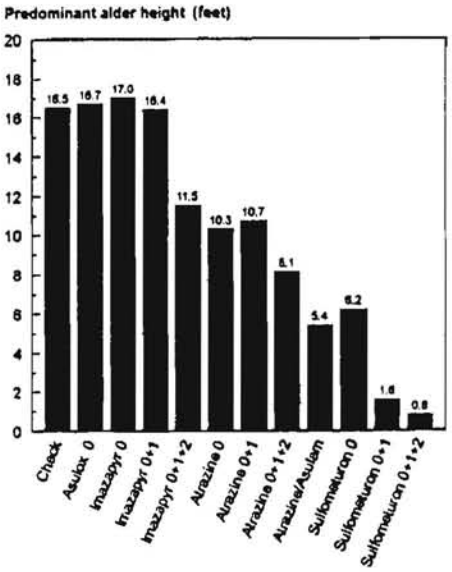


Figure 4. Age 6 red alder mean height in the 50 to 100 ft. zone from the seed source by treatment.



Black cottonwood seed germination control using sulfometuron: Plantation age two status report. Paul F. Figueroa. Black cottonwood is a hardwood competitor that occurs in many conifer plantations in the Pacific Northwest. It generally seeds into areas adjacent to water sources and particularly on soils that have intermittently high water tables. Black cottonwood can be a very prolific seeder when adjacent soil or water conditions are correct. It can have rapid juvenile growth that can quickly overtop planted trees and suppress conifer growth. Current standard control methods allow alder to develop until densities exceed a competition threshold (usually between plantation ages' two and six years).

Most aerial herbicide control treatments use triclopyr for spring-foliar conifer release treatments after the plantation is older than 2 years. The spring-foliar release window occurs when cottonwood leaves have developed to at least 50 to 75% of their previous years full size and there is no Douglas-fir bud expansion. This is the time Douglas-fir has the lowest risk of herbicide injury and when the cottonwood is susceptible to triclopyr. If any conifer bud swell or growth is detected, treatments are postponed until the next year. If treatment is not made there can be lower conifer growth for the succeeding years depending upon cottonwood densities.

An alternative control strategy is to prevent cottonwood seed from germinating through the use of sulfometuron as a pre-plant site preparation treatment. This approach has shown to be effective for control of red alder in similar situations where it could potentially eliminate or reduce future need for conifer release treatments.

The test was established in Weyerhaeuser Company's Cascade Region on a site that had no mechanical site preparation treatment following harvest. The treatment unit was located in an area where there was a high probability of cottonwood seed germination and high probability a release treatment would be required. Herbicide treatment was applied May 12, 1993 prior to conifer planting on June 3, 1993. The second-year release treatment was made on March 28, 1994 prior to conifer growth and expected cottonwood germination. Table 1 lists the treatments for this study.

Table 1. Spring applied herbicide treatments.

Treatment Name	Herbicide Rate	Timing
Check	None —	no herbicide treatment
Site Preparation	Sulfometuron (4 oz)	year 0 (May 1993)
Release Only	Sulfometuron (2.6 oz)	year 1 (March 1994 only)
Site Preparation plus Release	Sulfometuron (4 oz) plus Sulfometuron (2.6 oz)	year 0 (May 1993) year 1 (March 1994)

Each treatment consisted of a five acre block. Applications were made by helicopter using 10 gallons water per acre. Cottonwood seed germination was assessed on a set of ten 0.02 acre monitoring plots per treatment. On the basis of visual observations of each treatment block, it is unlikely that any block would have substantially different cottonwood germination and growth patterns.

As shown in Table 2 and Figures 1 through 4, two years after treatment there appears to be treatment effects. The non-treated check plots had 1140 cottonwood seedlings that averaged 4.4 feet in height. The release only treatment had higher density but is probably no different from the non-treated check plots. The predominant mean height differences may be significant in later years. Observation of the other competing vegetation indicates that the sulfometuron release treatment did reduce total vegetation cover. This reduction in grasses and forb competition appears to have given the established cottonwood more site resources and resulted in more vigorous seedlings. These visually different, higher vigor cottonwoods may have the potential to grow at a higher rate than the cottonwood on the non-treated check plots.

Cottonwood germination and growth on the site preparation treatment are lower than either the check or release treatments. This treatment was effective in controlling other competing vegetation including grasses and forbs into the second growing season. The lower cottonwood density probably accounted for the vigorous second year height growth.

The site preparation plus release treatment maintained the lowest level of cottonwood germination and growth. These two treatments provided grass and forb control below the level that is expected to impact conifer or hardwood growth. The surviving cottonwoods were of poor vigor showing potential longer term treatment effects.

On the basis of cottonwood density and height (relative to planted conifers), both the non-treated check and release only block would be scheduled for operational aerial broadcast release treatments. Additional measurement years will be needed to determine if either the site preparation or site preparation plus release treatments can effectively keep cottonwood competition from significantly affecting conifer growth or survival. (Weyerhaeuser Company, 505 North Pearl Street, Centralia, WA 98531).

Table 2. Black cottonwood density and predominant mean height for ages 1 and 2 years after treatment.

Treatment	Cottonwood Density age 1	Cottonwood Density age 2	Cottonwood Height age 1	Cottonwood Height age 2
	(tpa)	(tpa)	(feet)	(feet)
Check	100	1140	0.2	4.4
Release only	285	1935	0.2	4.8
Site Preparation only	5	340	0.1	4.2
Site Preparation + Release	0	5	0	0.4

Griffin Creek Mainline, 26198 Road site preparation and release trial. Black cottonwood density and height one and two years after plantation establishment. Sulfometuron applied at 4 oz product per acre for site preparation and 2.6 oz per acre for the release treatment.

Figure 1. Age 1 cottonwood density by treatment.

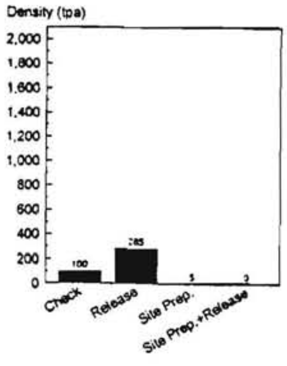


Figure 2. Age 2 cottonwood density by treatment.

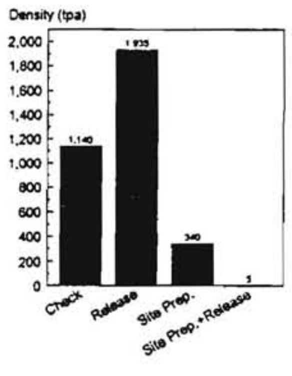


Figure 3. Age 1 cottonwood height by treatment.

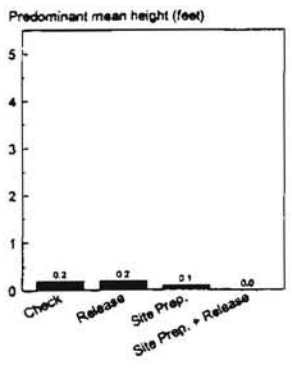
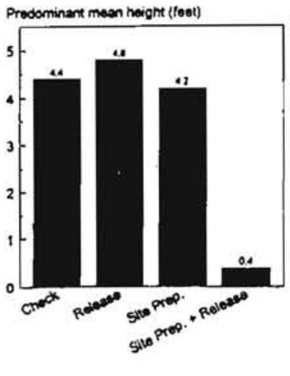


Figure 4. Age 2 cottonwood height by treatment.



<u>Percent live canopy of downy brome infested rangeland following one, two and three annual applications of paraquat and glyphosate (Kaycee, WY)</u>. Tom D. Whitson, Gerald E. Fink, R.E. Swearingen, D.C. Meyers. Research was established on rangeland at the Means Old 88 Ranch, Kaycee, WY to evaluate successive annual herbicide treatments for control of downy brome (*Bromus tectorum* L.). The studies were established at two downy brome growth stages, 2 to 8 leaf and early bloom. Treatments were applied to 35 by 660 ft. single blocks with four randomized permanent transects established within each block. Herbicides were applied with a tractor mounted sprayer delivering 13 gpa at 35 psi. Applications information: April 9, 1991 (air temp. 48F, relative humidity 48%, wind N 2-5 mph, sky clear, soil temp. - 0 inch 45F, 2 inch 45F and 4 inch 42F) downy brome was in the 2 to 3 leaf stage 1 inch tall, May 17, 1991 (air temp. 55F, relative humidity 55%, wind calm, sky cloudy, soil temp. - 0 inch 53F, 2 inch 49F and 4 inch 55F) to downy brome in the 2 to 8 leaf stage. April 23, 1992 (air temp. 59F, relative humidity 59%, calm winds, clear sky, soil temp. - 0 inch 67F, 2 inch 63F and 4 inch 63F) Downy brome in the 2 to 8 leaf stage, May 6, 1992 (air temp. 80F, relative humidity 32%, calm winds, clear sky, soil temp. - 0 inch 70F, 2 inch 70F and 4 inch 65F) to downy brome with 50% seed head emergence, April 29, 1993 (air temp. 65F, relative humidity 60%, clear sky, wind SW 2-3 mph, soil temp. - 0 inch 60F, 2 inch 62F and 4 inch 62F) to downy brome in the 2 to 3 leaf stage, and June 11, 1993 (air temp. 70F, relative humidity 71%, wind S 1 mph, clear sky, soil temp. - 0 inch 85F, 2 inch 75F and 4 inch 75F) to Downy brome was in early bloom. Downy brome was heavy with a uniform distribution.

Neither paraquat or glyphosate applied as a single year application provided satisfactory control of downy brome with the long-term objective of a reduction in its seed bank. Paraquat applications at 0.5 lb/acre for two consecutive years at either the 2 to 8 leaf or at early bloom stages provided greater than 90% downy brome control. Needleandthread (<u>Stipa comata</u>) live canopy cover increased from 8% in the check to greater than 21%. Western wheatgrass decreased from 5% in the check to 1%. Forbs increased from 1% to greater than 2% while bare ground increased from 32% in the check to greater than 49% in areas treated at both growth stages with paraquat at 0.5 lb/A.

Glyphosate applied three consecutive years at the 2 to 8 leaf stage at 0.5 lb/A provided greater than 98% downy brome control. Blue grama live canopy increased from 8% in the check t 12% in the treated area. Needleandthread live canopy increased from 8% in the check to 24% in the treated area, western wheatgrass decreased from 5% in the check to 1% in the treated area. Forbs increased from 1% in the check to 4% in the treated area while bare ground increased fro 32% in the check to 58% in the treated area. (Agric. Exp. Sta., Laramie, WY 82071 SR 1695).

<u>Table</u>. Percent live canopy of downy brome infested rangeland following one, two and three annual applications of paraquat and glyphosate. (Kaycee, WY)

Treatment[1]	Rate	Year	BROTE[2] 2-8 lf	BROTE EB	STICO 2-8 lf	STICO EB	BOUGR 2-8 lf	BOUGR EB	CARFI 2-8 lf	CARFI EB	AGRSM 2-8 lf	AGRSM EB	Misc forb 2-8 lf	Misc forb EB	Bare G 2-8 lf	Bare G EB
			Percent live canopy cover[3]													
Paraquat	0.5	1991	11	18	37	31	18	20	3	1	2	2	7	7	22	18
Paraquat	0.5	1991,1992	3	3	31	36	28	25	4	1	1	1	8	6	25	28
Paraquat	0.5	1991,1992,1993	1	1	20	37	36	31	6	0	1	0	7	3	29	28
Paraquat	0.7	1991	13	5	27	38	37	23	2	1	0	2	4	3	16	28
Paraquat	0.7	1991,1992	4	8	24	24	38	20	4	2	2	2	9	12	20	30
Paraquat	0.7	1991,1992,1993	1	0	26	40	24	26	4	0	1	1	10	5	32	29
Paraquat	0.9	1991	15	8	41	28	10	29	2	1	2	1	5	3	24	30
Paraquat	0.9	1991,1992	2	1	34	40	11	17	6	2	1	2	14	8	31	30
Paraquat	0.9	1991,1992,1993	0	0	16	37	26	22	13	1	0	0	9	3	35	37
Paraquat	1.1	1991	36	7	19	29	16	26	3	2	2	1	6	2	18	32
Paraquat	1.1	1991,1992	17	1	33	39	16	21	4	1	1	0	16	5	13	33
Paraquat	1.1	1991,1992,1993	1	0	10	28	31	30	9	0	1	0	7	4	40	38
Glyphosate	0.38	1991	44	30	20	16	7	15	0	0	12	10	4	3	13	25
Glyphosate	0.38	1991,1992	19	17	29	31	14	0	0	0	9	1	5	4	24	26
Glyphosate	0.38	1991,1992,1993	22	3	30	22	23	28	0	0	3	1	4	2	19	44
Glyphosate	0.5	1991	21	13	26	30	21	26	0	0	8	1	6	2	18	26
Glyphosate	0.5	1991,1992	9	12	33	29	27	22	0	0	0	4	9	5	18	28
Glyphosate	0.5	1991,1992,1993	1	4	33	24	36	26	0	0	1	7	7	1	18	38
Glyphosate	0.63	1991	10	38	27	12	34	15	0	0	3	11	9	4	17	19
Glyphosate	0.63	1991,1992	9	19	35	21	25	16	0	0	0	9	11	8	20	26
Glyphosate	0.63	1991,1992,1993	10	2	35	26	9	14	0	0	1	6	16	2	29	48
Glyphosate	0.75	1991	38	23	26	25	7	21	0	0	3	3	15	3	11	21
Glyphosate	0.75	1991,1992	31	14	13	35	9	17	0	0	2	5	22	2	20	21
Glyphosate	0.75	1991,1992,1993	8	0	23	27	13	20	0	0	1	1	16	2	34	49
Check	--	-------	33	33	18	18	14	14	0	0	18	19	2	1	15	15

[1]Treatments applied April 9, 1991, April 23, 1992 and April 29, 1993 downy brome 2 to 8 leaf stage, May 17, 1991, May 6, 1992 and June 11, 1993 downy brome early bloom.

[2]BROTE - <u>Bromus tectorum</u>, STICO - <u>Stipa comata</u>, BOUGR - <u>Bouteloua gracilis</u>, CARFI - <u>Carex filifolia</u>, AGRSM - <u>Agropyron smithii</u>, Misc. forb - miscellaneous forbs, Bare G. - Bare ground, 2-8 lf - 2 to 8 leaf, EB - Early Bloom.

[3]Weed control live canopy based on 400 pint frame counts/treatment, July 28-30, 1993.

Wild caraway control with herbicides on Colorado grass hay meadow. J.R. Sebastian, and K.G. Beck. An experiment was established in a grass hay meadow near Steamboat, CO to evaluate wild caraway (CARCA) control with triclopyr amine and ester, 2,4-D amine and ester, and 2,4-D amine plus liquid nitrogen. The design was a randomized complete block with four replications. All treatments were applied May 17, 1994 with a CO_2-pressurized sprayer using 11003LP flat fan nozzles at 24 gal/A, and 15 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Visual evaluations of treated plots were compared to non-sprayed control plots and taken June 20, 1994 before cutting. Fall rosettes failed to germinate in 1994 (possibly due to droughty conditions), so only one evaulation was completed. Triclopyr amine controlled 33 to 45% of CARCA and triclopyr ester controlled 20 to 63% of CARCA approximately 1 month after treatment (MAT). 2,4-D amine and ester provided 43 to 68% control of CARCA 1 MAT. 2,4-D amine plus nitrogen (1.0 and 2.0 lb ai/a plus 8.0 qt pr/a) provided 65 to 80% CARCA control 1 MAT but nitrogen did not improve 2,4-D amine's performance. There were no differences between similar rates of 2,4-D formulations. Indicated grass injury included slight stunting and leaf curling to all species present. Herbicide treatments will be evaluated again in 1995 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application information for wild caraway control on Colorado grass hay meadow.

Environmental data	
Application date	May 17, 1994
Application time	7:00 AM
Air temperature, F	50
Cloud cover, %	10
Relative humidity, %	40
Wind speed, mph	0 to 1
Soil temperature, (2.0 in.), F	46

Application date	species	growth stage	height (in)	density ($plts/ft^2$)
June 17, 1994	CARCA	rosette (1st year)	1	3 to 10
	CARCA	rosette (2nd year)	2	1 to 5
	TAROF	early flower		0 to 2
	BROSP	4 to 5 leaf	5	varies
	POASP	vegetative	3	varies
	PHLSP	4 to 5 leaf	5	varies
	DACSP	4 to 5 leaf	5	varies
	TRISP	vegetative	3	varies

Table 2. Wild caraway control on Colorado grass hay meadow.

Treatment	Rate	Wild caraway control	Grass injury
		June 20, 1994	
	(lb ai/a)	(% of check)	
triclopyr amine	0.5	40	0
	1.0	33	10
triclopyr ester[1]	0.13	20	0
	0.25	33	0
	0.5	34	8
	1.0	54	9
	2.0	63	13
2,4-D amine	0.5	43	3
	1.0	51	3
	2.0	75	8
2,4-D ester	1.0	56	0
	2.0	68	11
2,4-D amine + nitrogen[2]	0.5	56	3
	1.0	65	4
	2.0	80	4
LSD (0.05)		18	7

[1] Non-ionic surfactant added at 0.25% v/v to all triclopyr ester treatments.
[2] Nitrogen (8.0 qt pr/a) added to indicated treatments.

Wild caraway (Carum Carvi)control with various herbicides. T. Thomas, T.D. Whitson and J. Jenkins. Wild caraway is a decedent of the common parsley family. It was once cultivated but now has become a highly competitive weed. Wild caraway is a biennial plant, it's first year of growth has the characteristics of a small fern, growing low to the ground. Growth the second year starts from a single tap root and then produces a brownish red hollow stem 1 to 3 feet tall with a white to pink floral top. Seed are approximately 1/8 inch long, with five tan linear lines. Wild caraway is in the bloom stage by mid June. Wild caraway grows and thrives in areas of wet to damp soils, such as mountain meadows, roadsides, hay meadows and irrigation ditches.

A study was established for control of wild caraway on June 16, 1994 near Meeteetse, WY. Plots 10 by 27 ft. with four replications arranged as a randomized complete block design. Application information: air temperature 43F, surface temperature 1 inch 51F, 4 inches 47F and 5 inches 45F. The study site was a hay meadow containing both alfalfa and mixed grass species which was densely infested with wild caraway. Thirteen different treatments consisting of six different herbicides at various rates were applied with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 40 psi. All treatments were evaluated two times on July 8 and September 8, 1994. The average of the two evaluations are presented in Table 1.

All herbicides with the exception of glyphosate caused some damage to either the grass or alfalfa. The treatment combination of clopyralid plus 2,4-D at 0.19+1.0 lb ai/A controlled 85 percent control of the wild caraway with little damage to the grass hay. This study will be evaluated in the spring and fall of 1995 to provide further information on control and vegetation regrowth. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1703).

Table 1. Wild caraway control with various herbicides.

Herbicide[1]	Rate ai/acre	% control[2]	% Hay Damage Grass	% Hay Damage Alfalfa
Picloram	0.25	70	80	50
Picloram	0.5	80	90	50
picloram	1.0	90	90	100
Metsulfuron	0.6 oz	96	90	100
Metsulfuron	0.45 oz	90	50	100
Metsulfuron	0.3 oz	90	25	100
Metsulfuron	0.15 oz	90	5	15
Metsulfuron	0.08 oz	87	5	10
2,4-D+clopyralid	0.5+0.05	80	5	50
2,4-D+clopyralid	1.0+0.1	85	10	65
Clopyralid	0.23	50	5	5
Glyphosate	1.0	0	5	5
Check	---	0	0	0

[1] Herbicides were applied 6/16/94.
[2] Evaluations were made July 8 and September 8, 1994, those data were very similar, therefore it was averaged.

Halogeton control with metsulfuron, dicamba, picloram, and 2,4-D on Colorado rangeland. J.R. Sebastian and K.G. Beck. Two rangeland experiments were established near Maybell, CO to evaluate halogeton (HALGL) control with metsulfuron, dicamba, picloram, and three 2,4-D formulations. The design was a randomized complete block with four replications. Treatments were applied June 17 and June 23, 1992 at sites 1 and 2, respectively, with a CO_2-pressurized sprayer using 11003LP flat fan nozzles at 24 gal/A, and 15 psi. Non-ionic surfactant at 0.25% v/v was included with all treatments. Other application information is presented in Table 1. Plot size was 10 by 30 feet. Site 1 had 1 to 3 foot tall greasewood overstory while site 2 was a solid, single species HALGL stand.

Visual evaluations of treated plots were compared with non-sprayed control plots and taken at both sites in October of each year. Metsulfuron provided good to excellent (73 to 94%) HALGL control at both sites approximately 5 months after treatment (MAT) while providing poor to good control 17 MAT. Dicamba (32 oz ai/A) or dicamba tank mixes controlled 33 to 90% of HALGL and the three 2,4-D formulations controlled 0 to 53% of HALGL 5 and 17 MAT. Picloram controlled 19 to 49% and 26 to 82% of HALGL 5 and 17 MAT, respectively. All treatments failed to provide adequate HALGL control 28 MAT.

Drought conditions occurred at both sites in 1992 and may have decreased HALGL control. Also, at site 1 loss of HALGL control was apparent around the bases of greasewood plants due to poor herbicide coverage at application. In 1993, HALGL in plots where 40-60% of plants were controlled were more robust than plants in check plots. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application data for halogeton control on Colorado rangeland metsulfuron, dicamba, picloram, and 2,4-D on Colorado rangeland.

Environmental data		
Location	Site 1	Site 2
Application date	June 17, 1992	June 23, 1992
Application time	8:00 PM	5:00 PM
Air temperature, C	22	33
Cloud cover, %	0	10
Relative humidity, %	30	28
Wind speed, mph	0	0 to 1
Soil temperature, (2.0 in.), C	30	32

Application date	Species	Growth stage	Height (in)	Density (plants/ft^2)
Site 1				
June 17, 1992	HALGL	vegetative	1 to 3	7 to 14
Site 2				
June 23, 1992	HALGL	vegetative	1 to 3	20 to 34

Table 2. Halogeton control with metsulfuron, dicamba, picloram, and 2,4-D on Colorado rangeland.

Treatment	Rate	Timing	Halogeton October 12, 1992 Site 1	Halogeton October 12, 1992 Site 2	October 18, 1993 Site 1	October 18, 1993 Site 2	October 9, 1994 Site 1	October 9, 1994 Site 2
	(oz ai/A)		(% of check)					
metsulfuron	0.1	1-3"	83	73	58	34	0	0
	0.2	1-3"	88	81	85	43	15	0
	0.3	1-3"	93	90	80	50	0	0
	0.5	1-3"	80	84	76	65	13	8
	0.6	1-3"	83	94	87	61	0	5
metsulfuron + dicamba	0.1 3	1-3"	64	76	30	33	0	8
	0.2 3	1-3"	78	81	78	38	23	5
picloram	2	1-3"	49	19	60	26	0	0
	4	1-3"	26	28	58	69	0	5
	8	1-3"	36	40	73	82	13	0
dicamba	8	1-3"	49	45	43	40	7	0
	16	1-3"	61	50	58	78	0	8
	32	1-3"	78	68	90	90	13	10
dicamba + picloram	8 2	1-3"	68	56	74	60	0	14
	16 2	1-3"	70	56	70	78	0	8
	8 4	1-3"	68	48	84	75	0	0
2,4-D amine	16	1-3"	38	41	0	5	0	0
dimethylamine[1] + diethan.	16	1-3"	53	36	0	0	0	0
2,4-D butoxy[2] + free acid	16	1-3"	51	35	0	0	0	0
dicamba + 2,4-D amine	8 16	1-3"	72	61	43	40	0	0
LSD (0.05)			25	17	25	17	20	15

[1] dimethylamine + diethanolamine salt (Hi-Dep)
[2] 2,4-D butoxyethyl ester + free acid (Weedone 638)

Houndstongue control on Colorado rangeland with spring-or fall-applied herbicides. J.R. Sebastian and K.G. Beck. A rangeland experiment was established near Craig, Colorado to evaluate Houndstongue (CYWOF) control with metsulfuron, metsulfuron plus dicamba, metsulfuron plus 2,4-D amine, dicamba, picloram, and picloram plus dicamba. Spring (June 4, 1992) and fall (October, 12 1992) applications were made for timing comparison. The design was a randomized complete block with four replications. Treatments were applied with a CO_2-pressurized sprayer using 11003LP flat fan nozzles at 24 gal/A, 15 psi. A non-ionic surfactant at 0.25% v/v was included with all treatments. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Visual evaluations of treatments were compared to non-sprayed control plots and were taken in October 1992-94. Indicated control ratings are for CYWOF rosettes only (very few bolted CYWOF plants were apparent in 1994 due to drought conditions). All spring applied treatments (with the exception of dicamba 8 oz ai/a) provided 77 to 100% CYWOF control approximately 4 months after treatments (MAT) were applied (Table 2). Spring-applied metsulfuron (> 0.5 oz ai/a), metsulfuron plus 2,4-D, and picloram plus dicamba (8 plus 2 oz ai/a) provided 83 to 92% CYWOF control approximately 16 MAT. Metsulfuron (0.6 oz ai/a) and picloram plus dicamba (4 plus 8 oz ai/a) applied in the spring continued to provide 78 to 80% CYWOF control 28 MAT. Metsulfuron (0.6 oz ai/a) and picloram plus dicamba (2 plus 16 oz ai/a) applied in fall controlled 73% of CYWOF 12 MAT. Spring-applied herbicides consistently out-performed similar fall applications through the study. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application data for Houndstongue control on Colorado rangeland with spring or fall-applied herbicides.

Environmental data		
Application date	June 4, 1992	October 12, 1992
Application time	9:00 AM	8:00 AM
Air temperature, C	23	20
Cloud cover, %	50	40
Relative humidity, %	35	47
Wind speed, mph	0 to 2	0 to 5
Soil temperature, (2.0 in.), C	14	12

Application date	Species	Growth stage	Height (in)	Density (plants/ft^2)
June 4, 1992	CYWOF	rosette	1	1 to 10
	CYWOF	bolting	7 to 18	1 to 15
October 12, 1992	CYWOF	rosette	1 to 4	1 to 10
	CYWOF	bolting	12 to 20	1 to 15

Table 2. Houndstongue control on Colorado rangeland.

Treatment[1]	Rate	Timing	Houndstongue control[2] October 1992	October 1993	October 1994
	(oz ai/a)		--------(% of check)--------		
metsulfuron	0.1	spring	94	73	53
	0.2	spring	83	57	48
	0.3	spring	100	72	
	0.5	spring	95	83	63
	0.6	spring	93	92	78
metsulfuron + dicamba	0.1 + 3	spring	77	68	63
	0.2 + 3	spring	82	67	65
metsulfuron + 2,4-D amine	0.3 + 16	spring	100	92	67
picloram	4	spring	90	77	58
dicamba	8	spring	53	40	5
	16	spring	87	33	23
picloram + dicamba	2 + 8	spring	93	70	63
	4 + 8	spring	97	92	80
	2 + 16	spring	89	70	32
metsulfuron	0.1	fall	-	0	0
	0.2	fall	-	20	20
	0.3	fall	-	20	23
	0.5	fall	-	60	55
	0.6	fall	-	73	47
metsulfuron + dicamba	0.1 + 3	fall	-	43	48
	0.2 + 3	fall	-	23	25
metsulfuron + 2,4-D amine	0.3 + 16	fall	-	45	47
picloram	4	fall	-	22	10
dicamba	8	fall	-	18	10
	16	fall	-	35	27
picloram + dicamba	2 + 8	fall	-	28	15
	4 + 8	fall	-	50	20
	2 + 16	fall	-	73	45
LSD (0.05)			18	32	38

[1] Non-ionic surfactant added at 0.25% v/v to all treatments.
[2] Houndstongue control ratings are for rosette plants only.

The establishment of perennial grasses in areas infested with Russian knapweed. Tom Whitson, Rick Bottoms, Bridger Feuz, Ron Swearingen and David Koch. Even though perennial grasses have been introduced and compete successfully with leafy spurge *Euphorbia esula* L. they have not been successfully introduced in stands of Russian knapweed (*Centaurea repens* L.). Russian knapweed is allelopathic, therefore areas must be tilled before new seedlings can grow. Russian knapweed a deep rooted perennial is highly competitive on disturbed sites and reductions of land values from $75 to $150 per acre have been found by land appraisers.

Two studies located on Lander Complex sandy loam soils near Riverton and Ft. Washakie, WY were treated with various herbicides on October 10 and 11, 1991. Plots were tilled with a rototiller October 20, 1991. Metsulfuron and clopyralid were applied in August, 1992 and all herbicides were reapplied in August, 1994. Russian knapweed had started into winter dormancy during the 1991 application and was in late bloom in 1992 and early bloom in 1994. All plots were seeded with Sodar streambank wheatgrass, critana thickspike wheatgrass, Hycrest crested wheatgrass, Rosana western wheatgrass and bozoisky Russian wildrye at 10 lbs PLS/acre except Russian wildrye which was seeded at 6 lbs/A on April 11 and 12, 1992.

Russian knapweed live canopy was reduced from over 50% in the untreated check to 10% in the areas treated with picloram and clopyralid plus 2,4-D. Stands of the five perennial grasses averaged 27% live canopy cover in the clopyralid plus 2,4-D treatments and 33% in the areas treated with picloram. Neither burning or mowing reduced the live canopy cover of Russian knapweed. The two grasses having the greatest overall establishment were Critana thickspike wheatgrass with an average of 19.7% live canopy cover and Sodar streambank wheatgrass with 18.2% live canopy cover. The lowest amount of Russian knapweed (13.1%) and the highest % live canopy of grasses (24.2%) were found in areas treated with the three clopyralid plus 2,4-D treatments and seeded to Sodar streambank wheatgrass (Table 1).

Grasses were clipped twice during the growing season analyzed for T.D.N. and protein. Hay values were then derived from the TDN, protein and production for each species (Table 2). Crested wheatgrass had the highest yield and value with 1829 lbs of air dried forage/acre valued at $73/acre. Other values ranged from $32 to $52/acre. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1698)

Table 1. Comparison of % live canopy cover of Russian knapweed and seeded to 5 grasses in 5 weed control treatments (Ave. 2 locations)

	Treatment									
	Metsulfuron 0.5 oz		Clopyralid 0.29 lb+2,4-D 1.5 lb		Picloram 0.25 lb		Mow		Burn	
	R knap	Grass	R knap	Grass	R Knap	Grass	R knap	Grass	R knap	Grass
	%		%		%		%		%	
Streambank wheatgrass	44.4	9.7	13.1	24.2	13.3	28.3	35.8	6.0	38.7	7.8
Thickspike wheatgrass	50.0	12.8	16.5	24.7	15.5	29.2	41.7	4.9	42.9	3.9
Crested wheatgrass	44.3	8.4	16.2	12.9	18.0	13.8	39.2	3.8	41.4	2.3
Western wheatgrass	48.4	6.5	14.8	16.8	20.1	15.8	38.9	3.9	44.5	4.2
Russian wildrye	46.0	8.2	14.4	19.0	20.4	16.8	40.5	3.4	39.0	1.4

Table 2. Production and value as hay forage values in plots treated with clopyralid plus 2,4-D and planted to various wheatgrass species as well as Russian wildrye.

	Streambank	Thickspike	Crested	Western	Russian
Clipped 6/15/94					
Dry Matter(lb/A)	855	922	994	600	778
TDN (lb/A)	525	428	492	278	398
Protein (lb/A)	117	95	127	65	79
Value	$ 34	$ 37	$ 40	$ 24	$ 31
Clipped 8/4/94					
Dry Matter(lb/A)	1298	956	1829	796	1024
TDN(lb/A)	515	380	807	356	449
Protein(lb/A)	116	78	126	73	98
Value	$ 52	$ 38	$ 73	$ 32	$ 41

Russian knapweed control with herbicides on Colorado rangeland. J.R. Sebastian and K.G. Beck. A rangeland experiment was established near Eagle, CO to evaluate Russian knapweed (CENRE) control with picloram, dicamba, picloram plus dicamba, chlorsulfuron, and metsulfuron. Fall (September 12, 1989) and spring (June 18, 1990) applications were made for timing comparison. The design was a randomized complete block with four replications. Chlorsulfuron and metsulfuron treatments were applied with a non-ionic 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, 15 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Visual evaluations of treated plots were compared to non-treated control plots and taken in June and August 1990, October 1991, and September 1992-94. Picloram fall-applied at 1.0 lb/A controlled 80 to 100% of CENRE approximately 6, 11, 25, 36, 48, and 60 months after treatment (MAT) (Table 2). Picloram at 0.5 lb/A fall-applied provided 92% CENRE control 11 MAT and 70 to 81% control 25, 36, and 48 MAT, respectively. Picloram at 0.5 and 1.0 lb/A spring-applied provided 71 and 92% control 16 MAT, respectively. However, only picloram at 1.0 lb/A spring-applied provided acceptable long-term control. Chlorsulfuron and metsulfuron did not provide acceptable long-term control. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application information for Russian knapweed control with herbicides on Colorado rangeland.

Environmental data

Application date	Sep 12,1989	Jun 18, 1990
Application time	1:00 PM	9:00 AM
Air temperature, C	12	16
Cloud Cover, %	100	10
Relative humidity, %	60	44
Wind speed, mph	0	0
Soil temperature (2.0 in), C	11	16

Weed data

Application date	Species	Growth stage	Height (in.)	Density (shoots/ft^2)
September 12, 1989	CENRE	fall vegetative	10 to 12	1 to 6
June 18, 1990	CENRE	bolting	6 to 10	1 to 6

Table 2. Russian knapweed control on Colorado rangeland.

Treatment	Rate	Timing	Russian knapweed control					
			Jun 1990	Aug 1990	Oct 1991	Sep 1992	Sep 1993	Sep 1994
	(lb ai/a)		(% of check)					
picloram	0.25	fall	75	60	46	42	40	40
	0.5	fall	92	81	72	70	66	53
	1.0	fall	100	94	92	86	86	80
dicamba	0.5	fall	51	13	8	8	9	5
	1.0	fall	77	41	8	3	0	0
picloram	0.25							
+ dicamba	0.5	fall	92	49	38	36	35	33
	0.13							
	1.0	fall	96	71	49	43	40	39
chlorsulfuron[1]	0.02	fall	63	31	6	6	5	4
	0.05	fall	86	59	0	0	0	0
metsulfuron[1]	0.02	fall	78	48	0	0	0	0
picloram	0.25	spring	-	59	44	40	35	30
	0.5	spring	-	70	71	65	65	64
	1.0	spring	-	80	92	91	89	88
dicamba	0.5	spring	-	50	4	3	3	0
	1.0	spring	-	67	15	22	20	19
picloram	0.25							
+ dicamba	0.5	spring	-	72	58	54	54	46
	0.13							
	1.0	spring	-	65	25	20	19	18
chlorsulfuron	0.02	spring	-	39	0	0	0	0
	0.05	spring	-	68	24	13	11	5
metsulfuron	0.02	spring	-	56	10	10	7	4
LSD (0.05)				11	20	26	24	23

[1] Non-ionic surfactant added at 0.25% v/v to all chlorsulfuron and metsulfuron treatments.

Efficacy of 2,4-D formulations for leafy spurge control. Mark A. Ferrell. This research was conducted near Devil's Tower, Wyoming to compare the efficacy of various formulations of 2,4-D on the control of leafy spurge. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 30 psi June 9, 1992 (air temp. 82 F, soil temp. 0 inch 125 F, 1 inch 110 F, 2 inch 95 F, 4 inch 85 F, relative humidity 27%, wind south at 5 mph, sky partly cloudy). Retreatments were applied June 15, 1993 (air temp. 74 F, soil temp. 0 inch 90 F, 1 inch 85 F, 2 inch 80, 4 inch 75, relative humidity 35%, wind south at 3 mph, sky clear). Retreatments were applied June 14, 1994 (air temp. 60 F, soil temp. 0 inch 75 F, 1 inch 75 F, 2 inch 75, 4 inch 70, relative humidity 67%, wind northwest at 2 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 7 to 12 inches high in 1992, 24 to 30 inches high in 1993 and 18 to 24 inches high in 1994. Infestations were heavy throughout the experimental area. Evaluations were made June 9, 1992; July 8, 1992; September 10, 1992; June 15, 1993; September 21, 1993; June 14, 1994; and September 14, 1994.

Shoot counts taken July 1992, one month after treatment, show all treatments significantly reduced leafy spurge shoot counts compared to the untreated control. Shoot counts taken September 1992, June 1993, September 1993 and June 1994 show no difference between the untreated control and the other treatments. All treatments show a significant reduction in shoot counts, when compared to the untreated control in September 1994. However, data indicate there are no differences between 2,4-D formulations for leafy spurge control at any evaluation date. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1693.)

Table. Efficacy of 2,4-D formulations for leafy spurge control.

		Evaluation date						
Treatment[a]	Rate	June 9, 1992	July 8, 1992	Sept. 10, 1992	June 15, 1993	Sept. 21, 1993	June 14, 1994	Sept. 14, 1994
	lb/A	No. shoots/0.25 m²[b]						
Weedar 64®	2.0	44	6	26	47	23	34	8
Hi Dep®	2.0	37	5	27	38	19	29	7
Weedone LV4®	2.0	47	4	29	41	21	30	6
Weedone 638®	2.0	41	2	33	40	20	29	6
Esteron 99C®	2.0	47	5	34	44	23	35	9
Tordon 22K®	0.5	50	19	23	48	16	36	9
Weedy check	---	45	26	26	49	35	32	23
(LSD 0.05)		12	3	10	11	10	8	8
(CV)		19	24	23	17	30	16	58

[a]Treatments applied June 9, 1992. Retreatments applied June 15, 1993 and June 14, 1994.

[b]Leafy spurge shoot counts are based on means of three 0.25 m^2 quadrats/plot. Counts were taken before treatment application on June 9, 1992.

Leafy spurge control with quinclorac. Mark A. Ferrell. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with early fall applications of quinclorac, alone or in combination with 2,4-D amine or picloram. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Early fall herbicide treatments were applied broadcast with a CO_2 pressurized hand-held sprayer delivering 20 gpa at 40 psi on September 21, 1993 (air temp. 65 F, soil temp. 0 inch 65 F, 1 inch 65 F, 2 inch 65 F, 4 inch 64 F, relative humidity 37%, wind north at 5 mph, sky clear). The soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was past seed production and 14 to 20 inches in height for the early fall treatments. Infestations were heavy throughout the experimental area. Visual evaluations were made June 15, 1994 and September 14, 1994.

Early fall applications of quinclorac + picloram (1.0 + 0.5 lb/A) + Scoil, provided 89% control of leafy spurge, nine months after treatment. However, control had dropped to 76%, 12 months after treatment. Quinclorac (1.25 lb/A) + Scoil provided good control (82%) nine months after treatment, with control dropping to 72%, 12 months after treatment. No other treatments provided satisfactory control of leafy spurge. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1692.)

Table. Leafy spurge control with quinclorac.

Treatment	Rate	Application date/evaluation date: Sept. 21, 1993/June 15, 1994	Application date/evaluation date: Sept. 21, 1993/Sept. 14, 1994
	lb/A	control[1]	
Quinclorac[2]	0.75	61	40
Quinclorac[2]	1	72	58
Quinclorac[2]	1.25	82	73
Quinclorac	1	76	63
Quinclorac + picloram[2]	0.75+0.5	89	76
Picloram	0.5	76	53
Picloram + 2,4-D amine	0.5+1	58	38
(LSD 0.05)		22	23
(CV)		23	32

[1]Percent control by visual evaluation.

[2]Methylated-seed-oil adjuvant (Scoil) added at 1 quart/acre.

Fluroxypyr control of leafy spurge. Mark A. Ferrell. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with fluroxypyr applied prebud to bud and full-flower. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Prebud to bud treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 25, 1993 (air temp. 73 F, soil temp. 0 inch 80 F, 1 inch 73 F, 2 inch 70 F, 4 inch 67 F, relative humidity 40%, wind south at 3 mph, sky clear). Full-flower treatments were applied June 16, 1993 (air temp. 60 F, soil temp. 0 inch 75 F, 1 inch 70 F, 2 inch 68 F, 4 inch 65 F, relative humidity 90%, wind north at 5 mph, sky cloudy). The soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was 14 to 18 inches in height, for prebud to bud treatments and 14 to 20 inches in height, for full-flower treatments. Infestations were heavy throughout the experimental area. Visual evaluations were made June 14, 1994 and September 14, 1994.

Treatments applied prebud to bud provided no leafy spurge control, one year after application. Treatments applied at full-flower provided only limited control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1691.)

Table. Fluroxypyr control of leafy spurge.

Treatment[1]	Rate	Leafy spurge control[2] Prebud to bud	Full-flower
	lb/A	%	
Fluroxypyr	0.125	0	0
Fluroxypyr	0.25	0	8
Fluroxypyr	0.5	0	20
Fluroxypyr+2,4-D amine	0.25+1	0	23
Picloram+2,4-D amine	0.25+1	0	36
Picloram	0.5	0	28
2,4-D amine	2	0	8
Fluroxypyr+picloram	0.125+0.25	0	15
Fluroxypyr+picloram	0.25+0.25	0	4
Weedy check	----	0	0
(LSD 0.05)		ns	25
(CV)		–	121

[1]Treatments applied prebud to bud May 25, 1994 and full-flower June 16, 1994.
[2]Weed control visually evaluated June 14, 1994.

Comparison of imazaquin, imazethapyr, and various liquid and powder 2,4-D formulations for leafy spurge control. Rodney G. Lym and Calvin G. Messersmith. The most cost-effective treatment for leafy spurge control is picloram plus 2,4-D. Previous research at North Dakota State University has shown that leafy spurge control is increased 15 to 25% when 2,4-D at 1 lb/A is applied with picloram at 0.5 lb/A or less compared to picloram alone. Control has been similar regardless of the 2,4-D formulation applied with picloram. Soon several formulations of 2,4-D will no longer be available because they will not be reregistered with the EPA. Also, several powder formulations of 2,4-D have been formulated to decrease the cost of container shipment and disposal. The purpose of this research was to evaluate several formulations of 2,4-D applied alone or with other herbicides for leafy spurge control.

The first experiment was established June 8, 1992 near Valley City, ND when leafy spurge was in the yellow bract to flowering growth stage with lush growth and 18 to 24 inches tall. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. All plots were 10 by 30 ft in a randomized complete block design with four replicates. The 2,4-D formulations were added to water immediately prior to application and no surfactants were used. All treatments were reapplied to the same plots in June 1993 and 1994.

The water soluble powder CL-782 provided only 68% topgrowth control 1 month after the first treatment (MAFT) compared to 97% or better for all other 2,4-D formulations (Table 1). Control was similar for all 2,4-D formulations 3 and 12 MAFT, including CL-782, and averaged 20 and 13%, respectively. 2,4-D butoxyethyl ester following a second treatment in June 1993 tended to provide better leafy spurge control 15 MAFT than the other 2,4-D formulations. 2,4-D dimethylamine plus diethanolamine provided 65% control following three annual appolications, which was better leafy spurge control than for the other 2,4-D formulations evaluated. Picloram applied at 0.5 lb/A for 3 consecutive years provided 97% leafy spurge control.

A second experiment was established August 27, 1992 near Chaffee when leafy spurge was in the fall regrowth stage. Picloram plus 2,4-D dimethylamine provided better leafy spurge control than picloram plus 2,4-D mixed amine 12 MAFT and tended to provide better control 24 MAFT (Table 2). Imazaquin or imazethapyr applied at 4 oz/A with Scoil (methylated crop oil adjuvant) provided control similar to picloram plus 2,4-D 21 MAFT. However, control declined rapidly especially by 24 MAFT. Control was not improved when 2,4-D mixed amine was applied with either imazaquin or imazethapyr plus Scoil.

In general, leafy spurge control was similar with most 2,4-D formulations. 2,4-D mixed amine provided better control than other formulations evaluated but only after 3 annual applications. Control was enhanced when 2,4-D dimethylamine but not mixed amine was applied with picloram but not with imazethapyr or imazaquin. (Published with approval of the Agric. Exp. Stn., North Dakota State University, Fargo 58105).

Table 1. Comparison of various 2,4-D formulations applied in June 1992 through 1994 for leafy spurge control (Lym and Messersmith).

Treatment	Rate	Months after first treatment 1	3	12	15	24	27
	lb/A	% control					
2,4-D dimethylamine (Weedar 64)	2	98	20	19	46	21	25
2,4-D dimethylamine + diethanolamine (Hi-Dep)	2	98	13	11	56	43	65
2,4-D butoxyethyl ester (Weedone LV4)	2	100	18	22	57	30	45
2,4-D acid + butoxyethyl ester (Weedone 638)	2	99	18	13	75	38	45
2,4-D isooctyl(2-ethylhexyl)ester (Esteron 99)	2	99	18	10	47	30	28
2,4-D triisopropanolamine + diethylamine (Formula 40)	2	97	17	6	43	18	40
2,4-D dimethylamine 80% WSP (CL-782)	2	68	28	13	53	40	37
2,4-D dimethylamine 85% WSP (Savage)	2	99	26	11	47	23	39
Picloram	0.5	99	89	65	94	93	97
LSD (0.05)		11	27	17	25	22	17

Table 2. Comparison of 2,4-D formulations applied with imazaquin or imazethapyr twice annually in the fall near Chaffee, ND (Lym and Messersmith).

Treatment	Rate	Months after first treatment 9	12	21	24
	— oz/A —	% control			
2,4-D mixed amine[a]	32	81	8	69	21
Picloram	8	95	27	98	22
Picloram + 2,4-D mixed amine[a]	8 + 16	98	39	98	36
Picloram + 2,4-D dimethylamine	8 + 16	99	61	95	50
Imazaquin + Scoil	2 + 1 qt	93	23	87	28
Imazethapyr + Scoil	2 + 1 qt	93	18	99	26
Imazaquin + Scoil	4 + 1 qt	98	43	88	23
Imazethapyr + Scoil	4 + 1 qt	85	50	94	8
2,4-D mixed amine[a] + imazaquin + Scoil	8 + 2 + 1 qt	97	15	87	9
2,4-D mixed amine[a] + imazethapyr + Scoil	8 + 2 + 1 qt	97	43	79	17
LSD (0.05)		14	24	16	18

[a]Mixed amine salts of 2,4-D (2:1 dimethylamine:diethanolamine) - Hi-Dep.

Comparison of picloram amine, ester, and potassium salt formulations applied at three growth stages for leafy spurge control. Rodney G. Lym. Picloram formulated as the potassium (K) salt (Tordon 22K) has been the most effective herbicide for leafy spurge control. However, picloram is poorly absorbed into leafy spurge, so relatively high rates are used which means high treatment costs. The purpose of this research was to evaluate an amine and ester formulation of picloram for leafy spurge control.

The liquid picloram formulations evaluated included a triisopropanol amine, isooctyl ester, and K-salt. Picloram amine was commercially combined with 2,4-D triisopropanol amine at a ratio of 1:4 (Tordon 101) and picloram ester was commercially combined with triclopyr butoxyethyl ester at 1:2 (Access). Previous research at North Dakota State University has shown that triclopyr does not control leafy spurge so any leafy spurge control from the ester combination was assumed to be from only picloram.

A series of experiments was established during the true-flower, flower-to seed-set, and fall-regrowth growth stages of leafy spurge. Treatments were applied on June 8, 1992 near Valley City, June 26 near West Fargo, and September 9 near Hunter, ND for the true-flower, early-seed-set, and fall-regrowth growth stages, respectively. Treatments were reapplied on a similar date in 1993. Treatments were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The experiments were in a randomized complete block design with four replications, and plots were 10 by 30 ft. Treatments were evaluated visually based on percent stand reduction as compared to the control.

Table. Comparison of picloram amine, ester, and potassium salt formulations for leafy spurge control, applied at three leafy spurge growth stages in 1992 and 1993 (Lym).

		Growth stage and Months after first treatment								
		Flower[a]				Seed-set			Fall	
Treatment	Rate	3	12	24	27	2	11	23	9	12
	— oz/A —	% control								
Picloram amine+2,4-D[b]+X-77	4+16+0.5%	96	76	90	89	96	12	39	82	2
Picloram amine+2,4-D[b]+X-77	8+32+0.5%	99	92	95	93	98	6	26	94	25
Picloram[c]+2,4-D amine+X-77	4+16+0.5%	92	69	86	82	95	9	18	87	2
Picloram[c]+2,4-D amine+X-77	8+32+0.5%	98	80	97	90	98	9	21	97	49
Picloram ester+triclopyr[d]+picloram[c]	1+2+3	93	64	93	78	93	5	13	74	2
Picloram ester+triclopyr[d]+picloram[c]	1+2+7	97	81	92	84	96	7	22	..	..
Picloram ester+triclopyr[d]+picloram[c]	2+4+6	98	83	93	93	95	3	6	97	19
Picloram ester+triclopyr[d]+picloram[c]+2,4-D amine	1+2+3+16	96	92	90	87	90	3	10	93	20
Picloram K-salt[c]	4	99	83	91	81	88	6	7	70	3
Picloram K-salt[c]	8	98	79	92	75	92	3	21	84	6
LSD (0.05)		NS	17	5	11	5	NS	NS	20	20

[a]Treatments were reapplied in June 1993.
[b]Picloram triisopropanol amine plus 2,4-D triisopropanol amine (1:4) - Tordon 101.
[c]Picloram potassium salt - Tordon 22K.
[d]Picloram isooctyl ester plus triclopyr butoxyethyl ester (1:2) - Access.

Leafy spurge control 12 months after treatment tended to be better with picloram amine plus 2,4-D than picloram K-salt plus 2,4-D when applied at the true flower growth stage (Table). However, control was similar with picloram amine or K-salt formulations when applied at the early-seed-set or fall-regrowth growth stages. Previous research at North Dakota State University has shown that picloram ester at 4 to 8 oz/A kills leafy spurge topgrowth rapidly and provides only short-term control. Picloram ester at 1 or 2 oz/A was applied with picloram K-salt in this study in an attempt to reduce initial leaf injury but still increase absorption and thus long-term control. However, leafy spurge control with treatments containing picloram ester was either similar to or less than treatments that contained picloram K-salt or amine formulations. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Leafy spurge control with quinclorac applied with various adjuvants for 3 years. Rodney G. Lym. Quinclorac is an auxin-type herbicide with moderate soil residual. Previous greenhouse research at North Dakota State University has shown that quinclorac will injure leafy spurge and may be more effective when applied with a seed-oil adjuvant rather than alone. The purpose of this research was to evaluate quinclorac applied alone and in combination with picloram or various spray adjuvants as an annual retreatment.

The experiment was established near West Fargo on September 14, 1990, when leafy spurge was in the fall regrowth stage, and 20 to 30 inches tall with 2 to 3 inch long new fall growth on stems. Retreatments were applied on approximately the same date in 1991 and 1992. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 ft in a randomized complete block design with four replications. Evaluations were based on a visual estimate of percent stand reduction as compared to the control. Previous research has shown that quinclorac provided the best leafy spurge control when fall-applied.

Treatment[a]	Rate	Evaluation date				
		June 91	June 92	June 93	Sept 93	Sept 94
	— lb/A —	% control				
Quinclorac + BAS-090	1+1 qt	90	93	99	92	90
Quinclorac + Scoil	1+1 qt	74	95	99	94	81
Quinclorac	1	49	82	89	59	31
Quinclorac + picloram	1+0.5	85	97	97	94	93
Quinclorac + picloram + BAS-090	1+0.5+1 qt	91	99	99	97	97
Picloram + 2,4-D	0.5+1	81	92	94	90	84
Picloram + 2,4-D + Scoil	0.5+1+1 qt	43	69	92	61	63
Picloram + 2,4-D + BAS-090	0.5+1+1 qt	57	83	94	73	68
Picoram + Scoil	0.5+1 qt	71	82	95	60	63
Picloram	0.5	60	84	96	81	79
LSD (0.05)		28	14	6	28	22

[a]Treatments applied annually in September for 3 yr.

Quinclorac either alone or with Scoil provided better leafy spurge control in June 1992 following a second application compared to June 1991 (Table). Leafy spurge control in June 1993 following a third application averaged 92% or better with all treatments except when quinclorac was applied alone. Quinclorac at 1 lb/A plus BAS-090 or the methylated-seed-oil adjuvant Scoil provided better long-term leafy spurge control than quinclorac applied alone. Control in September 1994, which was 24 months after the third annual treatment averaged 90% with quinclorac plus an adjuvant and/or picloram but only 31% when quinclorac was applied alone. Long-term control with quinclorac plus BAS-090 or Scoil was better than picloram plus 2,4-D at 0.5 plus 1 lb/A, the most commonly used fall-applied treatment. Scoil applied with picloram did not improve leafy spurge control compared to picloram alone, and both Scoil and BAS-090 reduced control when applied with picloram plus 2,4-D.

Quinclorac plus BAS-090 or Scoil fall-applied provided good leafy spurge control and could be an alternative to picloram plus 2,4-D. There was no grass injury with any treatment. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Comparison of liquid and powder picloram formulations applied alone or with glyphosate or adjuvants for leafy spurge control. Rodney G. Lym. Previous research at North Dakota State University has shown that the liquid picloram K-salt formulation provided better leafy spurge control than water-soluble powder (WSP) formulations. However, control from the picloram WSP formulations was improved when applied with 2,4-D or adjuvants compared to the dry formulation alone. The purpose of this research was to further evaluate various formulations of picloram alone and with additives for improved leafy spurge control compared to the picloram K-salt formulation.

A series of experiments was established in the spring or fall of 1992 at various locations in North Dakota. All treatments were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi either in June or September when the plants were in the true-flower or fall-regrowth growth stages, respectively. The spring treatments were reapplied in June 1993. All experiments were in a randomized complete block design with four replications, and plots were 10 by 30 ft. Treatments were evaluated visually based on percent stand reduction as compared to the control.

The first experiment evaluated picloram formulated as the K-salt, an acid WSP (XRM-5255), or a K-salt WSP (XRM-5173) applied either alone or with Scoil (a methylated seed oil adjuvant) or 2,4-D. Picloram K-salt applied as a liquid formulation provided better leafy spurge control than the acid WSP and tended to be better than the K-salt WSP following one or two annual applications (Table 1). Control with the K-salt liquid averaged over rates was 71 and 80% 12 and 24 months after the first treatment (MAFT), compared to 53 and 54% for XRM-5255, respectively, and 64 and 68% for XRM-5173, respectively. The difference between picloram formulations was most pronounced when the lower rates of 0.25 and 0.5 lb/A were used. XRM-5255 or XRM-5173 at 0.5 lb/A applied either with Scoil or 2,4-D at 0.25 lb/A provided control similar to the comparable picloram K-salt liquid formulation treatment.

The second experiment evaluated the various picloram formulations applied alone or with various liquid or powder formulations of 2,4-D at two locations in North Dakota. In general, picloram liquid and powder formulations provided similar leafy spurge control at comparable rates (Table 2). However, initial leafy spurge control with picloram plus 2,4-D tended to be higher when at least one of the herbicides was a liquid formulation, compared to when both were WSP formulations.

Picloram liquid K-salt and K-salt powder (XRM-5173) applied in the late-flower to early-seed-set growth stage provided similar leafy spurge control when applied with 2,4-D LVE or 2,4-D amine or a seed-oil adjuvant (Table 3). However, control with picloram acid powder (XRM-5255) was improved when applied with 2,4-D compared to applied alone. Glyphosate plus 2,4-D applied at 4 + 7 oz/A provided the most consistent control at both locations, averaging 78 and 69% 3 and 24 MAFT applied alone or with picloram. There was no grass injury at either location.

Glyphosate plus 2,4-D at 4 + 7 oz/A applied in September did not provide satisfactory leafy spurge control the following growing season (Table 4). Control was similar with all picloram formulations, whether applied alone or with 2,4-D or a seed-oil adjuvant. No treatment provided satisfactory control 12 months after treatment.

In summary, picloram K-salt liquid formulation provided better leafy spurge control than the acid powder formulation when applied in mid-June during the true-flower growth stage. XRM-5255 or XRM-5173 provided similar leafy spurge control as liquid picloram K-salt when applied with 2,4-D or a seed-oil adjuvant. Glyphosate plus 2,4-D provided good leafy spurge control when applied in late June but not when fall-applied (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table 1. Comparison of picloram liquid and water-soluble powder formulations for leafy spurge control applied in June 1992 and 1993, established near Valley City, ND (Lym).

Treatment	Rate	Months after first treatment 3	12	15	24
	— lb/A —	% control			
Picloram[a]	0.25	67	48	68	65
XRM-5255[b]	0.25	36	45	61	33
XRM-5173[c]	0.25	51	38	52	41
Picloram[a]	0.5	96	73	85	81
XRM-5255[b]	0.5	46	37	57	44
XRM-5173[c]	0.5	85	70	71	70
Picloram[a]	1	100	92	98	94
XRM-5255[b]	1	97	78	76	85
XRM-5173[c]	1	99	84	92	93
XRM-5255[b] + Scoil	0.5 + 1 qt	98	88	75	78
XRM-5173[c] + Scoil	0.5 + 1 qt	97	88	83	79
Picloram[a] + 2,4-D	0.25 + 1	90	64	89	79
XRM-5255[b] + 2,4-D	0.25 + 1	91	57	93	79
XRM-5173[c] + 2,4-D	0.25 + 1	91	48	93	76
LSD (0.05)		17	25	13	18

[a]Picloram K-salt liquid - Tordon 22K.
[b]Picloram acid formulated as a water-soluble powder.
[c]Picloram K-salt formulated as a water-soluble powder.

Table 2. Comparison of picloram water-soluble acid powder, K-salt powder, and liquid K-salt formulations alone and with liquid and powder 2,4-D formulations for leafy spurge control when applied in June 1992 and 1993 at Valley City and West Fargo, ND (Lym).

		Months after first treatment							
		Valley City			West Fargo			Mean	
Treatment	Rate	3	12	24	3	12	24	3	24
	— lb/A —	% control							
XRM-5255[a]	0.25	69	13	51	31	8	30	50	40
XRM-5173[b]	0.25	90	24	45	38	9	25	64	35
Picloram[c]	0.25	82	19	49	28	4	8	55	28
XRM-5238[d]	1	56	6	31	44	9	8	50	19
2,4-D amine WSP[e]	1	41	3	23	45	6	8	43	15
2,4-D amine liquid[f]	1	48	5	26	46	5	15	47	20
XRM-5255[a] + XRM-5238[d]	0.25 + 1	78	23	64	52	6	14	65	39
XRM-5173[b] + XRM-5238[d]	0.25 + 1	68	17	50	60	12	27	64	38
Picloram[c] + XRM-5238[d]	0.25 + 1	90	37	66	63	9	15	76	40
Picloram[c] + 2,4-D amine WSP[e]	0.25 + 1	83	20	59	62	19	34	72	46
Picloram[c] + 2,4-D amine liquid[f]	0.25 + 1	91	26	65	77	19	38	84	51
XRM-5255[a] + 2,4-D amine WSP[e]	0.25 + 1	90	30	78	68	18	30	78	54
XRM-5173[b] + 2,4-D amine WSP[e]	0.25 + 1	93	31	70	68	15	32	80	51
LSD (0.05)		22	12	16	17	9	21	27	21

[a]Picloram acid formulated as a water-soluble powder.
[b]Picloram K-salt formulated as a water-soluble powder.
[c]Picloram K-salt liquid - Tordon 22K.
[d]2,4-D amine water-soluble powder 85%.
[e]80% WSP (Savage)
[f]Dimethylamine (Weedar 64)

Table 3. Comparison of various picloram formulations alone or with additives and glyphosate plus 2,4-D applied during the late-flower to early seed set growth stage at Sheyenne and West Fargo, ND (Lym).

Treatment	Rate	Month after first treatment							
		Sheyenne			West Fargo			Mean	
		3	12	24	3	12	24	3	24
	— oz/A —	% control							
Glyphosate + 2,4-D[a] + X-77	4+7+0.5%	99	69	58	91	80	70	74	64
Glyphosate + 2,4-D[a] + picloram + X-77	4+7+4+0.5%	99	87	70	96	76	78	81	74
XRM-5255[b]	4	97	42	3	18	12	8	27	5
XRM-5255[b] + 2,4-D LVE	4+16	97	36	35	85	21	44	28	39
XRM-5255[b] + 2,4-D amine	4+16	99	60	53	92	13	8	36	31
XRM-5173[c]	4	96	48	17	40	7	5	28	11
XRM-5173[c] + 2,4-D LVE	4+16	99	47	44	91	19	26	33	35
XRM-5173[c] + 2,4-D amine	4+16	99	41	26	96	22	30	32	28
Picloram[d]	4	99	60	35	74	12	16	39	25
Picloram[d] + 2,4-D amine	4+16	99	53	33	92	14	27	33	30
Picloram[d] + 2,4-D LVE	4+16	100	55	77	92	13	16	34	46
Picloram[d] + BAS-090	4+1 qt	100	63	65	95	28	49	45	57
Picloram[d] + 2,4-D + BAS-090	4+16+1 qt	99	56	90	90	12	26	31	57
Picloram[d] + Scoil	4+1 qt	99	41	54	90	17	29	29	41
Picloram[d] + 2,4-D + Scoil	4+16+1 qt	99	48	81	91	23	44	35	57
LSD (0.05)		2	NS	34	16	14	27	15	39

[a]Commercial formulation - Landmaster BW.
[b]Picloram acid formulated as a water-soluble powder.
[c]Picloram K-salt formulated as a water-soluble powder.
[d]Picloram K-salt liquid - Tordon 22K.

Table 4. Comparison of various picloram formulations alone or with additives and glyphosate plus 2,4-D applied in September 1992 near Hunter, ND (Lym).

Treatment	Rate	Months after treatment	
		9	12
	— oz/A —	% control	
Glyphosate + 2,4-D[a] + X-77	4+7+0.5%	30	0
Glyphosate + 2,4-D[a] + picloram + X-77	4+7+8+0.5%	98	32
XRM-5255[b]	8	92	15
XRM-5255[b] + 2,4-D LVE	8+16	96	33
XRM-5255[b] + 2,4-D amine	8+16	96	22
XRM-5173[c]	8	99	62
XRM-5173[c] + 2,4-D LVE	8+16	98	40
XRM-5173[c] + 2,4-D amine	8+16	95	33
Picloram[d]	8	83	11
Picloram[d] + 2,4-D amine	8+16	83	6
Picloram[d] + 2,4-D LVE	8+16	84	6
Picloram[d] + BAS-090	8+1 qt	87	20
Picloram[d] + 2,4-D + BAS-090	8+16+1 qt	90	31
Picloram[d] + Scoil	8+1 qt	86	5
Picloram[d] + 2,4-D amine + Scoil	8+16+1 qt	92	25
LSD (0.05)		14	35

[a]Commercial formulation - Landmaster BW.
[b]Picloram acid formulated as a water-soluble powder.
[c]Picloram K-salt formulated as a water-soluble powder.
[d]Picloram K-salt liquid - Tordon 22K.

Leafy spurge control with fall-applied imazethapyr, picloram, and quinclorac. Rodney G. Lym and Calvin G. Messersmith. Previous research at North Dakota State University has shown that fall-applied imazethapyr at 2 to 4 oz/A and quinclorac at 16 to 24 oz/A provide good leafy spurge control. However, treatment costs at these rates would be prohibitive. Control has occasionally been increased when these herbicides have been applied with an adjuvant. The purpose of this research was to evaluate imazethapyr and qinclorac applied at reduced rates with various spray adjuvants or other herbicides for leafy spurge control.

The experiment was established near Fort Ransom and on the Ekre Experiment Station, near Walcott, ND, on September 23, 1993. Leafy spurge was approximately 24 inches tall, branched, and the leaves were beginning to senesce and turn red. The soil was a loam at Fort Ransom and loamy sand at Ekre. Soil moisture was near field capacity, and the pH was 6.8 at both locations. Soil organic matter was much higher at Fort Ransom than Ekre at 7.0 and 2.9%. respectively. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Plots were 10 by 30 ft, and each treatment was replicated three and four times at Ekre and Fort Ransom, respectively. Visual evaluations were based on percent stand reduction as compared to the control.

Leafy spurge control was better at Ekre than Fort Ransom regardless of treatment (Table). The decreased control at Fort Ransom compared to Ekre is likely due to the high soil organic matter at Fort Ransom. Imazethapyr, quinclorac, and picloram generally have moderate to long soil residual in North Dakota soils but can be bound by organic matter which would decrease control. Leafy spurge growth stage, soil moisture, and weather conditions at treatment were similar at both locations and should not have affected initial herbicide absorption and translocation.

Picloram and quinclorac at 0.5 to 1 lb/A and imazethapyr at 0.125 to 0.25 lb/A provided better than 80% control 9 months after treatment (MAT) at Fort Ransom (Table). However, control declined rapidly and no treatment provided satisfactory control by 12 MAT. All treatments provided excellent control at Ekre 9 MAT but only picloram at 1 lb/A provided 90% or better control 12 MAT. Qinclorac plus Sun-It II (a methylated seed oil adjuvant) provided similar control regardless of herbicide rate and averaged 57% 12 MAT at Ekre, similar to picloram at 0.5 lb/A. Imazethapyr provided control averaging 49% at Ekre, whether applied with the adjuvants X-77 plus 28% N or with picloram, 2,4-D, or quinclorac.

In general, quinclorac at 0.5 to 1 lb/A and imazethapyr at 0.125 to 0.25 lb/A applied with Sun-It II plus 28% N provided similar leafy spurge control to picloram at 0.5 to 1 lb/A. Herbicides applied with adjuvants provided better control than various herbicide combination treatments. (Published with approval of the Agric. Exp. Stn., North Dakota State University, Fargo 58105)

Table. Leafy spurge control with picloram, quinclorac, and imazethapyr fall-applied at two locations in North Dakota (Lym and Messersmith).

		Location and evaluation date			
		Fort Ransom		Ekre	
Treatment	Rate	9 MAT[a]	12 MAT[a]	9 MAT[a]	12 MAT[a]
	lb/A	% control			
Picloram+2,4-D+Sun-It II	0.25+1+0.5%	61	20	95	51
Picloram+Sun-It II	0.5+0.5%	85	20	92	69
Picloram+Sun-It II	1+0.5%	97	32	99	94
Quinclorac+Sun-It II	0.5+0.5%	76	17	96	67
Quinclorac+Sun-It II	0.75+0.5%	82	14	99	48
Quinclorac+Sun-It II	1+0.5%	90	34	98	55
Picloram+quinclorac+Sun-It II	0.5+0.5+0.5%	96	25	96	69
Imazethapyr+X-77+28%N	0.25+0.25%+0.5%	88	19	98	47
Imazethapyr+picloram+X-77+28%N	0.125+0.25+0.25%+0.5%	82	11	87	61
Imazethapyr+picloram+X-77+28%N	0.25+0.25+0.25%+0.5%	96	23	99	55
Imazethapyr+picloram+X-77+28%N	0.25+0.5+0.25%+0.5%	82	7	97	50
Imazethapyr+2,4-D+X-77+28%N	0.25+1+0.25%+0.5%	69	16	100	29
Imazethapyr+quinclorac+X-77+28%N	0.25+0.5+0.25%+0.5%	79	22	95	49
LSD (0.05)		20	15	NS	30

[a]Months after treatment.

Leafy spurge control with glyphosate plus 2,4-D applied in late-June. Rodney G. Lym. Several long-term management alternatives provide a choice of herbicides and duration of leafy spurge control. When leafy spurge infests an area that can be treated annually then dicamba at 2 lb/A or picloram plus 2,4-D at 0.25 + 1 lb/A spring-applied will provide 85% or better leafy spurge control after 3 to 5 years. However, when these herbicides are fall applied, the picloram rate must be increased to 0.5 lb/A with 2,4-D to provide similar leafy spurge control to the spring treatment and is no longer cost-effective. Glyphosate applied with 2,4-D at 0.4 + 0.6 lb/A in the fall provides 70 to 90% control but can cause severe grass injury. The purpose of this research was to evaluate glyphosate plus 2,4-D applied in late-June annually or rotated with various auxin herbicides for leafy spurge control.

The experiments were established on June 21 and June 28, 1993 near Jamestown and Valley City, North Dakota, respectively. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Leafy spurge was in the late-flower to early seed-set growth stage at both locations. Retreatments for the second experiment were applied on June 29, 1994 at both locations when leafy spurge was in the vegetative to flowering growth stage. The soil at both locations was a loam with a 6.8 pH. The grass species present were generally bluegrass and brome with occasional wheatgrass. Visual evaluations were based on percent stand reduction as compared to the control.

Glyphosate plus 2,4-D generally provided better long-term leafy spurge control then picloram plus 2,4-D after a single application. Glyphosate plus 2,4-D at 0.4 + 0.6 lb/A averaged 93% leafy spurge control 3 months after treatment (MAT) when applied alone or with the adjuvant X-77 (Tables 1 and 2). Control with picloram or picloram plus 2,4-D averaged over application rate was 41 and 78% at Jamestown and Valley City, respectively. Grass injury only averaged 11% with glyphosate plus 2,4-D and was similar whether applied alone or with X-77. Leafy spurge control was similar when picloram was applied with glyphosate plus 2,4-D compared to glyphosate plus 2,4-D applied alone.

Glyphosate alone provided much less leafy spurge control then glyphosate plus 2,4-D at comparable rates (Tables 1 and 2). Glyphosate alone only provided 4% leafy spurge control at Jamestown with 49% grass injury 3 MAT (Table 1). Control declined rapidly at Jamestown by 12 MAT for all treatments. Glyphosate plus 2,4-D averaged 53% control compared to 5% with picloram plus 2,4-D (Table 1).

Leafy spurge control with glyphosate plus 2,4-D still averaged 68% 12 MAT at Valley City and was much better then either picloram plus 2,4-D treatment that only averaged 37% (Table 2). Control was similar with glyphosate whether applied alone or with 2,4-D or picloram at Valley City, but grass injury tended to be higher with glyphosate plus X-77 compared to glyphosate plus 2,4-D.

The increased control at Valley City compared to Jamestown may have been due to weather conditions at the time of treatment. The temperature was 91 F with 54% relative humidity at Jamestown compared to 62 F and 60% at Valley City. The warmer conditions at Jamestown may have stressed the plants and dried the herbicide application too rapidly for good absorption and translocation.

Glyphosate plus 2,4-D generally provided similar initial leafy spurge control to picloram plus 2,4-D and dicamba in the first months after application, but better long-term control 12 MAT in the first year of a rotational program (Table 3). Grass injury averaged 15% with glyphosate plus 2,4-D at 0.4 + 0.6 lb/A 3 MAT, but declined to near zero the second year even when glyphosate plus 2,4-D was applied for 2 consecutive years. In general, leafy spurge control was similar with glyphosate plus 2,4-D applied alone or with picloram. Control was similar regardless of treatment 15 months after the first treatment (MAFT).

Glyphosate plus 2,4-D should be used in a long-term leafy spurge management program. The treatment costs approximately $4 to $5/A less then picloram plus 2,4-D at 0.25 + 1 lb/A, provides better control 12 MAT, and can be used in areas with a high water table. The 15 to 20% grass injury is of minor concern especially if glyphosate plus 2,4-D is used as an initial treatment in a dense stand where grass production is already severely reduced. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table 1. Glyphosate plus auxin herbicide combinations for leafy spurge control applied in late-June at Jamestown, North Dakota.

		Evaluation			
		3 MAT[a]		12 MAT[a]	
Treatment	Rate	Control	Grass inj.	Control	Grass inj
	lb/A	%			
Glyphosate+2,4-D[b]+X-77	0.4+0.6+0.5%	91	8	44	0
Glyphosate+2,4-D[b]+picloram+X-77	0.3+0.45+0.19+0.5%	91	5	63	0
Glyphosate+2,4-D[b]+picloram+X-77	0.4+0.6+0.25+0.5%	84	27	32	0
Glyphosate+picloram+X-77	0.4+0.25+0.5%	93	10	63	0
Glyphosate+2,4-D[b]	0.4+0.6	94	10	64	0
Glyphosate+2,4-D[b]	0.3+0.45	88	8	60	0
Glyphosate+X-77	0.4+0.5%	7	44	29	0
Glyphosate	0.4	1	37	11	0
Glyphosate+X-77	0.3+0.5%	4	49	18	0
Picloram	0.25	34	0	19	0
Picloram+2,4-D	0.25+1	54	0	5	0
Picloram+2,4-D	0.5+1	36	0	5	0
LSD (0.05)		22	22	23	..

[a]Months after treatment.
[b]Commercial formulation LandmasterBW.

Table 2. Glyphosate plus auxin herbicide combinations for leafy spurge control applied in late-June at Valley City, North Dakota.

		Evaluation				
		3 MAT[a]		12 MAT[a]		15 MAT[a]
Treatment	Rate	Control	Grass inj.	Control	Grass inj	Control
	lb/A	%				
Glyphosate+2,4-D[b]+X-77	0.4+0.6+0.5%	94	17	73	0	65
Glyphosate+2,4-D[b]+picloram+X-77	0.3+0.45+0.19+0.5%	89	7	71	0	79
Glyphosate+2,4-D[b]+picloram+X-77	0.4+0.6+0.25+0.5%	92	7	70	0	59
Glyphosate+picloram+X-77	0.4+0.25+0.5%	79	9	77	0	63
Glyphosate+2,4-D[b]	0.4+0.6	88	10	74	0	75
Glyphosate+2,4-D[b]	0.3+0.45	89	10	66	0	69
Glyphosate+X-77	0.4+0.5%	70	20	83	15	73
Glyphosate	0.4	63	11	86	6	77
Glyphosate+X-77	0.3+0.5%	64	14	86	8	75
Picloram	0.25	63	4	20	0	13
Picloram+2,4-D	0.25+1	83	0	33	0	26
Picloram+2,4-D	0.5+1	87	3	41	0	31
LSD (0.05)		12	6	22	10	27

[a]Months after treatment.
[b]Commercial formulation LandmasterBW.

Table 3. Glyphosate plus 2,4-D treatments alternated with auxin herbicides over 2 years applied in late June at two locations in North Dakota.

1993		1994		Evaluation					
				3 MAFT[a]		12 MAFT[a]		15 MAFT[a]	
Treatment	Rate	Treatment	Rate	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.
	lb/A		lb/A	%					
				Jamestown					
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	88	18	47	0	51	0
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Picloram + 2,4-D	0.25+1	90	12	59	0	68	0
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Dicamba + X-77	2+0.5%	94	11	68	0	75	0
Picloram + 2,4-D	0.25+1	Picloram + 2,4-D	0.25+1	60	0	23	0	62	0
Dicamba + X-77	2+0.5%	Dicamba + X-77	2+0.5%	76	0	22	0	69	0
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Gly + 2,4-D[b] + pic + X-77	0.4+0.6+0.25+0.5%	97	8	65	0	72	0
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Picloram + 2,4-D	0.25+1	97	15	69	0	59	0
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Dicamba + X-77	2+0.5%	98	11	65	0	65	0
LSD (0.05)				13	7	18	...	NS	NS
				Valley City					
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	94	16	88	0	85	12
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Picloram + 2,4-D	0.25+1	97	16	94	5	92	0
Gly + 2,4-D[b] + X-77	0.4+0.6+0.5%	Dicamba + X-77	2+0.5%	97	16	93	0	94	0
Picloram + 2,4-D	0.25+1	Picloram + 2,4-D	0.25+1	89	1	43	0	98	0
Dicamba + X-77	2+0.5%	Dicamba + X-77	2+0.5%	80	3	30	0	96	0
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Gly +2,4-D[b] + pic + X-77	0.4+0.6+0.25+0.5%	98	11	91	0	90	2
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Picloram + 2,4-D	0.25+1	96	9	80	0	90	0
Glyphosate + 2,4-D[b] + pic[c] + X-77	0.4+0.6+0.25+0.5%	Dicamba + X-77	2+0.5%	93	12	86	0	93	0
LSD (0.05)				8	9	17	3	NS	5

[a]Months after the first treatment.
[b]Glyphosate + 2,4-D was a commercial formulation - Landmaster BW.
[c]Picloram.

Effect of application timing on leafy spurge control with fluroxypyr. Rodney G. Lym and Calvin G. Messersmith. Fluroxypyr is a pyridinecarboxylic acid herbicide similar to picloram but with less soil residual and a different weed control spectrum. Previous research at North Dakota State University has shown that fluroxypyr does not provide satisfactory leafy spurge control when applied in the flower or fall regrowth growth stages. The purpose of this research was to evaluate leafy spurge control with fluroxypyr applied in the vegetative growth stage.

The experiment was established in a dense stand of leafy spurge at Chaffee and Hunter ND. Treatments were applied to leafy spurge in the vegetative and flowering growth stages on May 17 and June 11, 1993, respectively, at both locations. The soil was a sandy loam and sand at Chaffee and Hunter, respectively, both with a pH 7.8. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 14 by 25 feet with 3 replications. Evaluations were based on percent stand reduction as compared to the control.

			Location and evaluation date					
	Growth		3 MAT[a]			12 MAT[a]		
Treatment	stage	Rate	Chaffee	Hunter	Mean	Chaffee	Hunter	Mean
		— lb/A —	% control					
Fluroxypyr	Veg.	0.125	0	5	3	0	15	8
Fluroxypyr	Veg.	0.25	3	7	5	11	21	16
Fluroxypyr	Veg.	0.50	0	14	7	0	19	10
Fluroxypyr	Flower	0.125	29	31	30	13	30	22
Fluroxypyr	Flower	0.25	38	27	33	12	8	10
Fluroxypyr	Flower	0.50	46	11	29	35	15	25
Picloram + 2,4-D	Flower	0.25 + 1	69	62	66	28	52	49
2,4-D	Flower	2	39	6	23	17	4	10
Fluroxypyr + picloram	Veg.	0.125 + 0.25	42	71	57	20	36	28
Fluroxypyr + picloram	Flower	0.25 + 0.25	51	54	53	18	49	34
Untreated check		0	0	0	0	0	0	0
LSD (0.05)			17	28	17	NS	28	28

[a]Months after treatment.

Leafy spurge control with fluroxypyr was better when applied in the flowering compared to vegetative growth stage at both locations (Table). However, control was less then 50% 3 months after treatment (MAT) unless fluroxypyr was applied with picloram. No treatment provided satisfactory leafy spurge control 12 MAT. Fluroxypyr may be useful in a leafy spurge retreatment program, especially when applied with picloram, but does not provide satisfactory control when applied alone regardless of growth stage. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Wooly locoweed and broom snakeweed control with various herbicides in New Mexico. K. C. McDaniel. Wooly locoweed is a short-lived toxic plant that is particularly common on disturbed blue grama grasslands. For example, high numbers of wooly locoweed occur in favorable years along the Santa Fe wagon trail and on various abandoned homestead fields throughout northeastern New Mexico. Broom snakeweed is also widespread on grazing land in the region and is regarded as undesirable because it interferes with forage growth and is toxic to livestock. Herbicide control trials for these species growing together were established near Gladstone, NM. Plots were 30 by 30 ft. with three replications in a randomized complete block. Herbicides were broadcast with a CO_2 pressurized sprayer delivering 21 gpa at 60 psi on April 28, 1993 (AT 66°F, ST 67°F @ 6", RH 42%, wind SW 5 to 12 mph) and September 22, 1993 (AT 79°F, ST 67°F @ 6", RH 43%, wind SW 2-7 mph). Soil was a sandy loam and soil water was moderate in April but low in September. Wooly locoweed was in early flower in April with about 10-15% of plants in bloom while broom snakeweed was vegetative. In September both species were in late-bloom and early fruiting. Ten plants of each species were individually flagged in each plot at the time of spraying. The number of flagged plants dead 6 mos. post-treatment was used to calculate apparent mortality.

For treatments applied in April 1993 and evaluated in September 1993, picloram and clopyralid provided the best control of both wooly locoweed and broom snakeweed. Treatments applied in September 1993 could not be evaluated in April 1994 because the fourlined locoweed root borer had infested and killed nearly all wooly locoweed plants in the check and surrounding area. When the research site was revisited in September 1994, no live wooly locoweed and few broom snakeweed plants could be found in nonsprayed areas, presumably because of the combination of root borers and summer 1994 drought. (Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM 88003).

Table. Evaluation of various herbicides for wooly locoweed and broom snakeweed near Gladstone, NM.

		Species and application date			
		Wooly locoweed		Broom snakeweed	
Herbicide	Rate	4/93	9/93	4/93	9/93
	oz/A	Apparent mortality[1]			
Metsulfuron		80	100[2]	93	100
Metsulfuron		99	100	99	100
	lb/A				
Picloram	0.25 + 0.375	96	100	98	100
Picloram	0.25	95	100	99	100
Picloram	0.375	98	100	99	100
Picloram + dicamba	0.25 + 0.125	74	100	68	100
Dicamba	0.5	71	100	98	100
Dicamba + 2,4-D	0.25 + 1.0	65	100	79	100
2,4-D	4.0	74	100	99	100
Triclopyr + 2,4-D	0.25 + 0.5	59	100	56	40
Clopyralid	0.25	98	100	83	100
Check		0	100[2]	5	60

[1]Apparent mortality based on 10 flagged plants counted as alive or dead 6 mos. post-treatment.
[2]Wooly locoweed became infested with root borers over the 1993-1994 winter and eliminated all plants in checks.

Testing the potential use of quinclorac for yellow starthistle control. Lawrence W. Lass and Robert H. Callihan. Yellow starthistle's development of picloram resistance has increased the need to find other herbicides having different modes of actions that could control this Federal Noxious Weed. Initial tests in the green house suggest quinclorac would control yellow starthistle. Quinclorac, code number BAS 51416H, was developed and screened in 1982 with registration in rice in 1992. Quinclorac is a quinoline structure having plant hormone mode of actions and if following other compounds in the group the mechanism of action is increased cell division. Typical use rates in rice are between 4 to 8 oz ai/a. Other research has focused on wheat production by the Western States for control of field bindweed with rates between 2 to 8 oz ai/a. Registration for wheat is pending.

The plots were established on Hatwai Ridge near Lewiston Idaho in the fall of 1993. Stems and seeds of the previous summers growth were dispersed by mowing on August 31, 1993. The plot size was 10 by 20 feet with 4 replications in a randomized block design. The site has a 5% slope to the SW and the soil is a rocky silt loam. The yellow starthistle used in this study was not resistant to picloram. The objective of the project was to determine the effect of quinclorac on yellow starthistle.

Seedling yellow starthistle plants were sprayed on November 1, 1993 about 4 weeks after germination. The yellow starthistle had one true leaf and there was 90% trash cover, consisting mainly of mowed yellow starthistle stems. Herbicides applied were chlorosulfuron at 0, 0.96, 2.88, and 5.76 oz ai/a, quinclorac at 0, 2, 8, and 32 oz ai/a, picloram at 0, 2, 4, and 8 oz ai/a, triclopyr at 0, 2, 4, and 8 oz ai/a, clopyralid at 0, 2, 4, and 8 oz ai/a and 2,4-D at 0, 2, 8, and 32 oz ai/a. There was no wind immediatly prior to application. A CO2 backpack sprayer traveling at 2.4 mph delivering 23.2 gal/a was used to apply the herbicide. Application time took 2.5 hours. The after-application air-temperature was 48 F, soil surface temperature was 64 F and soil temperature at 2 and 6 inches were both 44 F. The relative humidity was 45 % and there was no cloud cover. Wind speed was 7 mph from the SW with periods of calm. No dew was present. Field bindweed seedlings had 2 leaves and were present at densities of 1 to 2 per plot.

Spring treatments were applied on May 2, 1994. The herbicide was quinclorac at 0, 2, 8, and 32 oz ai/a. A CO2 backpack sprayer traveling at 2.2 mph delivering 19.3 gal/a was used to apply the herbicide. Wind speed was 1 to 2 MPH from the north prior to application. The application took 0.5 hours. The after-application air temperature was 57 F, soil surface was 73 F, 2" depth was 61 F, 6" depth was 54 F. The relative humidity was 60% and the sky was nearly clear. The wind speed was 2 to 3 mph from the North. No dew was present. The yellow starthistle had 3 to 5 leaves and was about 1 inch tall. Field bindweed was 5 inches tall with an average density of 10/yrd^2. Red stem filaree was 3 inches tall and represented about 10% of the cover. Other weeds present included lupine ssp. and annual bromes both about 2 inches tall.

The previous reported successful treatments of clopyralid and picloram controlled yellow starthistle 8 months after application. Higher rates of chlorsulfuron at 0.96 oz ai/a and 2,4-D at 32 oz ai/a provided control of yellow starthistle. Annual brome grass were controlled by the highest rate of chlorsulfuron, but this would not be cost effective. Triclopyr reduced yellow starthistle densities, but remaining plants were taller than those found in the check plots.

Yellow starthistle was controlled by field application of quinclorac. Fall treatments were less successful than spring treatments because of spring germinating starthistle. Spring germination represented about 30% of the cover. Quinclorac applied at 32 oz ai/a in the fall had enough carryover to control the spring germinating plants. All rates of quinclorac applied in the spring controlled yellow starthistle. Long term control and potential use of quinclorac for controlling picloram resistant yellow starthistle is yet to be determined. (Department of P.S.E.S., University of Idaho, Moscow, ID 83844-2339)

Table. Yellow starthistle control

Herbicide (oz ai/a)		Timing	Yellow starthistle Height (cm)	Yellow starthistle Cover (%)	Annual Brome Cover (%)
2,4-D	0	Fall	24 CBD[1]	76 BA	23 I
2,4-D	2	Fall	26 CB	83 BA	15 I
2,4-D	8	Fall	31 CB	74 BA	25 HI
2,4-D	32	Fall	24 CBD	30 ED	70 EBDAGCF
Chlorsulfuron	0	Fall	32 CB	78 BA	23 I
Chlorsulfuron	0.96	Fall	68 A	2 E	51 EBDHIGCF
Chlorsulfuron	2.88	Fall	34 CB	23 ED	41 EHIGF
Chlorsulfuron	5.76	Fall	0 F	0 E	6 I
Clopyralid	0	Fall	22 CED	83 BA	18 I
Clopyralid	2	Fall	23 CEBD	3 E	86 BDAC
Clopyralid	4	Fall	6 EFD	8 E	93 BAC
Clopyralid	8	Fall	4 EF	3 E	95 BA
Picloram	0	Fall	17 CEFD	76 BA	24 HI
Picloram	2	Fall	0 F	0 E	78 EBDACF
Picloram	4	Fall	0 F	0 E	100 A
Picloram	8	Fall	0 F	0 E	80 EBDAC
Triclopyr	0	Fall	20 CED	65 BAC	35 HIGF
Triclopyr	2	Fall	41 B	49 BDC	48 EDHIGF
Triclopyr	4	Fall	26 CB	40 DC	33 HIG
Triclopyr	8	Fall	36 CB	50 BDC	50 EDHIGCF
Quinclorac	0	Fall	21 CED	79 BA	21 I
Quinclorac	2	Fall	18 CEFD	80 BA	18 I
Quinclorac	8	Fall	19 CEFD	30 ED	70 EBDAGCF
Quinclorac	32	Fall	6 EFD	1 E	68 EBDHAGCF
Quinclorac	0	Spring	18 CEFD	91 A	9 I
Quinclorac	2	Spring	4 EF	3 E	36 EHIGF
Quinclorac	8	Spring	0 F	0 E	76 EBDAGCF
Quinclorac	32	Spring	0 F	0 E	40 EHIGF

1. means having the same letter are not significantly different at the 5% level.

Control of fringed sagewort using picloram alone and in combination with 2,4-D at vegetative and flower stages, and during fall dormancy. Tom D. Whitson and R. J. Swearingen. Fringed sagewort (*Artemisia frigida*) is a native perennial which produces good wildlife forage on western rangelands. However, on disturbed or poorly managed land, fringed sagewort can compete for nutrients and moisture, displacing some of the desirable livestock forages. Three studies were established in 1993 to determine the effects of various rates of picloram alone and combined with 2,4-D applied at three growth stages. Herbicides were applied with a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Plots were 10 by 27 feet arranged in a randomized complete block design with four replications. Application information for June 25 at the vegetative growth stage, temperature: air 65F, soil surface 60F, 2 inch 60F, 2 inches 65F, 4 inches 68F, with 60% relative humidity and calm winds. Application information for July 20 at flower stage, temperature: air 60F, soil surface 60F, 1 inch 63F, 2 inches 65F, 4 inches 74F, with 60% relative humidity and 1 to 2 mph winds from the NW. Application information for October 6 after plants initiated fall dormancy, temperature: air 60F, soil surface 70F, 1 inch 70F, 2 inches 70F, with 50% relative humidity and 2 to 3 mph westerly winds.

Picloram alone at 0.25 lb and higher provided 89% control or better at all three application timings. Picloram at 0.18 lb combined with 2,4-D at 1.0 lb provided excellent control when applied at flower or fall dormancy stages. 2,4-D alone failed to control fringed sagewort. The highest and most consistent control was with the treatments that were applied October 6, during fall dormancy. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1694).

Table. Control of fringed sagewort using picloram alone and combined in 2,4-D applied at the vegetative, flower, and fall dormancy stages.

Herbicide[1]	Rate lb ai/A	% Control Application time Vegetative	Flower	Dormancy
Picloram+2,4-D	0.125+1.0	70	65	82
Picloram+2,4-D	0.18+1.0	82	97	95
Picloram+2,4-D	0.25+1.0	95	99	98
Picloram	0.25	89	96	99
Picloram	0.38	97	98	99
2,4-D	1.0	0	8	10

The effects of grass planting time on establishment in yellow starthistle infestations. Lawrence W. Lass and Robert H. Callihan. The purpose of this project was to determine the best time for planting grass on land infested with yellow starthistle. Climates with little precipitation from July to October require seedling grasses to set deep roots rapidly to avoid death by dehydration. Spring plantings often fail because of early drought. Late fall rains provide moisture, but temperatures are low, resulting in slow germination and growth. Neither spring or fall conditions are typically conducive to grass establishment.

The study site was ungrazed non-crop land with a southern exposure and a slope of 3 to 5%. The soil type was slickpoo silt loam. The plot size is 16 by 15 ft with 4 replications in a split-split-split-split-block design. Planting dates were November 14, 1993 and April 17, 1994. Luna pubescent wheatgrass was planted at a rate of 12 seeds per foot of row and Covar sheep fescue was planted at a rate of 26 seeds per foot of row. A modified John Deere Powr-till seeder 1500 with a cone seeder distribution system was used to plant the grass seed. The row spacing was 8 inches. Seven days prior to planting, glyphosate at 0.8 oz plus R11 surfactant (1% v/v) was applied to half of the 32 by 30 foot grass plot. Picloram at 0.25 lb plus R11 surfactant (1% v/v) was applied on May 30, 1994 when the starthistle was beginning to bolt (2 to 6 inches tall).

Fall glyphosate treatment was applied with a tractor mounted sprayer using a hydraulic driven pump. The output of the sprayer in November was 46 GPA and the speed was 1.28 mph. High water volume was used to increase potential contact of the herbicide because of residual trash from old yellow starthistle stems. The wind was 3 mph from the SW at both the beginning and end of application. Air temperature was 50 F and soil at 2 inches depth was 52 F and 6 inches depth was 59 F. There was a 1% cloud cover and the relative humidity was 60%. There was dew present. Current-year yellow starthistle stems were dead, but 2 to 3 ft tall. Fall seedlings had 3 to 4 leaves and were about 0.5 inch in diameter.

Spring glyphosate application was made with a motorized plot sprayer having a direct drive pump. The output of the sprayer in April was 10 GPA. The wind was calm at the beginning of application and ranged from 2-5 mph from the east throughout application. The air temperature after application was 53 F. The soil surface was 68 F and the temperature at 2 inches depth was 55 F and 6 inches depth was 48 F. The relative humidity was 62% and there were no clouds.

The picloram treatment was made with a CO_2 backpack sprayer calibrated to deliver 11 GPA. The wind at the beginning of application was calm and at the end of application was 2 to 5 MPH from the West. The air temperature after application was 57 F. The soil surface temperature was 66 F and the temperature at 2 inches depth was 61 F and at 6 inch depth was 59 F. The relative humidity was 76% and there was a 90% cloud cover.

In June 1994, field bindweed appeared in all spring-treated glyphosate plots. Field bindweed density ranged from 10 to 38 plants per yd^2. Field bindweed levels in 3 of the 4 replications were sufficient to warrant further treatment with quinclorac at the rate of 2 oz. Applications were made with a CO_2 backpack sprayer calibrated to deliver 11 GPA to all spring treated glyphosate plots. The yellow starthistle was budding where not sprayed with picloram and the bindweed had 1 to 2 flowers in bloom. The air temperature was 81 F. Soil surface temperatures were 97 F. Soil temperatures were 75 F at 2 inches depth and 64 F at 6 inches depth. The wind was 2 to 3 mph from the west. The relative humidity was 54% and there was about 25% cloud cover.

Grass establishment the first year was determined in September 1994. Grasses had become established in the areas treated with picloram but were not present in the post-treatment check plots. Pubescent wheatgrass had become established in all spring planted plots when pre-plant with glyphosate to reduce seedling weeds and post-treated with quinclorac to reduce bindweed and with picloram after grass emergence. Sheep fescue established in 3 of the 4 replicates if the plots were sprayed with glyphosate pre-plant and quinclorac and picloram post-emergence. Other treatments failed to result in grass establishment. This could be reflective of the dry year. (Department of P.S.E.S., University of Idaho, Moscow, ID 83844-2339)

Table. Establishment of grass in yellow starthistle treated with picloram.

Planting Time	Grass	Herbicide plus post-treatment of picloram	Grass Establishment (No. of replicates)
Fall	Check	Check	0
Fall	Check	Glyphosate	0
Fall	Fescue	Check	0
Fall	Fescue	Glyphosate	0
Fall	Wheatgrass	Check	0
Fall	Wheatgrass	Glyphosate	0
Spring	Check	Check	0
Spring	Check	Glyphosate	0
Spring	Fescue	Check	0
Spring	Fescue	Glyphosate + Quinclorac	3
Spring	Wheatgrass	Check	1
Spring	Wheatgrass	Glyphosate + Quinclorac	4

Establishment is defined as visually seeing the grass species growing at any density.
The grasses failed to establish in the checks of the picloram treatment blocks.

Detecting yellow starthistle with high resolution remote sensing equipment. Lawrence W. Lass, Hubert W. Carson, and Robert H. Callihan. Detailed detection of species occupancy is important for land resource management as well as for applied and basic plant science. Changes in plant communities must be documented to determine whether specific management practices are working. Previous methods of detection have required visual surveys by ground or air; these are expensive and not sufficiently precise or accurate. Extensive surveys of yellow starthistle infestations have been conducted by several federal, state, and private agencies that manage land in the Pacific Northwest. Such surveys normally concentrate on accessible land, infestations already detected from visual surveys or on critical areas. Such data acquisition is a particularly costly process, and it does not provide total infestation details necessary for adequate management. Yellow starthistle has infested 20 of 44 counties in Idaho. Yellow starthistle generally infests rangeland or non-crop land with south facing slopes too steep or rocky for small grain farming.

Automated techniques offer the best hope for this intensive survey of a plant species. Current satellite imagery from LANDSAT will detect plant communities with 30-meter resolution on the ground. However, a single plant species is not detectable unless it dominates the reflectance, in part because of averaging of spectral reflectance values due to the low spatial resolution and the broad spectral wavelength range of each band. For example, Band 4 of LANDSAT averages mid-infrared data between 760 to 900 nm and Band 3 averages red light between 630 and 690nm. Comparison of theses two wide ranges or bands of light reflectance values allows for discrimination between soil and vegetation, but is inadequate for reliable discrimination among species. Images with 30 by 30 meter resolution will seldom record spectral reflectance values that represent a single species unless the species reflectance properties are unique and the population is widespread. Mixed populations make classification difficult since both the wide band width and poor spatial resolution severely average the data. Some satellite images like SPOT increase the resolution to 20 by 20 meters but offer fewer bands and the spatial resolution is still too coarse for detection of most plant species. Overall, developing a spectral signature unique to a plant species has not been possible because of wavelength-averaging, coarse spatial resolution and signature confusion. Therefore, accurate remote sensing by satellite has not been possible for most plant species.

It should be possible to detect many plant species with data collected by an airborne data acquisition and registration system (ADAR) developed by Positive Systems, Whitefish, MT. The ADAR technology allows (1) selection of a narrow wavelength range, (2) increased spatial resolution and (3) selective multi-date analysis of more than one phenological, or growth, stage. Multispectral charge coupled devices (CCD) mounted in an airplane can collect digital images with a surface resolution of 25 cm to 4 m per pixel. This is far more precise than available satellite remote sensing, and is critical to detection of small colonies. Each image has a pixel array of 1000 by 1500 that covers about four times the area of a typical video image. Four user-definable bands between 400 and 1000 nm are available, and each band can be set as narrow as 12 nm depending on the filters selected. Global positioning system data is used to record the location of the aircraft at the time each image is acquired.

The study area was located in Garden Gulch near Lapwai, ID. This site contained a large herbicide-seedling grass interaction trial that has been maintained for the past 7 years with results reported in previous WSWS progress reports. These plots were used in part for classification and verification of the images.

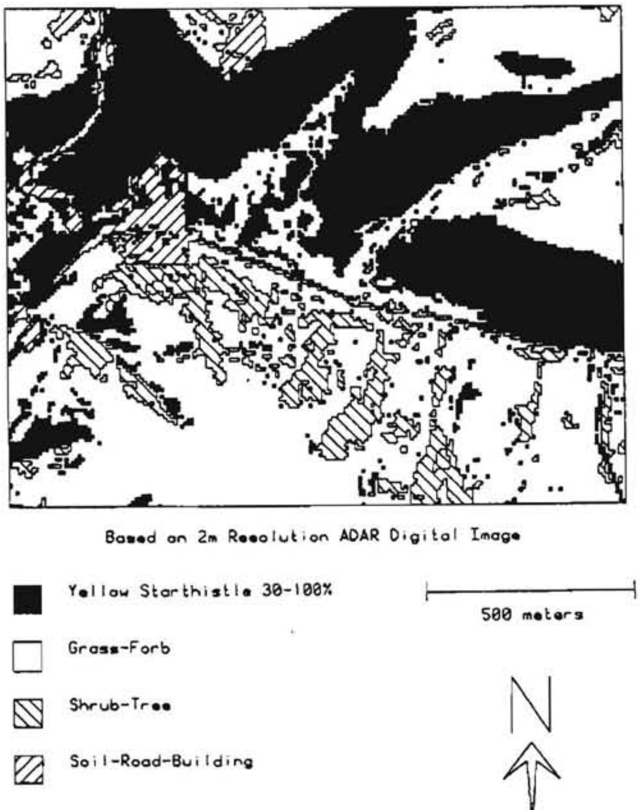
Twelve 1 by 2.5 m strips of white plastic were placed in an 'L' configuration on the ground near the herbicide plot prior to the ADAR flight. Geographic coordinates of the 12 markers were recorded with a Trimble Navigation Systems professional model GPS. The experimental plot corner point and ground marker coordinates were entered into a geographic information system (GIS) and projected into UTM coordinates.

High-resolution multispectral digital images were recorded by an aircraft-mounted ADAR system June 21 and July 17 1994. The flight elevation was controlled to enable recording digital ADAR images at 2, 1, and 0.5 m ground resolution. Each image recorded by the ADAR flight contained data for each of four light wavelength ranges or bands. Band 1 of the image measured blue-green light reflectance, with a light wavelength range of 460 to 570 nm. Band 2, for yellow to red reflectance, ranged from 575 to 625 nm. For measurement of red light reflectance, band 3 ranged from 610 to 670 nm and for near infrared band 4 ranged from 780 to 1000 nm. All four bands for the images in the study area were processed on a personal computer using an Idrisi GIS and image processing system. The coordinates of the images were registered to match the UTM ground coordinates gathered with the GPS at the markers.

After conversion to ground coordinates, the images were combined into a large image for each of the four bands and for each resolution. The resulting image was classified using unsupervised routines for categories of yellow starthistle and other vegetation or land use features. A mean and standard deviation of light reflectance values for each class is used to assign all areas of the image to one of the predetermined classes. The unsupervised routine creates a variable number of clusters of digital image pixels with similar light reflectance values. No previous knowledge is required of the area for unsupervised classification, but after the pixels are grouped, vegetation and land use designations must be assigned to each group.

In the unsupervised classification, the four bands were reduced to three principal component (PCA) images. The PCA images contain the most significant differentiating characteristics of the original images. The three PCA images were composited into one image, then clustered into multiple classes. Results of the 2.25 m resolution images of the study site are displayed as a simple four-class system of yellow starthistle, grass-forb, shrub-tree and soil-road-building in Figures 1 and 2. The yellow starthistle class represents infestations ranging from 30 to 100% cover. The grass-forb represents grass, crops, weeds including yellow starthistle at low cover, and other forbs. The shrub-tree class represents tall forbs, shrubs, and trees. The soil-road-building class represents soil, rock, roads, farm equipment, and buildings. Differences between the two image dates indicated changes in detectability over time. The June 21 image showed more soil-road-building than the July 17 images. The soil-road-building polygon in the upper left corner of the June 21 image was a thin wheat stand. The soil-road-building polygon in the upper left corner of the July 17 image represents an area in a harvested wheat field. Yellow starthistle in small patches of the lower center of the map were detected in the first image but fewer were found in the second image. Yet the second image detected and enlarged some infestations in the more established areas. Data indicate that yellow starthistle is detectable with the ADAR system. Further refinements on classification and resolutions providing the best detection are necessary. (Dept of P.S.E.S., University of Idaho, Moscow ID., 83844-2339)

Figure 1. Yellow Starthistle Infestation
Lapwai, Idaho on June 21, 1994



Based on 2m Resolution ADAR Digital Image

Yellow Starthistle 30-100%

Grass-Forb

Shrub-Tree

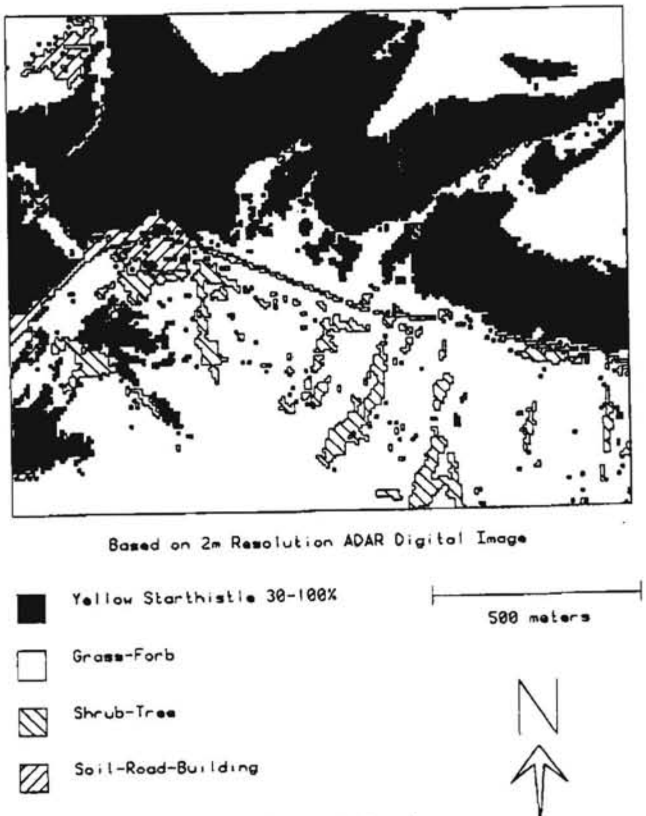
Soil-Road-Building

500 meters

N

Produced by U of I Weed Mapping Laboratory

Figure 2. Yellow Starthistle Infestation
Lapwai, Idaho on July 17, 1994



Based on 2m Resolution ADAR Digital Image

Yellow Starthistle 30-100%

Grass-Forb

Shrub-Tree

Soil-Road-Building

500 meters

N

Produced by U of I Weed Mapping Laboratory

Comparative digestibility of yellow starthistle (*Centaurea solstitialis* L.). Robert H. Callihan, L. W. Lass, C.W. Hunt, and G. Pritchard. Yellow starthistle, designated noxious in several states in the western U.S., is particularly invasive and has gained dominance in many arid and semiarid pastures. A fierce competitor toxic to horses, it reduces pasture productivity, biological diversity and recreational utility of infested land. Leaf samples of yellow starthistle, downy brome and intermediate wheatgrass were collected from northern Idaho (T36N, R5WBM)at four intervals throughout the growing season. Samples were air-dried, ground, and analyzed for digestibility by 24-hr fermentative *in-situ* dry matter disappearance (ISDMD) tests with rumenally cannulated steers. The ISDMD of all species declined progressively throughout the season as expected; however the ISDMD of yellow starthistle consistently remained much higher than is expected of most forage species under such conditions, ranging from 86% early to 63% at full bloom. Yellow starthistle leaf ISDMD was 27-46% higher than that of associated downy brome, with the difference increasing throughout the season. Yellow starthistle leaf ISDMD was 48-28% higher than that of associated intermediate wheatgrass, with the difference decreasing throughout the season. The data indicate that nutritional components of yellow starthistle leaves in good physiological condition may be highly digestible by ruminants. Because the spring pattern of growth coincides with that of palatable, more productive forage species; because of the disappearance of available yellow starthistle forage in late summer through winter; because of the development of injurious spines on yellow starthistle capitulae during their development; and because high proportions of centaurean relatives of yellow starthistle in ruminant diets are known to reduce ISDMD, the contribution of yellow starthistle to ungulate nutrition is questionable despite its high apparent digestibility and probable nutrient content. Studies are continuing. (Dept of PSES, University of Idaho, Moscow ID, 83844-2339

Table: Comparison of yellow starthistle ISDMD with that of associated grasses.

	Yellow Starthistle Growth stage			
Species	rosette	pre-bolt	bolt	anthesis
		ISDMD(%)		
Downy brome (DB)	68	63	50	43
Intermediate wheatgrass (IW)	58	54	51	49
Yellow starthistle (YST)	86	80	67	63
$P > .001$; $cv = 3.9\%$				
		ISDMD Difference (%)		
YST - DB / DB	27	27	34	46
YST - WH / WH	48	49	31	28

Canada thistle control two and three months following applications of various herbicides applied at two growth stages. Tom D. Whitson, R.J. Swearingen, and J.W. Freeburn. Canada thistle (Cirsium arvense) often invades disturbed sites and moist mountain meadows. Three experiments were established in 1994 to determine the effects of various herbicides for contro of Canada thistle. Herbicides were applied with a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Plots were 10 by 27 feet arranged in a randomized complete block design with four replications. The first study was initiated May 27 in Platte Co., WY in an irrigated hay meadow when Canada thistle was in the rosette to early bolting stage. Application information temperature: air 81F, soil surface 86F, 1 inch 84F, 2 inches 76F, 4 inches 74F, with 70% relative humidity and 0 to 5 mph winds from the SE. The second study was initiated June 8 on the University of Wyoming ranch near Bosler, WY when Canada thistle was in the rosette stage. Application information for June 8 - temperature: air 56F, soil surface 75F, 1 inch 60F, 2 inches 65F, 4 inches 55F, with 80% relative humidity and 2 to 5 mph winds from the NE. The third study was initiated July 5 on the UW ranch when Canada thistle was in the bud stage. Application information for July 5 - temperature: air 75F, soil surface 63F, 1 inch 69F, 2 inches 66F, 4 inches 56F, with 0 to 5 mph winds from the SW.

Clopyralid at 0.5 lb, dicamba combined with picloram, and picloram at 0.5 lb provided 90% control or greater at the Platte Co. location. Clopyralid at 0.38 lb plus 2,4-D at 2.0 lb and picloram at 0.5 lb exhibited greater than 90% control when applied at the rosette stage at the UW Ranch. Picloram at 0.5 lb applied during the bud stage at the UW ranch provided the highest level of control, which was 74%.

*Note - evaluations were made the same year the herbicides were applied; studies will be reevaluated in 1995 (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1697).

Table. Control of Canada thistle with various herbicides applied during the rosette and bud stages.

		Growth stage		
		Rosette		Bud
Herbicide[1]	Rate lb ai/A	Platte Co	UW Ranch	UW Ranch
Picloram+2,4-D+X-77	0.25+1.0	66	58	49
Clopyralid+2,4-D	1.19+1.0	55	67	29
Clopyralid+2,4-D	0.25+1.25	66	51	51
Clopyralid+2,4-D	0.38+2.0	66	91	65
Clopyralid+X-77	0.13	45	26	13
Clopyralid+X-77	0.19	61	23	30
Clopyralid+X-77	0.25	71	31	41
Clopyralid+X-77	0.38	75	66	33
Clopyralid+X-77	0.5	93	74	59
Clopyralid	0.19	83	21	20
Dicamba+2,4-D+X-77	0.5+1.0	41	43	23
Dicamba+Metsulfuron+X-77	0.5+0.0038	29	33	9
Dicamba+Metsulfuron+X-77	0.5+0.038	62	60	41
Dicamba+Picloram+X-77	0.5+0.125	90	43	41
Dicamba+Picloram+X-77	0.5+0.25	95	78	54
Dicamba+X-77	0.5	40	18	23
Picloram+X-77	0.25	79	51	40
Picloram+X-77	0.5	99	91	74
Metsulfuron+X-77	0.038	60	36	38
Check		0	0	0

[1] Herbicides were applied and evaluations were made in 1994.

Oxeye daisy control with various herbicides applied at full seed growth stage. Tom D. Whitson, R.J. Swearingen, G. Kurz, and B. Feuz. Oxeye daisy (*Chrysanthemum leucanthemum* L.) is an introduced perennial that has the competitive capabilities to displace native, more desirable plant species. Oxeye daisy can be found in meadows, roadsides, and waste places. An experiment was established June 27, 1994 near Dayton, Wyoming to study the efficacy of various herbicides for control of oxeye daisy. Herbicides were applied in full seed growth stage using a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Plots were 10 by 27 feet arranged in a randomized complete block design with four replications. The air temperature was 75F with no wind and clear skies.

Treatments were evaluated October 24, 1994. All picloram treatments alone or in combination with 2,4-D at 1.0 lb and dicamba at 0.5 lb provided greater than 95% control. Clopyralid at 0.38 lb plus 2,4-D at 2.0 lb controlled 97% while clopyralid at 0.38 and 0.5 alone provided 93 and 98% control, respectively. Dicamba at 0.5 lb combined with metsulfuron at 0.038 lb and metsulfuron alone at 0.038 lb provided excellent control. (Wyoming Agric. Exp. Sta., Laramie, WY SR 1699).

Table. Oxeye daisy control with various herbicides applied at full seed stage of growth.

Herbicide[1]	Rate lb ai/A	% Control Average
		- % --
Picloram+2,4-D+X-77	0.25+1.0+0.25%	98
Cloyralid+2,4-D+X-77	0.19+1.0+0.25%	39
Clopyralid+2,4-D+X-77	0.25+1.53+0.25%	84
Clopyralid+2,4-D+X-77	0.38+2.0+0.25%	97
Clopyralid+X-77	0.13+0.25%	24
Clopyralid+X-77	0.19+0.25%	84
Clopyralid+X-77	0.25+0.25%	90
Clopyralid+X-77	0.38+0.25%	93
Clopyralid+X-77	0.5+0.25%	98
Clopyralid	0.19	46
Dicamba+2,4-D+X-77	0.5+1.0+0.25%	59
Dicamba+metsulfuron+X-77	0.5+0.0038+0.25%	38
Dicamba+metsulfuron+X-77	0.5+0.038+0.25%	95
Dicamba+picloram+X-77	0.5+0.125+0.25%	97
Dicamba+picloram+X-77	0.5+0.25+0.25%	100
Dicamba+X-77	0.5+0.25%	60
Picloram+X-77	0.25+0.25%	98
Picloram+X-77	0.5+0.25%	96
Metsulfuron+X-77	0.038+0.25%	99
Check	-------	0

[1] Herbicides were applied June 27, 1994. Evaluations were made October 24, 1994.

Control of seaside arrowgrass with metsulfuron applied at various rates. Tom D. Whitson, R.J. Swearingen and D.C. Meyers. Seaside arrowgrass (Triglochin maritimum L.) is a native perennial to the western U.S. and the prairie providences of Canada which inhabits wet meadows and is very toxic to livestock. Previous herbicide screening studies concluded that the herbicide metsulfuron provided the best control. This experiment was established August 12, 1992 on the Benik Ranch near Laramie, Wyoming to determine the most effective and economical application rate for metsulfuron in an irrigated meadow situation. Herbicides were applied when arrowgrass plants were in full seed standing approximately 2 feet tall. Treatments 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. Temperatures for August 12, 1992 were: air 78F, soil surface 100F, 1 inch 83F, 2 inches 72F, 4 inches 75F, with 50% relative humidity and 2 to 3 mph winds.

Metsulfuron at 0.3 oz product/A provided 89% control while rates of 0.4 oz prod/A and higher provided >95% control. Rates less than 0.3 oz prod/A failed to provide adequate control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1701).

Control of seaside arrowgrass with metsulfuron applied at various rates.

Herbicide[1]	Rate oz/ prod/A	% control Avg.
Metsulfuron+X-77	0.1+0.25%	8
Metsulfuron+X-77	0.2+0.25%	68
Metsulfuron+X-77	0.3+0.25%	89
Metsulfuron+X-77	0.4+0.25%	96
Metsulfuron+X-77	0.5+0.25%	96
Metsulfuron+X-77	0.5+0.25%	98
Metsulfuron+X-77	0.7+0.25%	100
Metsulfuron+X-77	0.8+0.25%	100
Metsulfuron+X-77	0.9+0.25%	98
Check		0

[1] Herbicides were applied August 12, 1992 on the Benik Ranch, Laramie, WY; evaluations were made June 30, 1994.

Plumeless thistle (*Carduus acanthoides*) control in pasture and rangeland. Rodney G. Lym. Plumeless thistle is seldom found in cultivated fields even when there are infestations in nearby roadsides or pastures. Plumeless thistle tends to be shorter than other noxious biennial thistles; it typically is 2 to 4 feet tall but can be 6 feet or more in ideal growing conditions. Well established stands of plumeless thistle are self-renewing. Generally, there is no competition from other plant species, and old stalks catch snow insulating rosettes and increasing available moisture. Plumeless thistle infestations have been increasing in eastern North Dakota, especially along the Sheyenne River drainage. The purpose of this research was to evaluate various herbicides for control of large plumeless thistle plants.

The experiment was established in a dense plumeless thistle infestation on May 31, 1994. Most plants were in the prebud growth stage and 12 to 36 inches tall, but numerous rosettes up to 24 inches diameter also were present. Treatments were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The adjuvant X-77 at 0.25% was added to all herbicide treatments. The experiment was in a randomized complete block design with four replications, and plots were 10 by 30 ft. Treatments were visually evaluated for percent control 2 and 8 weeks after treatment.

Treatment	Rate	Cost[a]	2 WAT[b]	8 WAT[b]
	— lb/A —	— $/A —	— % control	—
Dicamba + X-77	0.5+0.25%	9.28	48	84
Dicamba + X-77	1+0.25%	18.18	65	96
Dicamba + 2,4-D[c] + X-77	0.5+1.4+0.25%	11.75	58	97
2,4-D amine + X-77	2.0+0.25%	5.87	59	88
Picloram + X-77	0.25+0.25%	11.62	62	99
Picloram + X-77	0.5+0.25%	22.87	70	99
Picloram + 2,4-D + X-77	0.25+1+0.25%	14.37	63	97
Clopyralid + X-77	0.3+0.25%	44.97	60	99
Clopyralid + 2,4-D[d] + X-77	0.3+1.5+0.25%	22.88	71	100
Metsulfuron + 2,4-D + X-77	0.035+1.0+0.25%	22.95	54	98
Glyphosate + 28% N + X-77	0.4+5%+0.25%	6.75	58	81
Glyphosate + 2,4-D[e] + X-77	0.4+0.6+0.25%	8.70	57	90
LSD (0.05)			NS	8

[a]Based on average retail price throughout North Dakota in 1993, excluding application cost.
[b]Weeks after treatment.
[c]Commercial formulation - Weedmaster
[d]Commercial formulation - Curtail
[e]Commercial formulation - Landmaster BW

All treatments provided rapid topgrowth control and prevented treated plants from flowering (Table). Most treatments provided near 100% control by 8 weeks after treatment. Less-than-complete control was probably due to poor spray coverage. Some plants were only partially sprayed when taller plants covered them as the spray boom passed over. Picloram was the only herbicide evaluated that provided season long rosette control based on observations that continued after these data were obtained. The most cost effective treatments were dicamba plus 2,4-D at 0.5 + 1.4 lb/A and picloram at 0.25 lb/A with an average cost of $11.70/A and an average of 98% control. Dicamba applied at 0.5 lb/A, 2,4-D amine at 2 lb/A, and glyphosate at 0.4 lb/A plus 28% N only averaged 84% control. 2,4-D at 2 lb/A only cost $5.87/A but would need to be applied twice a season to maintain acceptable control. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Silky crazyweed, broom snakeweed, and fringed sagebrush control with herbicide in northeastern New Mexico. K. C. McDaniel. Silky crazyweed often causes locoism to cattle grazing the plant whereas broom snakeweed and fringed sagebrush reduce forage productivity on rangelands in northern New Mexico. Research to compare various herbicides for control of these species was conducted about 18 miles east of Raton, New Mexico within ar ungrazed pasture on the T-O Ranch. Plots were 30 by 30 ft. with two replications in a randomized complete block. Herbicides were broadcast with a CO_2 pressurized hand-held sprayer (10 ft. swath) delivering 21 gpa at 6C psi on April 12, 1994 (AT 54°F, ST 48°F @ 6", RH 40%, wind SW 3-8 mph) and May 19, 1994 (AT 65°F, ST 60°F @ 6", RH 52%, wind SE 8-15 mph). Soil was a silty clay loam and very moist during both applications. All plants were in the vegetative stage during both application dates. Apparent mortality was estimated by visually comparing plant reduction in treated plots to adjacent untreated plots on October 4, 1994.

Herbicides generally provided similar control on all species irrespective of spray date. Picloram applied alone or in combination with 2,4-D or dicamba provided more consistent control of silky crazyweed and broom snakeweed than other herbicides. Clopyralid controlled a high percentage of these plants in April but provided poor control in May. Grass cover (mostly blue grama) increased from 10 to 25% in plots where silky crazyweed, broom snakeweed, and fringed sagebrush were reduced. (Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM 88003).

Table. Apparently mortality of silky crazyweed, broom snakeweed, and fringed sagebrush following spring herbicide applications.

		Species and application date					
		Silky crazyweed		Broom snakeweed		Fringed sagebrush	
Herbicide	Rate	4-12-94	5-19-94	4-12-94	5-19-94	4-12-94	5-19-94
	oz/A	Apparent mortality					
Metsulfuron	0.1875	40	98	90	100	70	60
Metsulfuron	0.375	--	100	--	90	--	80
Metsulfuron + 2,4-D	0.1875 + 1.0	85	99	98	100	70	60
	lb/A						
Picloram + 2,4-D	0.47	98	100	100	99	40	60
Picloram + 2,4-D	0.625	100	90	100	100	40	75
Picloram	0.25	100	99	100	100	40	60
Picloram	0.375	100	100	100	100	85	65
Dicamba	0.5	20	50	40	80	10	40
Dicamba + picloram	0.25 + 0.125	65	99	95	99	10	20
Dicamba + 2,4-D	0.25 + 1.0	65	60	90	60	65	40
Clopyralid	0.125	100	20	98	20	85	3
Clopyralid + 2,4-D	0.125 + 1.0	100	--	99	--	80	--
Triclopyr	0.25	--	0	--	0	--	0
Clopyralid + triclopyr	0.125 + 0.125	100	0	100	0	85	0
2,4-D	1.0	0	20	0	10	15	0
2,4-D	2.0	40	10	60	0	10	0
2,4-D	4.0	90	70	90	97	70	60

[1]Percent apparent mortality evaluated visually on October 4, 1994.

Control of silky crazyweed with various herbicides applied during the vegetative and bloom growth stages. Tom D. Whitson, R.J. Swearingen and D.C. Meyers. Silky crazyweed (Oxytropis sericea) is native to western rangelands and is toxic to livestock causing nervous disorders, abortions, and death. Two studies were established in 1990 near Buford, Wyoming to determine the effectiveness of various herbicides on cntrol of soily crazyweed when applied at two growth stages. Herbicides were applied using a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Plots were 10 by 27 feet arranged in a randomized complete block design with four replications. Application information for June 7, 1990 when crazyweed was in the vegetative growth stage, temperature: air 65F, soil surface 81F, 1 inch 75F, 2 inches 58F, 4 inches 52F, with 55% relative humidity and calm winds. Application information for July 4, 1990 when crazyweed was in the bloom stage, temperature: air 58F, soil surface 60F, 1 inch 65F, 2 inches 65F, 4 inches 59F, with 79% relative humidity and 3 to 5 mph winds from the NW. A third experiment was initiated in 1993 to further confirm the results of the 1990 study. Application information for June 21, 1993 when crazyweed was in the bloom stage, temperature: air 70F, soil surface 70F, 1 inch 60F, 2 inches 65F, 4 inches 70F, with 70% relative humidity and 1 to 2 mph winds.

Four years following herbicide application, picloram at 0.5 lb maintained the highest control level 89% when applied at the vegetative growth stage and 92% in the bloom stage. Almost all treatments provided excellent control up to two years after herbicide treatments were applied. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1702).

Table. Control of silky crazyweed one, two, and four years following herbicide applications made during the vegetative and bloom stages of growth.

		Application timing						
	Rate	Vegetative[1] 1990			Bloom[2] 1990			Bloom[3] 1993
Herbicide[4]	lb ai/A	1991	1992	1994	1991	1992	1994	1994
		% control						
Clopyralid+2,4-D	0.13+0.61	99	100	51	98	98	15	99
Clopyralid+2,4-D	0.18+1.0	100	100	69	100	100	28	100
Clopyralid	0.13	96	96	23	100	99	3	97
Clopyralid	0.19	100	100	44	98	100	5	100
Picloram	0.125	100	100	71	100	98	20	98
Picloram+2,4-D	.125+.5	100	100	76	100	100	37	99
Picloram	0.25	100	100	85	98	100	82	99
Picloram	0.5	100	100	89	100	100	92	100
Dicamba	1.0	97	100	59	98	100	12	98
Dicamba	2.0	100	100	81	100	100	30	100
Dicamba+2,4-D	.5+1.0	100	99	62	100	100	50	99
Dicamba+2,4-D	1.0+1.0	100	100	71	100	100	59	100
Diamba+Picloram	.5+.125	100	100	79	100	100	65	100
Dicamba+Picloram	.5+.25	100	99	79	100	100	74	100
Dicamba+Picloram	1.0+.125	100	100	76	94	100	51	100
Dicamba+Fluroxypyr	0.5+0.5	100	100	56	100	100	56	100
Dicamba+Clopyralid	.5+.125	100	100	73	100	99	19	100
Dicamba+Clopyralid	.5+.25	100	100	68	100	100	31	100
2,4-D	2.0	67	97	68	100	93	14	98
Metsulfuron+X-77	.0075+0.25%	99	100	54	100	100	33	100
Metsulfuron+X-77	.015+0.25%	100	100	72	100	100	39	100
Metsulfuron+X-77	.0225+0.25%	100	100	63	100	100	74	100
Check		0	0	0	0	0	0	0

[1] Herbicides were applied June 7, 1990.
[2] Herbicides were applied July 4, 1990.
[3] Herbicides were applied June 21, 1994.
[4] Evaluatins were made July 2, 1994.

Control of hairy goldenaster with various herbicides applied at two stages of growth. T.D. Whitson, P.A., Roseland and R.J. Swearingen. Hairy goldenaster (*Heterotheca villosa*) is a native perennial of the Great Plains and Rocky Mountain regions which has the potential to compete and displace more desirable forage species. Two experiments were established near Cheyenne, Wyoming to test the effects of various herbicide treatments on hairy goldenaster when applied in the vegetative and bloom stages of growth. The first experiment was initiated May 21, 1992 on Warren Livestock Co. and True Ranch when the plants were in the vegetative growth stage. The second experiment was initiated July 22, 1992 on Warren Livestock Co. and July 24, 1992 on True Ranch when plants were in full bloom. Plots were 10 by 27 feet 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. Temperatures on May 21, 1992 were: True Ranch - air 63F, soil 2 inches 70F, 4 inches 65F, with 50% relative humidity and 0 to 5 mph winds; Warren Livestock Co. - air 60F, soil 2 inches 65F, 4 inches 60F with 80% relative humidity and 0 to 5 mph easterly winds. Temperatures on July 22, 1992 for True Ranch were: air 82F, soil surface 100F, 1 inch 85F, 2 inch 84F, 4 inch 80F, with 43% relative humidity. Temperatures on July 24, 1992 for Warren Livestock Co. were: air 81F, soil surface 81F, 1 inch 83F, 2 inch 80F, 4 inch 75F, with 43% relative humidity and no wind.

Treatments providing greater than 90% control at both locations in the vegetative growth stage were dicamba at 1.0 lb/A combined with 2,4-D at 1.0 lb/A and dicamba at 0.5 lb combined with picloram at 0.25 lb. Picloram at 0.5 lb was the only treatment that provided greater than 90% control at the bloom application timing at both locations. Picloram at 0.5 lb provided 85% control at both locations and timings. (Agric. Exp. Sta., Laramie, WY 82071 SR 1700).

Table. Control of hairy goldenaster with various herbicides applied at two stages of growth.

Herbicide	Rate lb ai/A	Warren Livestock Co[1] vegetative	Warren Livestock Co[1] bloom	True Ranches[2] vegetative	True Ranches[2] bloom
		%			
Clopyralid+2,4-D	0.15+0.60	36	49	58	15
Clopyrali+2,4-D	0.19+1.0	21	56	85	20
Clopyralid	0.13	30	59	30	59
Clopyralid	0.19	55	36	68	45
Picloram	0.125	25	60	68	65
Picloram+2,4-D	0.125+0.5	46	95	71	67
Picloram'	0.25	68	86	82	90
Picloram	0.5	89	98	98	99
Dicamba	1.0	73	53	63	60
Dicamba	2.0	88	55	100	85
Dicamba+2,4-D	0.5+1.0	83	88	92	78
Dicamba+2,4-D	1.0+1.0	93	71	99	92
Dicamba+Picloram	0.5+0.125	60	44	73	79
Dicamba+Picloram	0.5+0.25	90	74	90	86
Dicamba+Picloram	1.0+0.125	63	69	80	88
Dicamba+Fluroxypyr	0.5+0.5	60	36	66	44
Dicamba+Clopyralid	0.5+0.125	44	41	75	46
Dicamba+Clopyralid	0.5+0.25	60	40	69	79
2,4-D	2.0	51	91	99	88
Metsulfuron+X-77	0.0075	34	20	49	21
Metsulfuron+X-77	0.015	28	30	35	29
Metsulfuron+X-77	0.0225	34	43	26	65

[1] Herbicides were applied May 21, 1992 in vegetative growth stage and July 24, 1992 when plants were in full bloom.

[2] Herbicides were applied May 21, 1992 in vegetative growth stage and July 22, 1992 when plants were in full bloom.

PROJECT 2

WEEDS OF HORTICULTURAL CROPS

Chairperson: Rick Arnold
New Mexico State University
Farmington, NM

Control of grasses and broadleaf weeds in sweet corn. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. A trial was conducted at the Hyslop Agronomy Farm near Corvallis, OR to evaluate herbicide treatments in controlling barnyardgrass, proso millet, and broadleaf weeds in 'Jubilee' sweet corn. The trial design was a randomized complete block with 10 by 35 ft plots and four replications. The front half of each plot was broadcast-seeded to proso millet and the back half was seeded to barnyardgrass. The trial area was infested with common lambsquarters, hairy nightshade, lesser snapdragon, and Powell amaranth. The preplant incorporated and preemergence treatments were applied on May 2, 1994. The postemergence treatment was applied on June 16 to corn and grasses that were 10 to 12 inches tall and broadleaf weeds that were 2 to 8 inches tall. A single-wheel compressed-air sprayer was used to deliver a broadcast spray of 20 gpa at 15 psi. The soil was a Woodburn silt loam with an organic matter content of 2.5%, a pH of 5.0, and a CEC of 20. The soil was moist on May 2 and a total of 0.8 inch of rain fell in the following 2 weeks. The proso millet and barnyardgrass portions of each plot were harvested separately.

The PPI treatments were more effective than the PES treatments on proso millet, but none of them were adequate on this species (Table). The nicosulfuron application controlled proso millet, but the corn did not recover from the early interference. All of the treatments provided good control of barnyardgrass and the broadleaf species, although nicosulfuron was barely adequate on common lambsquarters. Corn ear yields were poor in the proso millet half of all plots, but were much higher in the barnyardgrass half of all treated plots. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table. Weed control and corn ear yield in 'Jubilee' sweet corn, Corvallis, OR.

Treatment[3]	Rate	Applic. timing	Weed control[1] ECHCG[4]	PANMX[4]	CHEAL[4]	SOLSA[4]	ATHOR[4]	AMAPO[4]	Corn yield[2] ECHCG[4] area	PANMX[4] area
	(lb/A)		(%)						(T/A)	
metolachlor + atrazine	1.95 + 1.0	PPI	99	43	90	100	100	100	10.0	0.9
acetochlor + atrazine	1.75 + 1.0	PPI	100	85	100	100	100	100	11.6	5.8
dimethenamid + atrazine	1.25 + 1.0	PPI	99	75	100	100	100	100	10.5	4.7
metolachlor + atrazine	1.46 + 0.75	PES	99	0	100	100	100	100	11.2	0.2
acetochlor + atrazine	1.75 + 0.75	PES	100	50	100	100	100	100	9.7	1.4
dimethenamid + atrazine	1.25 + 0.75	PES	100	38	100	100	100	100	9.6	3.0
nicosulfuron	0.047	POE	99	90	83	89	97	100	9.2	2.8
check	0		0	0	0	0	0	0	0	0
								LSD (0.05)	1.8	1.9
								CV (%)	7.8	16.3

[1] Weed control evaluated visually on July 15, 1994
[2] Corn ears harvested on August 22, 1994
[3] Non-ionic surfactant added with nicosufluron at 0.25% v/v; acetochlor formulated with dichlormid; metolachlor formulated with benoxacor
[4] ECHCG = barnyardgrass
PANMX = proso millet
CHEAL = common lambsquarters
SOLSA = hairy nightshade
ATHOR = lesser snapdragon
AMAPO = Powell amaranth

Postemergence Application of E-9636 to Seedling Processing Tomatoes. Jack P. Orr. Four experiments were established at various locations in the Sacramento, California, area to evaluate the efficacy of E-9636 as a postemergence single and split application for weed control in seedling tomatoes. Plots were singe row, 5 by 20 feet, with four replications arranged in a randomized complete block. The herbicide E-9636 was applied in a band with a CO_2 pressurized knapsack sprayer delivering 33 gpa at 28 psi on May 1993. Air temperature ranged from 70°-90°F. The soils were loam. Irrigation was sprinkler at two sites and furrow at two other sites. Visual crop growth evaluations and visual weed control ratings were made in May and June 1993.

In experiment one (Table 1) where the E-9636 at 1.0 ounce per acre plus 1.0 ounce per acre was applied to black nightshade (SOLNI) and tomatoes at the first leaf stage, this resulted in a 70 percent vigor reduction. Tomato stand was not affected; however, vigor was slightly reduced at the higher rates.

In experiment two (Table 2), 98 percent control of hairy nightshade (SOLSA) was obtained with the split application of E-9636 applied at 0.5 ounce per acre plus 0.75 ounce per acre. Tomato vigor was reduced 30 percent. A single application at 1.0 ounce per acre gave 95 percent control, 25 percent tomato vigor reduction, and slight stand reduction. No chlorosis was observed.

In experiment three (Table 3), single applications of E-9636 resulted in excellent control of hairy nightshade (SOLSA) and no control of common lambsquarters (CHEAL). Tomato tolerance was excellent. There was moderate early chlorosis that the tomatoes outgrew. Split applications resulted in slight early vigor reduction to the tomatoes.

In experiment four (Table 4), excellent control of jimsonweed (DATST), velvetleaf (ABUTH), and lanceleaf groundcherry (PHYLA) was obtained. There was early tomato vigor reduction and no stand reduction or chlorosis. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827).

Table 1. Postemergence application of E-9636 to seedling processing tomatoes.

Treatment[1]	Rate	Weed Vigor[3] SOLNI		Tomato[2] Stand		Tomato[2] Vigor		Tomato[2] Chlorosis	
	oz/A	- - - % - - -		- - - - - - - - - - - - % - - - - - - - - - - - -					
Dupont E-9636	1.0 + 1.0	27	30	100	100	90	88	20	0
Dupont E-9636	0.75 + 1.0	25	40	100	100	98	83	20	0
Dupont E-9636	0.5 + 1.0	35	37	93	100	93	100	20	0
Dupont E-9636	0.25 + 1.0	50	40	100	100	95	85	16	0
Dupont E-9636	0.125 + 1.0	55	62	100	100	100	100	10	0
Control	-----	100	100	100	100	100	100	0	0
Dupont E-9636	0 + 1.0	32	42	100	100	98	95	20	0
Dupont E-9636	0 + 1.0	50	67	100	100	80	100	20	0

[1] Treatments applied May 11 and May 14, 1993. Tomatoes second leaf emerging on May 11, 1993.

[2] Tomato stand, vigor, and chlorosis visually evaluated on May 19 and May 27, 1993.

[3] Weed control visually evaluated on May 19 and May 27, 1993.

[4] Furrow irrigation.

Table 2. Postemergence application of E-9636 to seedling tomatoes.

Treatment[1]	Rate	Weed control[3] SOLSA	Tomatoes[2] Stand	Vigor	Cholrosis
	oz/A	%	- - - - - - - - - - - -	%	- - - - - - - - - - - -
Dupont E-9636	1.0	95	88	75	0
Dupont E-9636	0.75	95	80	78	0
Dupont E-9636	0.5	65	85	80	0
Dupont E-9636	0.25	70	83	83	0
Dupont E-9636	0.125	40	90	93	0
Control	-----	0	100	100	0
Dupont E-9636	0.5 + 0.75	98	93	70	0
Dupont E-9636	0.5 + 1.5	98	65	65	0

[1] Treatments applied May 7 and May 12, 1993. Hairy nightshade at cotyledon to first true leaf on May 7 and two true leaf on May 12.
[2] Tomato stand, vigor, and chlorosis visually evaluated on May 18, 1993. Tomatoes 1st true leaf on May 7.
[3] Weed control visually evaluated on May 18, 1993.
[4] Sprinkler irrigated.

Table 3. Postemergence application of E-9636 to seedling processing tomatoes.

Treatment[1]	Rate	Weed Vigor[3] SOLSA		CHEAL	Tomato[2] Stand		Vigor		Chlorosis	
	oz/A	- - - - -	%	- - - -	- - - - - - - - -		%		- - - - - - - - -	
Dupont E-9636	1.0	90	100	0	100	100	100	100	60	0
Dupont E-9636	0.75	80	100	0	100	100	100	100	40	0
Dupont E-9636	0.5	80	100	0	100	100	100	100	60	0
Dupont E-9636	1.5	90	88	0	98	100	100	90	60	0
Control	-----	0	0	0	100	100	100	100	0	0
Dupont E-9636	1.0 + 0.5		100	0		100		93		0
Dupont E-9636	0.75 + 0.5		100	0		100		93		0
Dupont E-9636	0.5 + 0.5		100	0		98		90		0
Dupont E-9636	1.5 + 0.5		100	0		100		78		6
Control	------		21	0		100		100		0
Dupont E-9636	0 + 1.0		96	0		100		95		0
Dupont E-9636	0 + 1.5		95	0		100		100		0

[1] Treatments applied on May 28, 1993, to tomatoes at first true leaf and hairy nightshade at two leaf; and on June 1, 1993, to tomatoes at second leaf and hairy nightshade at 2 to 3 leaf.
[2] Tomato stand, vigor, and chlorosis visually evaluated on June 1 and 8, 1993.
[3] Weed control visually evaluated on June 1 and 8, 1993.
[4] Sprinkler irrigated.

Table 4. Postemergence application of E-9636 to seedling processing tomatoes.

Treatment[1]	Rate	Weed control[3] DATST	PHYLA	ABUTH	Vigor	Tomatoes[2] Number	Height
	oz/A	- - - - - -	%	- - - - - -	%	per 3'	inches
Dupont E-9636	1.0	98	95	90	62	18.3	10.8
Dupont E-9636	0.75	93	90	90	75	16.3	11.3
Dupont E-9636	0.5	93	67	60	82	19.5	11
Dupont E-9636	0.25	83	65	40	90	20	10.8
Dupont E-9636	0.125	64	73	48	82	20.5	10.5
Control	-----	0	0	0	0	15.8	10

[1] Treatments applied July 13, 1993.
[2] Tomato stand, vigor, and chlorosis visually evaluated on August 2, 1993. Counts made August 26, 1993.
[3] Weed control visually evaluated on August 2, 1993.
[4] Sprinkler irrigated.

Postemergence Application of E-9636 to Seedling Processing Tomatoes. Jack P. Orr. Four experiments were established at various locations in the Sacramento, California, area to evaluate the efficacy of E-9636 as a postemergence single and split application for weed control in seedling tomatoes. Plots were singe row, 5 by 20 feet, with four replications arranged in a randomized complete block. The herbicide E-9636 was applied in a band with a CO_2 pressurized knapsack sprayer delivering 33 gpa at 28 psi on May 1993. Air temperature ranged from 70°-90°F. The soils were loam. Irrigation was sprinkler at two sites and furrow at two other sites. Visual crop growth evaluations and visual weed control ratings were made in May and June 1993.

In experiment one (Table 1) where the E-9636 at 1.0 ounce per acre plus 1.0 ounce per acre was applied to black nightshade (SOLNI) and tomatoes at the first leaf stage, this resulted in a 70 percent vigor reduction. Tomato stand was not affected; however, vigor was slightly reduced at the higher rates.

In experiment two (Table 2), 98 percent control of hairy nightshade (SOLSA) was obtained with the split application of E-9636 applied at 0.5 ounce per acre plus 0.75 ounce per acre. Tomato vigor was reduced 30 percent. A single application at 1.0 ounce per acre gave 95 percent control, 25 percent tomato vigor reduction, and slight stand reduction. No chlorosis was observed.

In experiment three (Table 3), single applications of E-9636 resulted in excellent control of hairy nightshade (SOLSA) and no control of common lambsquarters (CHEAL). Tomato tolerance was excellent. There was moderate early chlorosis that the tomatoes outgrew. Split applications resulted in slight early vigor reduction to the tomatoes.

In experiment four (Table 4), excellent control of jimsonweed (DATST), velvetleaf (ABUTH), and lanceleaf groundcherry (PHYLA) was obtained. There was early tomato vigor reduction and no stand reduction or chlorosis. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827).

Table 1. Postemergence application of E-9636 to seedling processing tomatoes.

		Weed Vigor[3]		Tomato[2]					
Treatment[1]	Rate	SOLNI		Stand		Vigor		Chlorosis	
	oz/A	- - - % - - -		- - - - - - - - - - - - % - - - - - - - - - - - -					
Dupont E-9636	1.0 + 1.0	27	30	100	100	90	88	20	0
Dupont E-9636	0.75 + 1.0	25	40	100	100	98	83	20	0
Dupont E-9636	0.5 + 1.0	35	37	93	100	93	100	20	0
Dupont E-9636	0.25 + 1.0	50	40	100	100	95	85	16	0
Dupont E-9636	0.125 + 1.0	55	62	100	100	100	100	10	0
Control	-----	100	100	100	100	100	100	0	0
Dupont E-9636	0 + 1.0	32	42	100	100	98	95	20	0
Dupont E-9636	0 + 1.0	50	67	100	100	80	100	20	0

[1] Treatments applied May 11 and May 14, 1993. Tomatoes second leaf emerging on May 11, 1993.

[2] Tomato stand, vigor, and chlorosis visually evaluated on May 19 and May 27, 1993.

[3] Weed control visually evaluated on May 19 and May 27, 1993.

[4] Furrow irrigation.

Table 2. Postemergence application of E-9636 to seedling tomatoes.

Treatment[1]	Rate	Weed control[3] SOLSA	Tomatoes[2] Stand	Vigor	Cholrosis
	oz/A	%	- - - - - - - - - - - %	- - - - - - - - - - -	
Dupont E-9636	1.0	95	88	75	0
Dupont E-9636	0.75	95	80	78	0
Dupont E-9636	0.5	65	85	80	0
Dupont E-9636	0.25	70	83	83	0
Dupont E-9636	0.125	40	90	93	0
Control	-----	0	100	100	0
Dupont E-9636	0.5 + 0.75	98	93	70	0
Dupont E-9636	0.5 + 1.5	98	65	65	0

[1] Treatments applied May 7 and May 12, 1993. Hairy nightshade at cotyledon to first true leaf on May 7 and two true leaf on May 12.
[2] Tomato stand, vigor, and chlorosis visually evaluated on May 18, 1993. Tomatoes 1st true leaf on May 7.
[3] Weed control visually evaluated on May 18, 1993.
[4] Sprinkler irrigated.

Table 3. Postemergence application of E-9636 to seedling processing tomatoes.

Treatment[1]	Rate	Weed Vigor[3] SOLSA		CHEAL	Tomato[2] Stand		Vigor		Chlorosis	
	oz/A	- - - - - %	- - - -		- - - - - - - - - %	- - - - - - - - -				
Dupont E-9636	1.0	90	100	0	100	100	100	100	60	0
Dupont E-9636	0.75	80	100	0	100	100	100	100	40	0
Dupont E-9636	0.5	80	100	0	100	100	100	100	60	0
Dupont E-9636	1.5	90	88	0	98	100	100	90	60	0
Control	-----	0	0	0	100	100	100	100	0	0
Dupont E-9636	1.0 + 0.5		100	0		100		93		0
Dupont E-9636	0.75 + 0.5		100	0		100		93		0
Dupont E-9636	0.5 + 0.5		100	0		98		90		0
Dupont E-9636	1.5 + 0.5		100	0		100		78		6
Control	------		21	0		100		100		0
Dupont E-9636	0 + 1.0		96	0		100		95		0
Dupont E-9636	0 + 1.5		95	0		100		100		0

[1] Treatments applied on May 28, 1993, to tomatoes at first true leaf and hairy nightshade at two leaf; and on June 1, 1993, to tomatoes at second leaf and hairy nightshade at 2 to 3 leaf.
[2] Tomato stand, vigor, and chlorosis visually evaluated on June 1 and 8, 1993.
[3] Weed control visually evaluated on June 1 and 8, 1993.
[4] Sprinkler irrigated.

Table 4. Postemergence application of E-9636 to seedling processing tomatoes.

Treatment[1]	Rate	Weed control[3] DATST	PHYLA	ABUTH	Vigor	Tomatoes[2] Number	Height
	oz/A	- - - - - - %	- - - - - -		%	per 3'	inches
Dupont E-9636	1.0	98	95	90	62	18.3	10.8
Dupont E-9636	0.75	93	90	90	75	16.3	11.3
Dupont E-9636	0.5	93	67	60	82	19.5	11
Dupont E-9636	0.25	83	65	40	90	20	10.8
Dupont E-9636	0.125	64	73	48	82	20.5	10.5
Control	-----	0	0	0	0	15.8	10

[1] Treatments applied July 13, 1993.
[2] Tomato stand, vigor, and chlorosis visually evaluated on August 2, 1993. Counts made August 26, 1993.
[3] Weed control visually evaluated on August 2, 1993.
[4] Sprinkler irrigated.

Tolerance of snap beans to preemergence acetochlor and dimethenamid under two irrigation levels. Peachey, R.E. and G. Crabtree. Snap beans were planted in two adjacent blocks on 30 inch rows on May 24, 1994 at the Vegetable Research Farm, Corvallis OR to evaluate tolerance to dimethenamid and acetochlor under two irrigation regimes. Three replicates of each treatment were included in each irrigation block, but only the highest herbicide rates were included in the 'high level' block. Metolachlor and lactofen are currently registered for preemergence application on snap beans and were included as controls. Herbicides were applied on May 25 to 2.3 by 9 m plots with 40 l water/acre. Irrigation water was applied to both blocks on May 26 (2.5 cm). On May 27 another 1.7 cm of water was applied to the 'high level' irrigation plots. However, rainy periods for the next 3 days added another 0.8 cm and cool cloudy conditions kept the surface very wet and did not allow application of more irrigation water before bean emergence. The 'high level' irrigation block received 30 percent more water (through both irrigation and rainfall) than the 'low level' block within the first week. Snap bean emergence, herbicide injury, and weed density were evaluated on June 23 (4 WAP). Plots were cultivated and kept weed free after the weed evaluation. Snap beans were harvested from 3 m of row on August 3 (10 WAP) and graded.

Though bean seedling emergence was unaffected, snap beans showed some early signs of damage one month after planting, and were particularly sensitive to the acetochlor treatments. Both dimethenamid and metolachlor caused a slight amount of damage at the low herbicide rate, but differences in injury were not noted between irrigation regimes. Snap bean yield was highest for dimethenamid (1.25 lb/A) and metolachlor (2.0 lb/A). Yields in all the 'high irrigation level' plots were less than the 'low irrigation' plots. Snap bean yields in the acetochlor and lactofen treatments were reduced most by the additional irrigation. The yield of the control plot was very low because of constant weeding to keep the plot weed free. The 'high irrigation level' may have decreased snap bean yield overall because of saturated soil conditions soon after planting.

The predominant weed at this site was nightshade (SOLSA). Dimethenamid, acetochlor, and lactofen controlled nightshade better than metolachlor. Pigweed (AMAPO) control was excellent with all treatments. Irrigation level had no significant effect on weed control. Weeds not completely controlled included lambsquarter (CHEAL) in the dimethenamid treatment and petty spurge (EPHPE) in the lactofen treatments. (Horticulture Dept., Oregon State University, Corvallis, OR, 97331)

Table. Tolerance of snap bean to preemergence applications of dimethenamid, acetochlor, metolachlor, and lactofen under two irrigation regimes.

Herbicide	Rate	Irrigation level	Emergence	Injury	Yield	Weeds SOLSA
	kg/ha		no./m of row	-%-	-t/ha-	no./m²
Dimethenamid	1.4	Lo	20	10	21.7	3.0
Dimethenamid	1.7	Lo	30	13	21.1	1.0
Dimethenamid	1.7	Hi	26	13	19.7	3.0
Acetochlor	1.4	Lo	18	40	19.7	0.3
Acetochlor	1.7	Lo	25	40	19.3	0
Acetochlor	1.7	Hi	25	27	16.6	0.3
Metolachlor	2.2	Lo	25	10	22.0	67.0
Metolachlor	2.2	Hi	27	6	20.8	51.0
Lactofen	0.2	Lo	30	7	20.6	1.0
Lactofen	0.2	Hi	25	3	17.2	0.6
Hand weeded[1]	-	Lo	20	0	13.9	133.0
Hand weeded[1]	-	Hi	18	0	12.5	243.0
LSD (p=0.05)			NS	11	4.5	65.0

[1] Hand weeded after weed evaluation at 4 WAP.

Comparison of low rates of clomazone in pickling cucumber. McReynolds, R.B., W.C. Friedkin and D.D. Hemphill. Efforts to identify replacement herbicides for chloramben on pickling cucumbers in the Willamette Valley of Oregon have focused on clomazone. In other regions of the country, there has been concern over potential damage to non-target vegetation, and residual effects on subsequent crops. This research was designed to evaluate the weed control effectiveness of low rates of clomazone that might reduce the injury potential to non-target plants and residues, yet still provide acceptable weed control. A field trial was conducted that included two rates of clomazone applied both ppi and pre-emergence, other registered herbicides, and untreated controls.

The ppi treatments were applied with a CO_2 backpack sprayer (40 psi, four 8002 nozzles spaced 19 in, 2400 ml of spray solution) to a dry soil surface and incorporated three inches deep with a PTO-driven power tiller on May 24, 1994. The trial was seeded with a Massey-Ferguson planter the following day and the pre-emergence treatments were applied. Subsequently, the plot was irrigated with approximately 1 inch of water. The trial was a randomized complete block design with four replications. Soil type was a Woodburn Silt Loam. Four rows were planted to a 12 by 30 foot plot. Shepherd's-purse, groundsel, and pigweed were distributed fairly uniformly throughout the trial area. Weed densities were measured on June 26, 1994. The hand-weeded control was weeded on June 27, 1994 and kept weed-free until harvest. Ten feet of the two center rows of each replicate were stripped of fruit to simulate a mechanical harvest on August 3, 1994.

The high rate, 0.025 lb ai/a, of clomazone applied pre-emergence produced yields significantly greater than most other treatments in the trial and was the only one to outyield the hand-weeded control. Even the lower, 0.125 lb ai/a, pre-emergence rate of clomazone was an excellent treatment. Clomazone pre-plant incorporated resulted in significantly lower yields and reduced weed control compared to the same rates applied pre-emergence. The high rate of clomazone pre-emergence reduced stands slightly compared to most other treatments, but yield was not adversely affected. Neither weed control nor yield were improved with the combination of either bensulide or naptalam with clomazone. The combination of ethalfluralin and naptalam was superior to ethalfluralin alone for both weed control and yield. Very minor phytotoxic symptoms of yellow leaf margins were observed at the clomazone 0.25 lb ai/a rate. (North Willamette Research and Extension Center, Oregon State University, Aurora, OR 97002)

Table. Herbicides applied to Flurry-M pickling cucumber.

Treatment	Rate	Yield	Stand count	Weed[1] density	Weed[2] control
	lb ai/a	lbs/plot	3 feet	$foot^2$	
Clomazone PRE	0.125	36.3	34	6.5	8.5
Clomazone PRE	0.25	43.6	26	4.5	9.4
Clomazone PPI	0.125	19.8	33	19.3	4.3
Clomazone PPI	0.25	32.6	33	13.0	5.7
Clomazone PPI Bensulide	0.125 6	30.4	34	24.3	3.6
Clomazone PPI Naptalam	0.125 4	29.7	32	8.5	7.0
Ethalfluralin PRE	1.5	26.0	29	9.5	5.7
Ethalfluralin PRE Naptalam	1.5 4	33.7	33	4.0	9.0
Naptalam PPI Bensulide	4 6	38.3	33	9.3	7.2
Handweeded	---	30.2	32	21.3	1.2
Untreated	---	7.9	34	23.0	1.2
LSD 0.05		10.1	6	14.7	

[1]Represents the average of 2 one-foot-square/replicate.
[2]0=no control, 10=complete control. Ratings represent the mean rating of the three project leaders.

Tolerance of sweet corn cultivars to chloroacetamide herbicides. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. Five sweet corn cultivars were investigated for their tolerance to dimethenamid, metolachlor, and metolachlor plus benoxacor. Each cultivar was investigated in a separate trial. The trials were conducted at the Hyslop Agronomy Farm near Corvallis, OR. The experimental design was a randomized complete block with four replications and 10 by 35 ft plots. The herbicides were applied as preplant-incorporated treatments and the corn was seeded on May 2, 1994. A single-wheel, compressed-air sprayer was used to deliver a broadcast spray of 20 gpa at 15 psi. The soil was a Woodburn silt loam with an organic matter content of 2.5%, a pH of 5.2, and a CEC of 20.

Visual evaluations on June 20 are reported in Table 1 and the yield of primary ears from 24 ft of row are reported in Table 2. Most visual injury ratings on corn treated with dimethenamid were higher than on corn treated with metolachlor plus benoxacor, and dimethenamid caused more stunting of 'Crisp and Sweet 710' and 'Supersweet Jubilee' than did metolachlor.

Ear yield of 'Supersweet Jubilee' following treatment with metolachlor was higher when the safener, benoxacor, was included. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table 1. Visual evaluations of injury to five sweet corn cultivars following preplant applications of chloroacetamide herbicides, Corvallis, OR, 1994.

Treatment	Rate	Corn injury[1]				
		Jub.[2]	C & S 710[2]	SS Jub.[2]	Van.[2]	GH[2]
	lb/A	(%)				
dimethenamid	1.25	8	14	13	11	16
dimethenamid	2.5	11	23	21	14	23
metolachlor + benoxacor	2	0	4	3	1	8
metolachlor + benoxacor	4	4	10	4	8	6
metolachlor	2	5	8	4	5	8
metolachlor	4	10	13	8	13	15
check	0	0	0	0	0	0
	$LSD_{(0.05)}$	6	10	6	10	9

[1] Evaluated June 20, 1994
[2] Jub. = 'Jubliee', C & S 710 = 'Crisp and Sweet 710', SS Jub. = 'Supersweet Jubilee', Van = 'Vantage', GH = 'GH 2684'

Table 2. Ear yield of five sweet corn cultivars following preplant applications of chloroacetamide herbicides, Corvallis, OR, 1994.

Treatment	Rate	Corn ear yield[1]				
		Jub.[2]	C & S 710[2]	SS Jub.[2]	Van.[2]	GH[2]
	lb/A	(T/A)				
dimethenamid	1.25	10.6	8.0	7.3	12.3	10.1
dimethenamid	2.5	10.0	7.5	6.2	11.8	9.1
metolachlor + benoxacor	2	11.4	8.0	9.5	12.0	11.4
metolachlor + benoxacor	4	11.9	8.5	8.8	13.0	10.6
metolachlor	2	11.0	7.9	8.5	13.0	10.6
metolachlor	4	10.7	7.5	7.7	11.7	11.6
check	0	12.6	8.8	9.7	13.3	11.6
	$LSD_{(0.05)}$	1.4	n.s.	1.0	1.1	n.s.
	CV (%)	8.6	11.5	8.2	5.9	13.0

[1] Harvested August 16, 1994
[2] Jub. = 'Jubilee', C & S 710 = 'Crisp and Sweet 710', SS Jub. = 'Supersweet Jubilee', Van. = 'Vantage', GH = 'GH 2684'

Effects of napropamide application on strawberry runner rooting, yield, and weed suppression. Joseph T. DeFrancesco and Bernadine C. Strik. Plots were established under irrigation at the North Willamette Research and Extension Center, Aurora, OR, to evaluate the efficacy of napropamide on runner rooting, yield and weed control in 'Totem' strawberries planted May 12, 1993. Plots were 10.5 by 19 ft. with four replications arranged in a randomized complete block design. The napropamide was applied broadcast with a CO_2 pressurized backpack sprayer delivering 25 gpa at 30 psi.

Napropamide was applied at a rate of 4.0 lb/A one week, three weeks, and five weeks after planting. An additional treatment of napropamide at 2.0 lb/A one week after planting was also applied. All treatments were compared to an untreated control. Amount of weed infestation was evaluated seven weeks after planting and number of rooted runners determined 10 weeks after planting. Yield, berry weight, and percentage of rotted berries were collected in 1994.

Weed infestation increased as the delay of application time increased. Napropamide at the 4.0 lb/A rate applied five weeks after planting resulted in the same amount of weeds as the untreated control. Weed suppression was similar at the 2.0 lb/A and 4.0 lb/A rates when applied one week after planting. Common groundsel, dogfennel, common vetch and subterranean clover were the dominant weeds with a small amount of annual bluegrass, quackgrass, and Italian ryegrass present.

Date or rate of napropamide application did not have a significant effect on early runner rooting. The summer of 1993 was unseasonably cool and wet, which may account for the slow growth and reduced number of runners produced. There were no significant effects on yield, berry weight, or percent rot due to treatments. (Oregon State University, North Willamette Research and Extension Center, Aurora, OR 97002)

Table. Effects of date and rate of napropamide application on strawberry runner rooting, yield, and weed suppression.

Napropamide treatment[1]	Rate	Yield[2]	Berry weight[2]	Rot[3]	Pegged Runners[4]	Weeds[5]
	lb/A	grams	grams	%	No.	%
One week	2.0	7323	19.9	9.5	0.75	0.75 a
One week	4.0	7575	19.7	6.2	1.75	0.25 a
Three weeks	4.0	7010	18.8	11.2	1.75	5.50 b
Five weeks	4.0	7199	19.7	6.9	1.50	16.25 c
Untreated control	---	7427	20.4	8.8	2.00	16.25 c
Significance[6]	NS	NS	NS	NS	NS	**

[1]Number of weeks after planting napropamide treatment was applied.
[2]Based on total of three harvests in 1994, from 10' section of row.
[3]Average of second and third harvests.
[4]Determined 10 weeks after planting, from 19' section of row.
[5]Evaluated seven weeks after planting.
[6]Significance: NS=nonsignificant, **=significance at $P<0.01$

The effect of rate and amount of water on the efficacy of bensulide incorporated by sprinkler irrigation. Barry Tickes, Dennis Monypeny and Al Baber. Bensulide has been used for several years as a preemergence treatment in cucurbits, peppers, broccoli, cabbage, lettuce, cauliflower, cotton and turf to control grass and broadleaf weeds. Weed control has been erratic on some species. This may be the result of several variables including rate, timing of application, type, amount and timing of irrigaiton, herbicide placement and incorporation, soil type and other factors. This test was conducted to evaluate the effect of two of these variables, irrigation amount and rate, upon the efficacy of Bensulide when incorporated by sprinkler irrigation.

The test was conducted at the University of Arizona Yuma Mesa Agriculture Center located approximately 5 miles south of the city of Yuma. Soil type at this facility is superstition fine sand with less than 1% organic matter. Colorado River water was used and applied through an overhead lateral move sprinkler system modified to apply variable amounts of water. Barnyardgrass was planted as an indicator crop into bare ground at a rate of 25 lbs. per acre. Four rates of Bensulide were applied with a CO_2 backpack sprayer and immediately incorporated with five amounts of water. Plot size was 3 foot by 25 foot randomized down the crop row and replicated three times.

One, 2, 3, 4, and 6 pounds active ingredient per acre of Bensulide 4E were applied in a 20 gallon per acre spray volume. Six strips measuring 3 foot by 300 foot of barnyardgrass were planted parallel to the lateral move overhead sprinkler. Each strip was treated a different rate of Bensulide and divided into 3 foot by 25 foot plots. Each plot received a variable amount of water. Three replications of each irrigation treatment were randomized down the crop row. The barnyardgrass was planted on 7-25-94 and received one uniform pretreatment irrigatio of 1.0 inch of water 24 hours before herbicide treatments were applied and incorporated with variable amounts of water. The 5 irrigation treatments were 0.25, 0.325, 0.5, 0.67 and 0.75 inches of water. The plots were uniformly irrigated following the herbicide application every 48 hours with 0.5" of water. Plots were evaluated 7 days after treatment by counting the numbe of emerged barnyardgrass seedlings in 3 feet of the center planted row of each plot.

The results (Table 1) indicated that all rates of Bensulide above 3.0 pounds of active ingredient per acre controlled barnyardgrass in this test when incorporated with all amounts of water applied. The 2.0 pound active ingredient per acre rate of Bensulide was effective only when incorporated with 0.5 or more inches of water. Weed control increased at all rates of Bensulide applied with increasing amount of water, except for the 1.0 pounds of active ingredient per acre rate which was ineffective.

Table 1. Barnyardgrass seedlings counted per 3 feet of row 7 days after Bensulide treatment.

Bensulide 4E Rate (lbs. ai/A)	Seedlings/3 Feet — Inches Water 0.25	0.325	0.5	0.67	0.75
Untreated	18.0	22.3	22.6	27.0	22.0
1.0	29.0	26.0	26.0	28.6	21.5
2.0	16.0	9.6	6.3	2.6	2.5
3.0	2.0	1.0	1.6	0.6	0.3
4.0	3.5	0.6	0.3	0	0
6.0	0	0	0.3	0	0

PROJECT 3

WEEDS OF AGRONOMIC CROPS

Chairperson: Joan Campbell
University of Idaho
Moscow, ID

Seedling alfalfa and weed response to imazethapyr. Evans, J.O. and R.W. Mace. A randomized complete block experiment with four replications was established June 10, 1994 at Smithfield, Utah to evaluate the response of seedling alfalfa (var. Apollo III), annual grasses, and broadleaf weeds to different rates of imazethapyr and two surfactants. The soil type was a Kidman sandy loam with 7.4 pH and an organic matter content of less than 1%. Individual treatments were applied with a bicycle sprayer delivering 16 gpa at 40 psi using 8001 flatfan nozzles with 18 inch spacings. The alfalfa was five inches high with 3 to 4 trifoliate leaves at treatment. Green foxtail (SETVI) ranged in height from 1 to 4 inches. Broadleaf weeds including redroot pigweed (AMARE), purslane (POROL), and lambsquarter (CHEAL) ranged in height from 2 to 4 inches. Visual evaluations of alfalfa injury, weed counts, and grass and broadleaf weed control, were taken July 11, 1994. One square meter of forage was harvested from each plot on July 12, and August 19, 1994. Samples were separated into alfalfa, grass and broadleaf yield. The August yields are not included in this report.

Alfalfa yields were not different among treatments including the check. Yields of grass and broadleaf weeds, separated from the forage, were significantly different from the untreated check but not from each other. There was little injury to alfalfa with any of the treatments, the highest being 20 percent injury for the high rate of imazethapyr+X-77. The injury index for weed control indicates that all weeds were severely damaged for each treatment and populations were significantly reduced by all treatments compared to the check. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Table. Postemergence weed control in alfalfa with imazethapyr.

		Yield[4]				Weed control[5]							
Treatment[1]	Rate	Alf	Gras	Brlf	Inj.	SETVI		AMARE		POROL		CHEAL	
	lb/A	---kg/Ha---			%	0-10	#/m^2	0-10	#/m^2	0-10	#/m^2	0-10	#/m^2
Imazethapyr+ X-77[2]	.047	1806	32	11	10	8.0	4.3	7.0	6.3	7.3	3.7	6.7	4.0
Imazethapyr+ X-77[2]	.063	2255	119	0	0	7.7	6.0	8.3	3.3	9.0	4.0	7.0	1.7
Imazethapyr+ X-77[2]	.094	2028	67	7	20	7.7	8.3	8.7	2.3	8.7	4.0	8.7	2.0
Imazethapyr+ sun-it[3]	.047	1784	87	10	10	7.7	6.0	8.3	3.0	8.0	4.3	8.3	1.7
Imazethapyr+ sun-it[3]	.063	1811	59	0	10	9.0	3.3	8.7	2.3	8.3	2.3	8.0	2.3
Imazethapyr+ sun-it[3]	.094	1661	78	0	13	8.0	8.3	9.0	2.7	8.3	4.0	9.0	1.3
Imazethapyr+ bromoxynil X-77[2]	.063 .125	1483	119	34	0	8.3	4.7	8.0	3.7	8.0	3.7	7.3	2.0
Imazethapyr+ bromoxynil sun-it[3]	.063 .125	2100	43	6	13	8.7	7.3	8.7	4..0	6.7	6.0	7.0	3.0
Untreated		1561	686	193	0	0.3	59.7	0.0	39.0	0.7	26.3	0.0	19.0
$LSD_{(.05)}$		710	238	91	11	1.4	7.1	1.7	6.2	2.2	5.7	2.1	5.0

[1]All treatments include N 28% 1 qt/A.
[2]X77 at .25% v/v.
[3]Sun-it at 2 pt/A.
[4]Harvested 7-12-94.
[5]Injury index rating 0 = no injury; 1-3 = slight inj.; 4-6 = moderate inj.; 7-9 = sever inj.; 10 = dead plants, and #/m2 = number of plants per meter squared.

Broadleaf weed control in seedling alfalfa with postemergence herbicide treatments. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. Delaying herbicide application until alfalfa has three or four trifoliolate leaves often allows the associated weeds to become too large for adequate control in Western Oregon. A trial was conducted to determine whether low rates of some herbicides would provide acceptable weed control in younger alfalfa without excessive crop injury. Alfalfa ('Fortress') was seeded in 12-inch rows on April 28, 1994 at the Hyslop Agronomy Farm near Corvallis, OR. The experimental design was a randomized complete block with four replications and 8 by 35 ft plots. Herbicide treatments were applied on May 20 to 1-trifoliolate alfalfa and 2- to 4-leaf weeds. The soil was a Woodburn silt loam with an organic matter content of 2.5% and a pH of 5.2. A single-wheel compressed-air sprayer was used to deliver a broadcast spray of 20 gpa at 15 psi.

All herbicide treatments caused some minor crop injury initially, but none reduced yields relative to the untreated check (Table 1). Bentazon, bromoxynil, and imazethapyr applied at low rates were more effective than 2,4-DB in reducing weed biomass, primarily because 2,4-DB was ineffective on lesser snapdragon (ATHOR)(Table 2). Powell amaranth (AMAPO) and hairy nightshade (SOLSA) were also less effectively controlled by 2,4-DB than by most of the other herbicides. Imazethapyr was the only herbicide to provide poor control of common lambsquarters (CHEAL). (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table 1. Visual evaluations of alfalfa injury and fresh weight yield of alfalfa following applications of herbicides on 1-trifoliolate alfalfa, Corvallis, OR, 1994.

		Alfalfa	
Treatment[1]	Rate	Injury[2]	Fresh weight[3]
	(lb/A)	(%)	(T/A)
pyridate	0.9	1	4.2
bentazon	0.5	9	3.9
bromoxynil	0.19	11	3.9
imazethapyr	0.03	3	4.2
2,4-DB	0.5	0	4.1
check	0	0	3.7
		$LSD_{(0.05)}$	n.s.
		CV (%)	11.6

[1] Crop oil concentrate added to bentazon treatment at 1 qt/A, nonionic surfactant added to imazethapyr treatment at 0.25% v/v.
[2] Visual evaluations June 21, 1994
[3] Harvested June 23, 1994

Table 2. Visual evaluations of weed control and weed biomass following applications of herbicides in 1-trifoliolate alfalfa, Corvallis, OR, 1994.

		Weed control[2]				Weed biomass[3]
Treatment[1]	Rate	AMAPO	CHEAL	ATHOR	SOLSA	Fresh wt
	(lb/A	%				(T/A)
pyridate	0.9	100	99	75	95	1.6
bentazon	0.5	79	100	89	93	0.5
bromoxynil	0.19	97	100	90	100	0.2
imazethapyr	0.03	100	60	86	100	0.8
2,4-DB	0.5	84	97	30	86	3.8
check	0	0	0	0	0	7.3
					$LSD_{(0.05)}$	0.9
					CV (%)	24.7

[1] Crop oil concentrate added to bentazon treatment at 1 qt/A, nonionic surfactant added to imazethapyr treatment at 0.25% v/v.
[2] Visual evaluations of weed control June 21, 1994.
[3] Weed biomass determined June 23, 1994.

Broadleaf weed control in spring-seeded alfalfa. Richard N. Arnold, Eddie J. Gregory, and Daniel Smeal. Research plots were established on May 11, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of spring-seeded alfalfa (var. Champ) and broadleaf weeds to postemergence applications of AC 299-263 and imazethapyr. All treatments except EPTC were applied postemergence with SUN-IT II at one qt/A. EPTC was applied preplant incorporated and rototilled to a depth of two in on May 11, 1994. 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 four replications. Individual plots were 10 by 30 ft in size. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on June 3, 1994 when alfalfa was in the second trifoliolate leaf stage and weeds were small. Black nightshade, redroot and prostrate pigweed infestations were heavy throughout the experimental area. Alfalfa stand counts, crop injury and weed control evaluations were made on July 5, 1994. Alfalfa was harvested August 8, 1994 using a self-propelled Almaco plot harvester.

All treatments had significantly higher plts/ft^2 than EPTC. AC 299-263 and imazethapyr at 0.12 and 0.094 lb/A caused significantly more injury (stunting only) than any other treatment. Black nightshade, redroot and prostrate pigweed control were excellent (>94%) with all treatments except the check. The check plot yielded significantly more T/A than any other treatment. All treatments had a significantly higher protein content than the check.

Table. Broadleaf weed control in spring-seeded alfalfa.

Treatment	Rate	Crop Injury	plts/ft^2	Weed Control SOLNI	AMARE	AMABL	Yield	Protein
	lb/A	--%---	no	--------%--------			T/A	%
AC 299-263	0.032	0	53	100	99	98	2.2	20.4
AC 299-263	0.047	3	49	100	100	100	2.1	21.0
AC 299-263	0.063	13	50	100	100	100	2.1	20.2
AC 299-263	0.094	24	52	100	100	100	2.2	20.2
AC 299-263	0.12	25	51	100	100	100	2.0	20.4
Imazethapyr	0.063	3	50	100	100	100	2.3	20.2
Imazethapyr	0.094	13	48	100	100	100	2.1	21.2
EPTC	3.0	0	31	100	100	100	2.4	19.8
AC 299-263	0.024	0	50	99	98	94	2.2	20.4
Imazethapyr	0.047	0	49	98	99	98	2.2	19.9
Handweeded check		0	51	100	100	100	2.1	20.3
Check		0	51	0	0	0	2.7	15.9
Weeds/ft^2				28	14	16		
LSD 0.05		3	5	2	1	2	0.3	1.6

Long-term impacts of yellow foxtail control in established alfalfa. R. F. Norris and J. A. Roncoroni. This experiment was conducted to test the efficacy of thiazopyr for control of yellow foxtail in established alfalfa. The experiment was conducted on the University of California at Davis farm in a field established in February of 1989 using 'Yolo' alfalfa. A high population of yellow foxtail existed in this field prior to initiation of this experiment. Rates of 1.0, 0.5, 0.25 lb ai/A of thiazopyr and were applied in yearly sequential treatments (see table). An untreated check was also included. The experiment was laid out to conform to the existing checks within the alfalfa field, and used a randomized complete block design with three replications. Plot size was 30 ft. by 50 ft. Herbicide application dates were Jan. 28, 1992, Nov. 11, 1992, and Nov. 15, 1993. The thiazopyr granules were applied using a Gandy hand pulled spreader in the first year. Subsequent applications were made with a tractor pulled Gandy air blower applicator. Alfalfa was irrigated, cut and baled according to conventional local practices.

Visual evaluations of yellow foxtail control were made on July 12, 1992 and on July 14, 1993. In 1992 weed control was 100% in all plots treated with thiazopyr. In 1993, after 2 years all sequential thiazopyr treatments resulted in complete (100 %) control of yellow foxtail. The treatment receiving 1.0 lb/A thiazopyr in January 1992 and then not retreated had decreased to 80% control.

Percent vegetation cover was estimated on Oct. 11, 1994 at the end of the third cutting season. Two 1 meter quadrats were assessed per plot. All treatments with thiazopyr at the 0.25, 0.5 and 1.0 lb/A rate in the third year had less than 2.5% yellow foxtail cover. All treatments with no application in the third year produced substantially less control; the amount of yellow foxtail cover reflected the rates of thiazopyr applied in the earlier years. Percent cover of alfalfa was greatest in those plots with lowest yellow foxtail coverage. The treatment receiving 1.0 lb/A of thiazopyr per year had over 6-fold more alfalfa cover than the untreated check. On Nov. 18, 1994 the alfalfa crowns in six 0.5 meter by 1.0 meter quadrats per plot were exhumed and counted from the plots receiving 1.0 lb/A of MON-13204 per year, and from the untreated check plots. The MON-13204 plots had 11.1 ± 0.8 (mean $\pm$ SD) crowns/0.5 m^2 and the untreated control had 6.5 ± 0.7 crowns/ 0.5 m^2 quadrat. The results of this experiment indicate that controlling yellow foxtail resulted in increased alfalfa stand longevity.

(Vegetable Crops Department, Weed Science Program, University of California, Davis, CA 95616.)

Table. Impact of three years of various sequences of thiazopyr on alfalfa and yellow foxtail vegetation cover. (Data are means ± SE)

Thiazopyr application sequence			Vegetation assessment, October 11,1994		
year 1	year 2	year 3	Alfalfa	SETLU	Bare
	Rate (lb/A)			% cover	
1.0	1.0	1.0	66.5±7.0	0.0±0.0	33.0±7.3
1.0	1.0	0.5	50.8±7.1	1.0±0.7	43.5±6.5
1.0	1.0	0.25	62.0±6.6	0.8±0.8	30.6±3.4
1.0	1.0	-	39.8±1.3	14.1±6.5	42.8±4.9
1.0	0.5	0.5	53.8±3.1	0.1±0.2	43.3±4.4
1.0	0.5	0.25	42.1±9.7	0.8±0.8	51.0±9.3
1.0	0.5	-	35.0±11.2	45.6±19.3	18.0±8.0
1.0	-	-	20.8±3.0	78.8±3.2	0.0±0.0
0.5	0.5	0.5	51.0±3.7	2.5±1.4	42.1±6.6
0.5	0.5	0.25	53.0±8.1	1.5±0.8	39.3±5.3
0.5	0.5	-	24.6±7.4	63.8±10.8	5.8±1.6
0.5	0.25	0.25	49.1±8.7	1.3±0.7	39.6±5.5
0.5	0.25	-	13.3±5.1	77.3±9.5	8.3±4.2
Untreated control			14.8±2.6	83.8±3.7	0.8±0.8

Effect of application timing and imazamethabenz rate on wild oat control in spring barley. Mark J. Pavek, Robert W. Downard, Don W. Morishita and Charles C. Cheyney. A study was established in Butte County to evaluate crop injury and wild oat (AVEFA) control in irrigated spring barley (var. 'Sunbar 560'). Barley was planted May 9 at 100 lb/A. The study was arranged as a split plot design with four replications. Plots were 8 by 25 feet. Soil type was a Mooretown loam with 2.45% OM, pH 7.4 and a CEC of 24 meq/100 g soil. Treatments were applied with a bicycle-wheel sprayer equipped with 11001 flat fan nozzles on 16-inch spacing. The sprayer was calibrated to deliver 10 gpa at 25 psi. Additional application data are presented in Table 1. Seven rates of imazamethabenz were applied (Table 2). Each rate of imazamethabenz was applied to three wild oat growth stages: spike to 1 leaf, 1 to 3 leaf, and 3 to 5 leaf. Weed control and crop injury were evaluated visually on July 25 and August 22. Plots were harvested September 8 with a small plot combine.

None of the imazamethabenz treatments injured the barley. Application timing did not affect wild oat control or yield and the data are presented by herbicide rate averaged across application timing (Table 2.). Wild oat control at each evaluation was the same for all rates between 0.21 lb/A and 0.41 lb/A. All herbicide treatments had yields greater than the untreated check. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83303).

Table 1. Herbicide application information.

Application date	5/23	5/29	6/6
Application timing	spike leaf	1-3 leaf	3-5 leaf
Air temperature (F)	58	50	54
Soil temperature (F)	52	50	56
Relative humidity (%)	46	73	59
Wind velocity (mph)	5	5	4

Table 2. Effect of imazamethabenz on wild oat control, barley injury, and yield.

		AVEFA control		
Treatment[1]	Rate	7/25	8/22	Yield
	lb ai/A	---%	---	bu/A
Untreated check		0	0	97
Imazamethabenz	0.07	47	51	108
Imazamethabenz	0.14	78	81	114
Imazamethabenz	0.21	87	87	113
Imazamethabenz	0.27	92	89	118
Imazamethabenz	0.34	96	94	112
Imazamethabenz	0.41	95	91	117
LSD(0.05)		14	12	10

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

Comparison of Tralkoxydim with other postemergence herbicides for wild oat control in barley. J.O. Evans and R.W. Mace. Tralkoxydim was compared with imazamethabenz and diclofop herbicides for wild oat (AVEFA) control in barley (Rollo). Plots were established at the Greenville research farm at Utah State University, Logan. Utah. The soil type was a Millville silt loam with 7.9 pH and an organic matter content of less than 2%. The barley was planted May 16, 1994 and treatments were established June 24, 1994 in a randomized block design, with three replications. Herbicides were applied with a CO_2 backpack sprayer delivering 25 gpa at 39 psi using 8002 flatfan nozzles. Barley was ten inches high and wild oats, population 10%, were in the second to third leaf stage at the time of application. There were few if any other grasses or broadleaf weeds within the plots due to early tillage and the late planting date. A visual evaluation for wild oat control was completed July 21, 1994 and the barley was sampled for grain yield from four rows 1 meter in length on August 18, 1994.

Tralkoxydim at the higher application rate provided comparable wild oat control to imazamethabenz or diclofop. In tank mixes with 2,4-D amine and bromoxynil+MCPA, the lower rate of tralkoxydim was not as effective in controlling wild oats as its higher rate. Imazamethabenz provided the most consistent control of wild oats. Grain yield was not statistically different between treatments even though the untreated plots had the lowest average yield. (Utah Agricultural Experiment Station, Logan, UT 84322-4820)

Table. Wild oat control with selected herbicides in barley.

Treatment	Rate	Weed control AVEFA	Crop response Injury	Crop response Yield
	lb/A	%	%	Bu/A
Tralkoxydim+ X-77[1]	0.18	77	0	67.8
Tralkoxydim+ X-77[1]	0.27	83	0	52.5
Tralkoxydim+ Imazamethabenz+MCPA+ X-77[1]	0.18 0.75	63	0	65.3
Tralkoxydim+ 2,4-D amine X-77[1]	0.18 0.5	53	0	58.2
Tralkoxydim+ 2,4-D ester X-77[1]	0.18 0.5	80	0	62.1
Imazamethabenz+ X-77[2]	0.47	83	0	42.1
Imazamethabenz+ 2,4-D amine X-77[2]	0.47 0.5	80	0	82.9
Imazamethabenz+ 2,4-D ester X-77[2]	0.47 0.5	90	0	52.6
Diclofop	1	68	0	44.9
Untreated		44	0	41.4
$LSD_{(0.05)}$		9.9	0	4.0

[1]X-77 at 0.5 % v/v
[2]X-77 at 0.25 % v/v

Wild oat control with tralkoxydim in spring barley. Terry L. Neider and Donald C. Thill. A study was established in Boundary county, ID to compare tralkoxydim with several other postemergence wild oat herbicides. The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Spring barley (var. Menuet) was seeded on April 24, 1994 in a clay loam soil (24% sand, 46% silt, 30% clay, pH 8.0, and 3.1% organic matter). Herbicide treatments were applied postemergence on May 24, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi to 4 leaf barley and 3 leaf wild oat. Environmental conditions were as follows: air temp. 74 F; relative humidity 68%; wind S at 2 mph; clear sky; and soil surface temp. 88 F, 2 inch 86 F, and 4 inch 86 F.

Tralkoxydim alone, tralkoxydim + bromoxynil, or tralkoxydim + bromoxynil + MCPA controlled wild oat 91% or bette by the second evaluation on July 13, 1994. However, wild oat control was reduced when tralkoxydim was combined with 2,4-D or MCPA. Imazamethabenz and fenoxaprop/2,4-D/MCPA treatments controlled wild oat 90 to 100%. Diclofop did not control wild oat effectively. Yield samples are being processed and yield data will be available at a late date. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Spring barley response and wild oat control, Boundary county, ID.

		Barley injury		Wild oat control	
Treatment[1]	Rate	6/29/94	7/13/94	6/29/94	7/13/94
	lb/A	%			
Tralkoxydim + TF8035	0.18	0	0	93	95
Tralkoxydim +	0.18	0	0	91	91
Bromoxynil +	0.375				
MCPA + TF8035	0.375				
Tralkoxydim +	0.18	0	0	76	99
Bromoxynil + TF8035	0.5				
Tralkoxydim +	0.18	0	0	50	59
2,4-D + TF8035	0.475				
Tralkoxydim +	0.18	0	0	84	83
MCPA + TF8035	0.5				
Diclofop	1	0	0	84	68
Fenox/2,4-D/MCPA	0.59	0	0	88	90
Imazamethabenz + NIS	0.47	0	0	83	95
Imazamethabenz + TF8035	0.47	0	0	91	100
Difenzoquat	1	0	0	84	85
Imazamethabenz +	0.235				
Difenzoquat	0.5	0	0	94	91
Imazamethabenz +	0.235	0	0	91	96
Difenzoquat + TF8035	0.5				
Untreated Check		--	--	--	--
LSD (0.05)		NS	NS	20.3	10.1
plants/ft²				17	

[1]TF8035 is a mineral oil and nonionic surfactant blend applied at 0.5 %v/v; NIS is an 80% nonionic surfactant applied at 0.25 % v/v; 2,4-D and MCPA are amine formulations; Fenox/2,4-D/MCPA is a commercial formulation of fenoxaprop + 2,4-D + MCPA.

Triallate resistant wild oat control with tralkoxydim, imazamethabenz, difenzoquat, and diclofop. Robert W. Downard and Don W. Morishita. A study near Squirrel, Idaho was established to evaluate wild oat (AVEFA) control in spring barley. Plot size was 8 by 25 feet with four replications arranged in a randomized complete block design. The soil type was a silt loam with a pH 5.3, CEC of 7 meq/100 g soil, and 2.3% o.m. The soil texture was 5.4% sand, 69.4% silt, and 25.2% clay. Herbicides were broadcast with a bicycle wheel sprayer at 28 psi and 10 gpa. Table 1 shows additional application data. Wild oats were at the 1 to 4 leaf growth stage and averaged 15 plants ft^{-2} on June 2. Visual crop injury and weed control ratings were taken on July 6 and August 10.

Table 1. Application data.

Application date	6/2
Application timing	1-4 leaf
Air temperature (F)	63
Soil temperature (F)	55
Relative humidity (%)	66
Wind velocity (mph)	0-7

No herbicide treatment injured the crop (Table 2). On both evaluation dates tralkoxydim at 0.25 lb/A plus surfactant provided the best wild oat control. All other herbicide treatments provided excellent (91-94%) wild oat control on August 8, except for difenzoquat. Difenzoquat has been reported to be cross-resistant to triallate resistant wild oats. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, ID 83301).

Table 2. Crop injury and wild oat control in spring barley, near Squirrel, Idaho.[1]

Treatment	Rate	Crop injury 7/6	Crop injury 8/10	AVEFA control 7/6	AVEFA control 8/10
	lb/A	%			
Check		0	0	0	0
Tralkoxydim[2]	0.18	0	0	84	94
Tralkoxydim	0.25	0	0	86	95
Imazamethabenz[3]	0.41	0	0	70	91
Diclofop	1.0	0	0	81	93
Difenzoquat	1.0	0	0	64	68
LSD (0.05)		NS	NS	12	11

[1]Weed species evaluated was wild oats (AVEFA).
[2]TF8035 surfactant added to all tralcoxydim treatments a 0.5% v/v.
[3]Nonionic surfactant added at 0.25% v/v.

Effect of application timing and herbicide rate on common lambsquarters control in spring barley. Mark J. Pavek, Robert W. Downard, and Don W. Morishita. A field trial was conducted near Hansen, ID to evaluate common lambsquarters (CHEAL) control and crop injury using a tank mixture of bromoxynil & MCPA + thifensulfuron & tribenuron. The mix was applied at the full labeled rate (0.375 lb/A + 0.025 lb/A) and at several reduced rates. An untreated check also was included. Each rate was applied to weeds at three application timings: cotyledon, 2 to 4 leaf, and 4 to 8 leaf. Treatments were arranged in a split plot design with four replications. Main plots were application timing and sub-plots were herbicide rate. Plots were 8 by 25 feet. Barley (variety 'AB 2601') was planted April 15 at 100 lbs/A. Soil was a silt loam with 1.4% OM, pH 7.9, and a CEC of 21.1 meq/100 g soil. A bicycle-wheel sprayer was calibrated to deliver 10 gpa at 25 psi, using 11001 flat fan nozzles. Additional application information is presented in Table 1. Weed control was evaluated visually two times and crop injury was evaluated once. Plots were harvested August 11 with a small plot combine.

None of the herbicide treatments injured the barley. The three lowest herbicide rates, at the two earlier application timings (cotyledon and 2 to 4 leaf), controlled common lambsquarters 73 % or higher on both evaluation dates (Table 2.). At the three higher herbicide rates, weed control was 90 % or greater across the three application timings. Herbicide treatments applied to weeds in the cotyledon stage produced higher barley yields than the untreated check. At the 2 to 4 leaf application stage, all but two herbicide treatments (bromoxynil & MCPA + thifensulfuron & tribenuron at 0.125 + 0.008 and 0.375 + 0.025 lb/A) produced barley yields greater than the untreated check. These data suggest that early application of reduced herbicide rates can satisfactorily control common lambsquarters. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83303).

Table 1. Herbicide application information.

Application date	4/29	5/6	5/18
Application timing	Cotyledon	2 to 4 leaf	4 to 8 leaf
Air temperature (F)	55	70	50
Soil temperature (F)	53	58	52
Relative humidity (%)	72	64	100
Wind velocity (mph)	1	4 to 10	0
Weed density (plants/ft^2)	96	78	90

Table 2. Control of common lambsquarters and spring barley yield near Hansen, Idaho.

Treatment[1]	Rate	Application timing	CHEAL control 5/31	CHEAL control 6/27	Yield
	lbs ai/A		%	%	bu/A
Untreated check			0	0	74
Brom & MCPA[2] + thif & trib[3]	0.063 + 0.004	cotyledon	73	88	94
Brom & MCPA + thif & trib	0.125 + 0.008	cotyledon	100	99	97
Brom & MCPA + thif & trib	0.188 + 0.013	cotyledon	99	96	96
Brom & MCPA + thif & trib	0.25 + 0.017	cotyledon	100	100	93
Brom & MCPA + thif & trib	0.313 + 0.021	cotyledon	100	100	89
Brom & MCPA + thif & trib	0.375 + 0.025	cotyledon	100	99	90
Untreated check			0	0	88
Brom & MCPA + thif & trib	0.063 + 0.004	2 to 4 leaf	92	89	98
Brom & MCPA + thif & trib	0.125 + 0.008	2 to 4 leaf	95	99	96
Brom & MCPA + thif & trib	0.188 + 0.013	2 to 4 leaf	99	99	98
Brom & MCPA + thif & trib	0.25 + 0.017	2 to 4 leaf	99	100	101
Brom & MCPA + thif & trib	0.313 + 0.021	2 to 4 leaf	100	100	97
Brom & MCPA + thif & trib	0.375 + 0.025	2 to 4 leaf	99	100	91
Untreated check			0	0	86
Brom & MCPA + thif & trib	0.063 + 0.004	4 to 8 leaf	45	56	86
Brom & MCPA + thif & trib	0.125 + 0.008	4 to 8 leaf	60	76	95
Brom & MCPA + thif & trib	0.188 + 0.013	4 to 8 leaf	80	74	91
Brom & MCPA + thif & trib	0.25 + 0.017	4 to 8 leaf	90	90	95
Brom & MCPA + thif & trib	0.313 + 0.021	4 to 8 leaf	94	97	96
Brom & MCPA + thif & trib	0.375 + 0.025	4 to 8 leaf	95	100	102
LSD(0.05)			11	9	9

[1]Nonionic surfactant added at 0.25% v/v.
[2]Brom & MCPA = bromoxynil plus MCPA preformulated mixture.
[3]Thif & trib = thifensulfuron plus tribenuron preformulated mixture.

Bioeconomic evaluation of weed control in spring barley. Michael J. Wille, Terry L. Neider, and Donald C. Thill. A study was established in Latah county, ID to evaluate the economic effectiveness of broadleaf weed control in 'Baronesse' spring barley. Field penneycress (THLAR), mayweed chamomile (ANTCO), henbit (LAMAM), and common lambsquarters (CHEAL) were the major weeds present. Thifensulfuron-tribenuron was applied to one half of a 70 by 130 ft strip, and the remaining half was left untreated. Individual plots were 35 by 130 ft with eight replications arranged in a randomized compete block design. The herbicide treatment was applied postemergence on May 14, 1994, to 4 to 5 leaf barley with 1 tiller, and 1 inch weeds. Environmental conditions were as follows: air temperature was 58 F; relative humidity 60%, wind S at 3 to 4 mph; clear sky; soil surface temperature 80 F; 2 inch 68 F; and 4 inch 54 F. The treatment was applied with a motorized sprayer delivering 10 gpa at 40 psi. The soil was a silt loam (26% sand, 60% silt, 14% clay, pH 5.6 and 3.0% organic matter). The cost of herbicide treatment, including surfactant and application costs, was $9.78/A. Net return was calculated using average barley yield in treated and control plots. Barley grain price used in calculation was $0.0385/lb. Broadleaf weed control and crop injury was evaluated visually on June 3, 1994. Barley was harvested on July 29,1994.

Thifensulfuron-tribenuron controlled field penneycress, common lambsquarters and mayweed chamomile 88% or better, while henbit control was 80%. Barley was not injured, and yields did not differ between treatments. Net economic return per acre for herbicide treatment was $-1.96/A. This data will be incorporated into a bioeconomic model evaluating the efficacy of weed control options in spring barley. (Plant Science Division, University of Idaho, Moscow, ID 83843-2339)

Table. Weed control with thifensulfuron-tribenuron in spring barley, Latah County, ID.

			Barley		Control			
Treatment[1]	Rate	Injury	Yield	Net return	ANTCO	CHEAL	THLAR	LAMAM
	lb/A	%	lb/A	$/A	%			
Thifensulfuron-tribenuron	0.019	0	3583	128.17	88	92	94	80
Untreated control	0.00	0	3380	130.13	0	0	0	0
LSD(.05)		NS	NS		4	4	3	5
Plants/ft^2					4	3	2	4

[1] Thifensulfuron-tribenuron was applied as a commercial formulation plus an 80% non-ionic surfactant added at 0.25% v/v.

Dose response of broadleaf herbicides in spring barley. Michael J. Wille, Terry L. Neider, and Donald C. Thill. A study was established in Latah county, ID to evaluate broadleaf weed response to herbicides at varying rates in 'Baronesse' spring barley. The major weeds present at this site were field penneycress (THLAR), mayweed chamomile (ANTCO), and common lambsquarters (CHEAL). Plots were 8 by 30 ft with four replications arranged in a split-plot design, with herbicides as main plots and herbicide rates as subplots. MCPA amine, bromoxynil-MCPA, or thifensulfuron-tribenuron were applied at either the full labeled rate, 2/3, or 1/3 full labeled rate. Weeds were counted on May 13, 1994, and treatments were applied postemergence on May 28, 1994 to 4 to 5 leaf barley with 2 tillers, and 1 to 2 inch weeds. Environmental conditions were as follows: air temp. 58 F; relative humidity 60%; wind S at 3 to mph; clear sky; soil surface; 80 F; 2 inch 54 F; and 4 inch 54 F. All treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi. The soil was a silt loam (26% sand, 60% silt, 14% clay, pH 5.6 and 3.0% organic matter). Weed control and barley injury were evaluated visually on June 8, 1994. Barley was harvested on July 29, 1994.

Field penneycress and common lambsquarters were controled 86% or better with all herbicide treatments. Mayweed chamomile was not controlled with MCPA. However, bromoxynil-MCPA or thifensulfuron-tribenuron at either 2/3 or full labeled rate controlled mayweed chamomile greater than 84%. Barley was not injured and yields did not differ among treatments. (Plant Science Division, University of Idaho, Moscow, ID 83843-2339)

Table. Broadleaf weed control in spring barley with MCPA, bromoxynil-MCPA, or thifensulfuron-tribenuron at different rates in Latah County, ID.

Treatment[1]	Rate	Barley Injury	Yield	Control THLAR	Control ANTCO	Control CHEAL
	lb/A	%	lb/A		%	
MCPA	0	-	3821	-	-	-
MCPA	0.25	0	3699	86	5	88
MCPA	0.50	0	3865	94	8	88
MCPA	0.75	0	3808	95	15	97
Bromoxynil-MCPA	0.00	-	3805	-	-	-
Bromoxynil-MCPA	0.165	0	3641	93	73	93
Bromoxynil-MCPA	0.33	0	3793	98	84	95
Bromoxynil-MCPA	0.50	0	3578	100	91	99
Thifensulfuron-tribenuron	0.00	-	3377	-	-	-
Thifensulfuron-tribenuron	0.006	0	3488	89	66	85
Thifensulfuron-tribenuron	0.012	0	3711	94	84	93
Thifensulfuron-tribenuron	0.019	0	3593	96	89	95
LSD (0.05)		NS	NS	NS	16.9	NS
Plants / ft^2				2	7	1

[1] MCPA was applied as the amine formulation. Bromoxynil-MCPA, and thifensulfuron-tribenuron were each applied as commercial formulations. An 80% non-ionic surfactant at 0.25% v/v was added to thifensulfuron-tribenuron.

Weed emergence with night tillage versus day tillage in Idaho. Joan M. Campbell, Larry Smith, and Donn Thill. Seed germination of some plant species is stimulated by exposure to light. Buried seed may remain dormant if it is kept in darkness during tillage. Weed emergence in spring barley was compared for seed beds prepared in daylight or darkness in Nez Perce County, Idaho. Soil was cultivated three times during the day or three times during the night. The cultivation was the same except the cultivator was covered with a tarp during the night tillage to prevent exposure from the tractor running lights. The moon was full the night of tillage. The experiment was a randomized complete block design with three replications. Plots were 30 by 500 ft. Weeds were counted at six locations within each plot by randomly placing a 0.5 yd^2 quadrat. Barley grain was harvested with a commercial combine and weighed on a weigh wagon.

Total weed emergence was 37% less with night cultivation than day cultivation (Table). Mayweed chamomile was the predominant weed species, but it had the highest amount of variability. Mayweed chamomile seedlings were clustered around the mother plant to a higher degree than the other weeds. Redroot pigweed densities were the lowest, but redroot pigweed was distributed throughout the field. Barley grain yield was not affected by the tillage treatments. The highest weed density was in the middle of the experimental area. A 45 by 30 ft swath in this high density area was sprayed with herbicides. This may have contributed to both treatments yielding similar amounts of grain. (Plant Science Division, University of Idaho, Moscow ID 83844-2339)

Table. Weed emergence and barley grain yield

Time of cultivation	Field pennycress	Redroot pigweed	Mayweed chamomile	Henbit	Total weeds	Barley grain yield
	plants/yd^2					(lb/a)
Night	8	1	23	10	42	2419
Day	12	3	35	16	67	2198
Prob > F[1]	*0.18*	*0.01*	*0.38*	*0.03*	*0.01*	*0.47*

[1] According to nonparametric analysis of variance

Spring barley variety response to increasing wild oat density. Traci A. Brammer, Carol A. Mallory-Smith, and Donald C. Thill. A study was established in the spring of 1994 at the University of Idaho Plant Science Farm near Moscow, Idaho to evaluate the response of different spring barley varieties at variable seeding rates to increasing densities of wild oat . The experiment was arranged as a split block design with main plots as wild oat densities (96 by 20 ft), subplots as spring barley varieties (24 by 80 ft) and sub-subplots as barley densities (8 by 80 ft). Wild oat was planted in 3.5 inch rows, 0.5 inches deep on April 23, 1994 with a cone seeder and immediately harrowed twice in perpendicular directions with a spring-tooth harrow. 'Baronesse', 'Steptoe', 'Harrington', and 'Morex' spring barley was planted in 7 inch rows, 1.5 inches deep on May 2 with a cone seeder . Wild oat and spring barley densities were determined May 25 from plant counts of a 5 ft^2 area. Wild oat densities were 1, 6, 7, and 10 plants/ft^2 and barley densities were 8, 9, and 10 plants/ft^2. Spring barley was harvested with a small plot combine from a 4.5 by 17 ft area for each experimental unit (8 by 20 ft) on August 8.

Barley variety average grain yield ranged from 2807 lb/A to 3614 lb/A, with 'Steptoe' significantly out yielding the other varieties (Table 1). Spring barley variety yields, except 'Baronesse' and 'Morex', were significantly different from each other. Increasing wild oat density reduced spring barley yield (Table 2). Spring barley yields increased as barley density increased, but were not different at 9 plants/ft^2 or greater. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho 83844-2339)

Table 1. Effect of increasing wild oat density on spring barley yield within spring barley variety and averaged across variety.

Spring barley variety	Type of spring barley	Wild oat density	Spring barley yield[1]	Average spring barley yield[2]
		plants/ft^2	lb/A	lb/A
Steptoe	6-row feed	1	4718 a	3614 a
Steptoe		6	3540 b	
Steptoe		7	3278 b	
Steptoe		10	2919 c	
Baronesse	2-row feed	1	4177 a	3051 b
Baronesse		6	3065 b	
Baronesse		7	2600 c	
Baronesse		10	2362 c	
Morex	6-row malting	1	3940 a	3044 b
Morex		6	2938 b	
Morex		7	2727 b	
Morex		10	2520 c	
Harrington	2-row malting	1	3692 a	2807 c
Harrington		6	3119 b	
Harrington		7	2331 c	
Harrington		10	2087 c	

[1]Barley grain yield within a variety with the same letter are not significant at $P < 0.05$.

[2]Average barley grain yield with the same letter are not significant at $P < 0.05$.

Table 2. Spring barley yield for wild oat density averaged over spring barley variety and density.

Wild oat density	Spring barley yield[1]
plants/ft^2	lb/A
1	4144 a
6	3166 b
7	2734 c
10	2472 d

[1]Treatments with the same letter are not significant at $P< 0.05$.

Table 3. Spring barley yield for spring barley density averaged over spring barley varieties and wild oat density.

Spring barley density	Spring barley yield[1]
plants/ft^2	lb/A
8	2929 a
9	3192 b
10	3267 b

[1]Treatments with the same letter are not significant at $P< 0.05$.

Evaluation of pendimethalin + metolachlor or pendimethalin + imazethapyr for velvetleaf control in six varieties of dry beans. Larry W. Mitich and Ernie J. Roncoroni. A field experiment was conducted at the University Research Farm, Davis, CA to evaluate the efficacy of imazethapyr at two rates on velvetleaf control and determine the tolerance of six bean varieties to the herbicides. Preplant applications of pendimethalin or pendimethalin + metolachlor were applied June 7, 1994, to 60 by 25 ft. plots (24 rows, 30 inches wide) with 4 replications arranged in a randomized complete block. All herbicide applications were made with a CO_2 pressure sprayer delivering 25 gpa with preplant treatments incorporated to a 3-inch depth. Six dry bean varieties--'Yolano' pink, 'Mezcla' and 'UC Luna' baby limas, 'California Dark Red' and 'California Early Light Red' kidneys and '46' California blackeye--were each planted in 4, 30-inch rows. After emergence the beans were furrow irrigated twice before applying imazethapyr on July 1, when the beans were in the 3 to 5 trifoliate leaf stage and 7 to 9 inches tall. The largest velvetleaf (ABUTH) plants were in the 3 to 4 leaf growth stage and from 1 to 4 inches tall. The applications were made over the top of the bean plants. Visual crop injury was evaluated July 20. A second visual evaluation for both crop injury and weed control was made August 24. Two 30-inch by 20 ft. rows were counted for velvetleaf stand in each treatment (table 1). The two center row of each 4 row plot were cut and allowed to dry before being harvested on October 19. The beans were cleaned of trash and weights taken.

Both rates of imazethapyr caused early stunting of all dry bean varieties. 'UC Luna' baby lima was the most sensitive variety with '46' California blackeye the least sensitive at the first observation. At the second evaluation, both rates of imazethapyr controlled velvetleaf and no visual injury was observed and there was no significant differences in yield (table 2). Early suppression of velvetleaf was obtained with the combination of pendimethalin and metolachlor, but by August the population began increasing. The application of pendimethalin in combination with metolachlor or imazethapyr gave 80% barnyardgrass (ECHCG) control. (Weed Science Program, Dept. of Vegetable Crops, University of California, Davis, CA 95616)

Table 1. Evaluation of pendimethalin + metholachlor or pendimethalin + imazethapyr for crop injury and weed control in 6 varieties of dry beans, UC Davis, 1994.

	Rate (lb/a)	Timing[1]	% Injury[2] Mezcla baby lima (vine)	UC Luna baby lima (bush)	46 California blackeye	Yolano pink
pendimethalin + metolachlor	1 + 2	PPI	0	0	0	0
pendimethalin + imazethapyr[3]	1 + 0.032	PPI + post	7.5	12.5	2.5	10
pendimethalin + imazethapyr[3]	1 + 0.047	PPI + post	10	17.5	7.5	17.5
untreated	- - -	- - -	0	0	0	0

			California Dark Red kidney	California Early Light Red kidney	% Weed control[4] ECHCG	ABUTH	ABUTH stand count[4]
pendimethalin + metolachlor	1 + 2	PPI	0	0	80	50	12.8
pendimethalin + imazethapyr[3]	1 + 0.032	PPI + post	10	10	86	90	4.0
pendimethalin + imazethapyr[3]	I + 0.047	PPI + post	12.5	12.5	80	90	5.5
untreated	- - -	- - -	0	0	0	0	25.8

1 PPI = preplant incorporated application application made 7 June 1994; post = postemergence application made 1 July 1994. Beans were in the 3 to 5 trifoliate leaf stage, 7 to 9 inches tall. Velvetleaf had 3 to 4 leaves, was 1 to 4 inches tall.
2 Bean injury visually evaluated 20 July 1994.
3 Includes X-77 surfactant at 0.25%.
4 Weed control evaluation and stand count made 24 August 1994.

Table 2. Yield of six varieties of dry beans treated with pendimethalin + metolachlor or pendimethalin + imazethapyr, UC Davis, 1994.

	Rate (lb/a)	Timing[1]	Yield (lb/a)[2] Mezcla baby lima (vine)	UC Luna baby lima (bush)	46 California blackeye
pendimethalin + metolachlor	1 + 2	PPI	1279 A	2855 A	1880 A
pendimethalin + imazethapyr[3]	1 + 0.032	PPI + post	2336 A	2841 A	2110 A
pendimethalin + imazethapyr[3]	1 + 0.047	PPI + post	1953 A	2746 A	2545 A
untreated	- - -	- - -	947 A	1501 B	1558 A

			Yolano pink	California Dark Red kidney	California Early Light Red kidney
pendimethalin + metolachlor	1 + 2	PPI	3320 A	2750 A	2714 A
pendimethalin + imazethapyr[3]	1 + 0.032	PPI + post	3270 A	2830 A	2999 A
pendimethalin + imazethapyr[3]	1 + 0.047	PPI + post	2974 A	2762 A	2985 A
untreated	- - -	- - -	3166 A	2350 A	2699 A

1 PPI = preplant incorporated application made 7 June 1994; post = postemergence application made 1 July 1994. Beans were in 3 to 5 trifoliate leaf stage, 7 to 9 inches tall. Velvetleaf had 3 to 4 leaves, was 1 to 4 inches tall.
2 Duncan's Multiple Range test; values followed by the same letter are not significantly different at the 5% level.
3 Includes X-77 surfactant at 0.25%.

Broadleaf weed control in pinto beans with early and late postemergence applied AC 299-263 and imazethapyr.. Richard N. Arnold, Eddie J. Gregory and Daniel Smeal. Research plots were established on May 12, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of pinto beans (var. Olathe) and annual broadleaf weeds to early and late postemergence applied Ac 299-263 and imazethapyr. Soil type was a Wall sandy loam with pH of 7.8 and an organic matter content less than 1%. The experimental design was a split-plot with timing as whole plots and treatments as sub-plots with three replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Early and late postemergence treatments were applied on May 30 and June 6, 1994 when pinto beans were in the first and second trifoliolate leaf stage and weeds were small. A adjuvant mixture of X-77 plus 32% nitrogen at 0.25% v/v and 2 pts/A was added to each treatment. Black nightshade, infestations were heavy and prostrate and redroot pigweed infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made on June 27, and July 6, 1994 for early and late postemergence treatments. Handweeded controls were hoed starting on June 8 about every two weeks until August 10, 1994. Stand counts were made on June 27, and July 6, 1994 by counting individual plants per 10 ft of one row of each plot. Dry beans were harvested for yield on August 28, 1994 with a self-propelled John Deere combine equipped with a load cell.

All herbicide treatments applied early postemergence injured pinto beans significantly more than late postemergence. There were no significant differences in stand count. All treatments gave good to excellent control of broadleaf weeds except the check. Yields ranged from 2713 to 2152 lb/A higher in the treated plots than the check.

Table. Broadleaf weed control in pinto beans with early and late postemergence applied AC 299-263 and imazethapyr.

Treatment	Rate	Crop Injury	Stand Count	Weed Control AMARE	Weed Control AMABL	Weed Control SOLNI	Yield
	lb/A	--%---	no	------------%----------			lb/A
Early Postemergence							
AC 299-263	0.024	4	47	100	99	94	2967
AC 299-263	0.047	32	52	100	100	98	2660
AC 299-263	0.063	37	48	100	100	100	2567
AC 299-263	0.094	55	50	100	100	100	2767
Imazethapyr	0.094	50	50	100	100	100	2721
Imazethapyr	0.047	24	52	100	100	100	2921
Handweeded check		0	56	100	100	100	3128
Check		0	51	0	0	0	461
	mean	25	51	88	87	87	2536
Late Postemergence							
AC 299-263	0.024	0	49	100	87	75	2721
AC 299-263	0.047	2	49	100	99	89	2921
AC 299-263	0.063	2	49	100	100	84	2967
AC 299-263	0.094	5	50	100	100	92	2813
Imazethapyr	0.094	6	50	100	92	88	2660
Imazethapyr	0.047	0	51	99	82	84	2767
Handweeded check		0	52	100	100	100	3121
Check		0	52	0	0	0	415
	mean	2	50	87	82	77	2552
LSD 0.05							
Timing		1	ns	ns	2	2	ns
Treatment		2	ns	1	4	4	492

Broadleaf weed control in pinto beans with imazethapyr alone or in combination. Richard N. Arnold, Eddie J. Gregory and Daniel Smeal. Research plots were established on May 12, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of pinto beans (var. Olathe) and annual broadleaf weeds to postemergence applications of imazethapyr alone or in combination. Soil type was a Wall sandy loam with pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 30, 1994 when pinto beans were in the first trifoliolate leaf stage and weeds were small. Black nightshade infestations were heavy and prostrate and redroot pigweed infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made on June 27, 1994. Handweeded controls were hoed starting on June 8 about every two weeks until August 10, 1994. Stand counts were made on June 27, 1994 by counting individual plants per 10 ft of one row of each plot. Dry beans were harvested for yield on August 29, 1994 with a self-propelled John Deere combine equipped with a load cell.

Imazethapyr at 0.047 lb/A had the highest injury rating of 18. There were no significant differences in stand count. All treatments gave good to excellent control of broadleaf weeds except bentazon, dimethenamid with and without an adjuvant, and the check. Yields ranged from 154 to 2767 lb/A higher in the treated plots than the check.

Table. Broadleaf weed control in pinto beans with imazethapyr alone or in combination.

Treatment[1]	Rate	Crop Injury	Stand Count	Weed Control SOLNI	AMARE	AMABL	Yield
	lb/A	--%---	no	---------%---------			lb/A
Imazethapyr	0.024	2	50	100	99	95	1691
Imazethapyr	0.032	7	52	100	100	98	2152
Imazethapyr	0.047	18	50	100	100	99	2460
Imazethapyr + dimethenamid	0.024+0.75	4	53	100	100	94	2766
Imazethapyr + dimethenamid	0.024+1.0	3	57	100	100	92	2766
Imazethapyr + dimethenamid	0.032+0.75	4	55	100	100	99	3382
Imazethapyr + dimethenamid	0.032+1.0	4	55	100	100	98	2460
Imazethapyr + dimethenamid	0.024+1.25	1	53	100	100	98	2921
Imazethapyr + dimethenamid	0.032+1.25	7	52	100	100	99	2614
Imazethapyr + bentazon	0.032+0.5	0	51	100	100	98	1999
Bentazon + dimethenamid	0.5+1.0	1	54	97	88	91	1384
Bentazon[2]	0.5	0	52	38	33	50	922
Dimethenamid[3]	1.0	0	52	7	71	70	769
Dimethenamid	1.0	0	53	0	71	83	769
Handweeded check		0	56	100	100	100	3229
Check		0	53	0	0	0	615
Weeds/m^2				45	12	18	
LSD 0.05		3	ns	9	14	13	446

1. Treatments applied with X-77 and 32% nitrogen solution at 0.25% v/v and 2 pts/A.
2. A COC was added at 2 pts/A.
3. No adjuvant was added.

Dose response of spring-planted canola to thifensulfuron-tribenuron. Traci A. Brammer, Jeffery S. Brennan, Carol A. Mallory-Smith, and Donald C. Thill. An experiment was established near Moscow, Idaho in 'IMC130' canola to evaluate canola injury and seed yield to low dose treatments of thifensulfuron-tribenuron. Plots were 15 by 20 ft arranged in a randomized complete block with four replications. Thifensulfuron-tribenuron was applied to a 8 by 20 ft area on the west side of each plot with a CO_2 pressurized backpack sprayer calibrated to deliver 20 gpa at 41 psi and 3 mph to 2 to 4 leaf canola on May 28, 1994 (Table 1). The remaining 7 ft served as a buffer stripe between plots. The treatments applied were percentages of the label rate, which was defined as 17.5 g/ha (0.25 oz/A) (the minimum label rate for wheat = 15.75 g/ha (0.225 oz/A)). Canola plant density was counted within two 10.8 ft^2 areas for each plot on June 10. Canola injury was evaluated visually on June 10 and June 30. Canola was direct combine harvested from a 4.5 by 20 ft area on August 17. Canola seed yield was suppressed by drought conditions.

Table 1. Application data and soil analysis.

Application date	May 28
Canola growth stage	2- 4 leaf
Air temperature (F)	58
Relative humidity (%)	65
Wind speed (mph, direction)	0-3,E
Cloud cover (%)	20
Soil temperature at 2 in (F)	50
pH	6.0
OM (%)	3.3
Texture	silt loam

Treatments of thifensulfuron-tribenuron at the 2.19 g/ha rate and above injured canola 88% or greater, while rates 0.55 and 1.09 g/ha injured canola 46 and 66%, repectively (Table 2). Canola yields were significantly less than the untreated check when thifensulfuron-tribenuron was applied at 0.27 g/ha or higher. No canola plants survived thifensulfuron-tribenuron treatments greater than 1.09 g/ha. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho 83844-2339)

Table 2. Dose response of spring-planted canola to decreasing rates of thifensulfuron-tribenuron.

			Canola		
Treatment[1]	Rate	% of Label Rate	Plant Counts	Injury	Yield
	g/ha		plants/ft^2	-- % --	lb/A
Untreated check	--	--	3	0	160
Thifensulfuron-tribenuron	0.04	0.20	4	0	149
Thifensulfuron-tribenuron	0.07	0.39	3	1	184
Thifensulfuron-tribenuron	0.14	0.78	4	14	116
Thifensulfuron-tribenuron	0.27	1.56	3	20	59
Thifensulfuron-tribenuron	0.55	3.13	3	45	32
Thifensulfuron-tribenuron	1.09	6.25	3	66	18
Thifensulfuron-tribenuron	2.19	12.50	0	88	4
Thifensulfuron-tribenuron	4.38	25.00	0	94	1
Thifensulfuron-tribenuron	8.75	50.00	0	97	1
Thifensulfuron-tribenuron	17.51	100.00	0	99	0
LSD(0.05)			1	5	64

[1] All treatments applied with R-11, a nonionic surfactant from Wilbur Ellis at 0.25% v/v.

Bioeconomic model for grass weed control in spring-planted canola. Traci A. Brammer, Jeffery S. Brennan, Ed Bechniski and Donald C. Thill. A field experiment was established during the spring of 1994 at the University of Idaho Plant Science Farm near Moscow, Idaho to evaluate the effect of wild oat and volunteer spring barley plant density and sethoxydim rates on wild oat (AVEFA) and volunteer spring barley (HORVX) control in canola and on canola seed yield and oil content. A bioeconomic model will be constructed for control of wild oat and volunteer spring barley with sethoxydim. Main plots were canola cultivars (32 by 160 ft), subplots volunteer spring barley or wild oat density (32 by 32 ft) and sub-subplots were sethoxydim dose (8 by 32 ft). The treatments were replicated four times in a randomized split block design. Wild oat or 'Russell' spring barley were seeded on April 19 in rows spaced 3.5 inches apart. Both species were seeded to attain established plant densities of 0, 1.9, 6.5, 11.1, and 15.8 plants/ft^2. 'Helios' and 'Westar' spring canola were seeded perpendicular to wild oat or volunteer spring barley in rows spaced 7 inches apart to achieve an established plant density of 9.3 plants/ft^2. Both cultivars were seeded on April 23 using practices standard to the area. Sethoxydim was applied at 0, 0.14, 0.19, and 0.28 lb ai/A with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi and 3 mph (Table 1). Weed control was evaluated visually July 11. Canola seed was direct combine harvested with a small plot combine from a 4.5 by 16 f area on August 17. A seed sample from each sub-subplot was analyzed for oil content using nuclear magnetic resonance (NMR) spectroscopy. Canola seed yields were low due to unusually dry and warm weather especially during flower induction period (June and July).

Table 1. Application data and soil analysis.

Application date		May 31	
Growth stage:			
Canola		3 to 5 leaf	
Wild oat		3 to 6 leaf	
Volunteer spring barley		3 to 6 leaf	
Air temperature (F)		67	
Relative humidity (%)		53	
Wind (mph, direction)		1 to 5, NW	
Cloud (%)		100	
Soil temperature (F)		57	
Replications	1 and 2		3 and 4
pH	6.0		6.2
OM (%)	2.8		2.7
Texture	silt loam		silt loam

All sethoxydim rates controlled volunteer spring barley 93% or better and wild oat 97% or better (Table 2). Canola seed yield increased as sethoxydim dose increased for all wild oat and volunteer spring barley densities, and canola seed yield of all doses were significantly different from the untreated check. Wild oat and volunteer spring barley density reduced canola seed yields as densities increased (Table 3 and 4). Total oil content of canola seed was not effected by sethoxydim dose or weed density (wild oat or volunteer spring barley). (Agriculture Experiment Station, University of Idaho, Moscow, Idaho 83844-2339)

Table 2. Wild oat and volunteer spring barley control and canola seed yield as effected by sethoxydim dose.

		Control		Canola seed yield		
				HORVX		AVEFA
Treatment	Rate	HORVX	AVEFA	Helios	Westar	
	lb ai /A	%		lb/A		
untreated check	--	--	--	157	167	243
Sethoxydim	0.14	93	96	224	258	336
Sethoxydim	0.19	96	98	247	260	352
Sethoxydim	0.28	97	98	321	257	332

Table 3. The effect of wild oat density on canola seed yield averaged over sethoxydim dose.

	Canola seed yield[2]	
Wild oat density[1]	Helios	Westar
plants/ft^2	lb/A	
6.2	398 a	351 a
5.9	378 a	353 ab
6.0	319 ab	243 c
8.4	277 b	277 c
10.4	260 b	299 bc

[1]A resident population of wild oat was present in two of the four replications.
[2]Treatments with the different letters are significant at $P < 0.05$.

Table 4. The effect of volunteer spring barley density on canola seed yield averaged over cultivar and sethoxydim dose.

Volunteer spring barley density	Canola seed yield[1]	
plants/ft2	lb/A	% of control
0	328 a	100
1.5	344 a	105
4.0	201 b	61
6.9	171 bc	52
9.1	140 c	43

[1]Treatments with the different letters are significant at $P < 0.05$.

Wild oat control with sethoxydim and quizalofop at two application timings. Jeffery S. Brennan and Donn C. Thill. A field experiment was established to evaluate wild oat (AVEFA) control with sethoxydim and quizalofop applied postemergence at two application timings. Plots were 8 by 30 feet and treatments were arranged in a randomized complete block design with four replications. Canola was seeded 1 in. deep with a double disk drill at 5.5 lb/A on April 21, 1994. Sethoxydim was applied May 27 and June 2 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi and 3 mph (Table 1). Crop injury was evaluated visually June 10 and June 30 for the two timings. Weed control was evaluated visually June 10, June 30, and July 15 for the first application timing and June 30 and July 15 for the second application timing. Canola seed was direct combine harvested with a small plot combine from three of four replications on August 18 from a 121.5 ft^2 area.

Table 1. Herbicide application and soil analysis data.

Application date	May 27	June 2
Growth stage:		
canola	1 to 3 leaf	3 to 5 leaf
Wild oat (AVEFA)	1 to 3 leaf	3 to 5 leaf
Air temperature (F)	68	56
Soil temperature (F)	58	63
Relative humidity (%)	57	80
Wind (mph) - direction	0 to 3 - S	Calm
Cloud (%)	50	30
Soil pH	6.0	
OM	3.3	
texture	silt loam	

Wild oat control was 91% or greater for 1 to 3 leaf wild oat and 98% or greater for 3 to 5 leaf wild oat for all rating dates (Table 2). Quizalofop at 0.03 lb/A was slightly less effective when applied to 1 to 3 leaf wild oat than when applied to 3 to 5 leaf wild oat. Canola was not injured by sethoxydim or quizalofop regardless of herbicide rate and application timing. Seed yield was affected by drought conditions and was not representative of herbicide efficacy. (Idaho Agriculture Experiment Station, University of Idaho, Moscow, ID 83844-2339)

Table 2. Wild oat control with sethoxydim and quizalofop at two application timings.

Treatment[1]	Rate	Canola Injury 6-10	1 to 3 leaf AVEFA 6-10	6-30	7-15	Canola Yield	Canola Injury 6-30	3 to 5 leaf AVEFA 6-30	7-15	Canola Yield
	lb/A	--------	%	--------		lb/A	------	%	------	lb/A
sethoxydim	0.14	0	92	96	96	16.0	0	99	99	24.0
sethoxydim	0.19	0	97	98	98	18.0	0	99	99	31.1
sethoxydim	0.29	0	98	96	99	49.0	0	99	99	87.0
quizalofop	0.03	0	92	91	92	31.0	0	98	99	19.0
quizalofop	0.04	0	98	99	99	20.0	0	99	99	27.0
quizalofop	0.05	0	98	99	99	6.0	0	99	99	124.0
Control		0	0	0	0	20.0	0	0	0	20.0
$LSD_{(0.05)}$		ns	5	7	6	56.0	ns	7	6	56.0

[1]Treatments applied with 1 qt/A of McGregor oil M COC, a petroleum based oil concentrate with 17% emulsifier.

Preemergence herbicide mixtures for corn weed control. Evans, J.O. and R.W. Mace. A randomized complete block experiment with four replications was established on May 14, 1994 at the Greenville Research Farm, Utah State University to evaluate the response of field corn (var. DK-656), annual grasses, and broadleaf weeds to preemergence herbicides. Soil type was a Millville silt loam with a pH of 7.9 and an organic matter content of less than 2%. Individual treatments were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 30 psi. Treatments were immediately incorporated with a spike tooth harrow drawn over the plot area twice with the second pass at right angles to the first harrowing. Visual evaluations of corn injury, grass and broadleaf weed control, were recorded on July 5, 1994 when the corn had reached approximately 18 inches in height and the weeds had emerged. Corn silage yields were determined by cutting two meters of row within each treatment plot on September 16, 1994.

All treatments provided excellent grass and broadleaf weed control in corn with little injury except those combinations with CGA 152005. These showed 42 and 47 percent phytotoxicity and a 30 percent yield reduction compared to other treatments. The addition of crop oil with CGA 152005 appears to have magnified the crop injury and may reduce yields beyond treatments without crop oil. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Table. Preemergence weed control with selected herbicides in field corn.

Treatment	Rate	Injury	Weed control grass	Weed control broadleaf	Yield
	lb/A	-----------	-%	-------------	T/A
Metolachlor+	1.2	0	91.5	96.3	21.2
Atrazine	0.6				
Metolachlor+	2.4	0	98.3	100.0	26.4
Atrazine	1.2				
Metolachlor+	1.5	0	90.0	100.0	26.4
Atrazine	0.75				
Metolachlor+	1.5	42.5	91.3	100.0	18.9
Atrazine+	0.75				
CGA 152005	0.07				
Metolachlor+	1.5	47.5	95.8	99.5	17.4
Atrazine+	0.75				
CGA 152005+COC[1]	0.07				
Untreated		0	0	0	19.6
$LSD_{(.05)}$		4.8	6.7	4.5	4.1

[1] crop oil concentrate at 2 pt/A

Dimethenamid and acetachlor compare favorably with metolachlor and alachlor for weed control in corn. Evans, J.O. and R.W. Mace. Preplant herbicides were evaluated for annual grass and broadleaf weed control in field corn (var. DK 656). Treatments were applied May 14, 1994 in a RCB design, with four replications. Herbicides were applied with a CO_2 backpack sprayer delivering 19 gpa at 39 psi using 8002 flatfan nozzles. Treatments were incorporated with two right angle passes using a spike tooth harrow immediately after herbicide application, and the corn was planted the next day. Visual evaluations of corn injury, grass and broadleaf weed control, were taken when the corn reached approximately 18 inches tall and the weeds had all emerged. The weed stand was not uniform within blocks so it was divided into grassy and broadleaf weeds. Corn silage yield was determined by harvesting two meters of row within each plot on September 16, 1994.

Dimethenamid plus atrazine provided the best grass and broadleaf weed control in corn and was the only treatment providing visual weed control ratings above 90 percent for both annual grasses and broadleaf weeds. Acetachlor also compared favorably with metolachlor and alachlor in annual grass control but did not exhibit acceptable broadleaf weed control in this test. None of the treatments caused visual injury to corn. Crop yields were very uniform for all treatments and weeds present in untreated plots lowered the corn yield by 22 percent compared to the yield of plots treated with dimethenamide plus atrazine. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Table. Weed control with selected preplant herbicides in field corn.

Treatment	Rate	Weed control		Crop response	
		grass	broadleaf	injury	Yield
	lb/A	%	%	%	T/A
Dimethenamid	1.0	75.0	25.0	0	21.2
Dimethenamid	1.3	81.3	60.0	0	24.2
Dimethenamid	1.5	81.7	53.3	0	21.8
Metolachlor	2.0	50.0	50.0	0	24.6
Alachlor	2.5	81.7	35.0	0	21.6
Acetachlor	1.5	85.0	35.0	0	24.0
Acetachlor	1.6	83.3	36.7	0	22.7
Acetachlor	1.8	81.7	33.3	0	21.5
Dimethenamid+	0.6	93.8	92.5	0	25.7
atrazine	0.7				
Untreated		0	0	0	19.2
$LSD_{(.05)}$		9.9	15.1	0	4.0

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold, Eddie J. Gregory and Daniel Smeal. Research plots were established on May 4, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Grand Valley 1230) and broadleaf weeds to preemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence treatments were applied on May 5, 1994 and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigiweed infestations were heavy and redroot pigweed and black nightshade infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made June 6, 1994. Handweeded controls were hoed starting on May 26, about every two weeks until August 25, 1994. Stand counts were made on June 6, 1994 by counting individual plants per 10 ft of the third row of each plot. Plant heights were taken on September 13, 1994 by recording and averaging the height of three plants per plot.

NAF-9 at 2.17 lb/A had the highest injury rating of 6. NAF-9 at 1.45 and 1.69 lb/A had a significantly higher stand count than NAF-72 at 0.17 lb/A. All treatments were significantly taller than the check. All treatments gave excellent control of redroot pigweed and black nightshade. Cyanazine at 1.5 lb/A gave poor control of prostrate pigweed.

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

Treatment[1]	Rate	Crop Injury	Stand Count	Crop Height	Weed Control AMARE	AMABL	SOLNI
	lb/A	--%---	no	in	--------%--------		
NAF-9	1.45	1	18	91	100	100	100
NAF-9	1.69	5	18	92	100	100	100
NAF-9	1.93	3	17	92	100	100	100
NAF-9	2.17	6	16	89	100	100	99
NAF-72	0.17	4	15	89	100	95	99
NAF-72	0.21	1	17	90	100	96	96
NAF-2	1.92	1	17	92	100	100	100
Atrazine	1.5	0	16	93	100	93	100
Cyanazine	1.5	1	16	89	100	44	100
Atrazine + metolachlor	3.6	0	16	91	100	100	100
Handweeded check		0	16	92	100	100	100
Check		0	16	79	0	0	0
Weeds/m^2					9	18	8
LSD 0.05		4	1	3	1	6	3

1. NAF-9, flumetsulam plus metolachlor, NAF-72, flumetsulam plus clopyralid, and NAF-2, flumetsulam plus metolachlor.

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold, Eddie J. Gregory, and Daniel Smeal. Research plots were established in May 4, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Grand Valley 1230) and annual broadleaf weeds preemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content less then 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were on May 5, 1994 and immediately incorporated with 0.75 in of sprinkler applied water. Redroot and prostrate pigweed and black nightshade infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made June 6, 1994. Handweeded controls were hoed starting on May 26, about every two weeks until August 25, 1994. Stand counts were made on June 6, 1994 by counting individual plants per 10 ft of the third row of each plot. Plant heights were taken on September 13, 1994 by recording and averaging the height of three plants per plot.

None of the treatments injured the corn significantly. The high rate of dimethenamid at 1.5 lb/A, dimethenamid at 1.2 lb/A in combination with atrazine at and 0.5 and 0.75 lb/A, acetochlor plus atrazine at 1.6 plus 0.5 lb/A and metolachlor at 2.0 lb/A had fewer plts/ten ft than any other treatments. Metolachlor at 2.0 lb/A had significantly shorter corn than any other treatment except the check. All treatments gave excellent control of redroot and prostrate pigweed and black nightshade except the check.

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

Treatment[1]	Rate	Crop Injury	Stand Count	Crop Height	Weed Control AMARE	AMABL	SOLNI
	lb/A	---%---	no	in	-------%--------		
Acetochlor	1.2	0	16	96	100	100	100
Acetochlor	1.6	0	16	95	100	99	93
Acetochlor	2.0	0	17	93	100	100	100
Acetochlor + atrazine (pm)	4.0	0	16	94	100	99	100
Acetochlor + atrazine	1.6+0.5	0	15	93	100	100	100
Acetochlor + atrazine	1.6+0.75	0	16	97	100	100	100
Dimethenamid	0.9	2	16	95	100	100	97
Dimethenamid	1.2	2	16	93	100	100	100
Dimethenamid	1.5	1	15	89	100	98	97
Dimethenamid + atrazine	1.2+0.5	1	15	93	100	100	100
Dimethenamid + atrazine	1.2+0.75	1	15	95	100	100	100
Dimethenamid + atrazine (pm)	2.5	2	16	94	100	100	100
Metolachlor	2.0	0	15	82	100	93	97
Metolachlor + atrazine (pm)	3.6	0	16	94	100	100	95
Handweeded check		0	17	93	100	100	100
Check		0	16	85	0	0	0
Weeds/m^2					10	8	10
LSD 0.05		ns	1	4	1	5	7

1. pm = packaged mix

Herbicide application timings for control of wild proso millet in corn. T.J. D'Amato and P. Westra. A study was established near Ft. Collins, Colorado to evaluate herbicide treatments for control of wild proso millet and assess subsequent effect on corn yields. Nine treatments were arranged in a randomized complete block with six replications. Plots were 10 by 25 feet. Treatments were applied with a CO_2 powered backpack sprayer, delivering 22 gallons per acre through 11002LP flat fan nozzles. Soil texture at this study site was a clay loam with an organic matter content of 1.9% and pH 7.8. Plots were located under a linear move overhead irrigation system. Force insecticide was applied at planting, at an approximate rate of 10 lbs. product per acre. Weed free check plots were hand weeded as needed through the growing season. The preplant incorporated (PPI) treatment was applied 1 day prior to corn planting, and incorporated immediately with a S-tine harrow. All nicosulfuron rates were applied postemergence with 1% volume per volume (v/v) crop oil concentrate, and 4% v/v 28% nitrogen solution. A standard field cultivator was used for cultivation treatments, 12 days after herbicide application in treatment 7, and 14 days after application in treatment 8. Percent control based on visual evaluations was assessed on June 30 and July 26, 1994.

Plots that received cultivation after nicosulfuron application (treatments 7,8) were significantly less weedy than those plots treated with the same herbicide rates without cultivation (treatments 3,4); when visually evaluated on July 26. Corn yield for the treated plots was lowest in treatment 6, where nicosulfuron application was delayed until wild proso millet was 10 to 14 inches tall. Average yield for untreated check plots (treatment 1) was significantly lower than yield for any treated plots. (Department of Plant Pathology and Weed Science, Colorado State University, Ft. Collins, CO 80523.)

Herbicide application timings for control of wild proso millet in corn[1].

Treatment	Rate	PANMI ht.	Application date	---PANMI Control---		Corn Yield
	lbs ai/A			%		bu/A
1. Weedy check				0 d	0 f	74 c
2. Weed free check				100 a	100 a	129 a
3. Nicosulfuron	0.047	2"	6/8/94	93 b	82 e	123 a
4. Nicosulfuron	0.047	4"	6/14/94	92 b	93 c	114 ab
5. Nicosulfuron	0.047	6"	6/16/94	90 b	96 bc	119 ab
6. Nicosulfuron	0.063	12"	6/27/94	50 c	82 e	99 b
7. Nicosulfuron (w/cultivation 12 DAT)	0.047	2"	6/8/94	100 a	99 ab	127 a
8. Nicosulfuron (w/cultivation 14 DAT)	0.047	4"	6/14/94	91 b	99 ab	125 a
9. Cyanazine EPTC	1.0 4.0	PPI PPI	5/9/94	89 b	88 d	124 a

[1]Means within a column followed by the same letter are not statistically different (P=0.05).

Herbicide combinations for weed control in flood irrigated corn. Curtis R. Thompson. Two studies were established near Garden City, Kansas to evaluate control of johnsongrass (SORHA) and broadleaf weeds in flood irrigated corn. 'Pioneer 3162IR' corn was planted May 9 (study 1) and May 19 (study 2) in 30 inch rows at 29000 seeds/a. All treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 20 gpa. Post-emergence (POST) treatments were applied to 4 leaf corn, 1 to 4 in Palmer pigweed, 1 to 5 in kochia, 1 to 4 in johnsongrass, and 1 to 5 in diameter puncturevine (TRBTE) in study one (Table 1). Treatments were replicated three times. Treatments were applied POST to 4 to 5 leaf corn, 1 to 8 in kochia, 1 to 8 in Palmer amaranth, and 4 to 14 in johnsongrass in study two (Table 1). Treatments were replicated four times. Experimental units in both studies were 10 by 30 ft and arranged in a randomized complete block design. Corn injury was evaluated in study one on June 14. Weed control was evaluated visually on the dates indicated in Tables 2 and 3. Grain was harvested from two 20-ft rows of each plot October 19 in study one and one 20-ft row of each plot in study 2 October 24.

Table 1. Application data.

	Study 1	Study 2	
Application date	6/3/94	5/21/94	6/16/94
Application time	POST	PRE	POST
Air temperature (F)	77	67	73
Relative humidity (%)	75	75	88
Wind speed (mph)	8	10	12
Leaf surface moisture	Dry	Dry	Dry
Soil surface moisture	Dry	Dry	Dry
Sprayer nozzle	8003VS	8003VS	8003VS
volume	20 gallon/a	20 gallon/a	20 gallon/a
pressure	30 psi	30 psi	30 psi

Leaf burn was present on corn treated with CGA-248757 and flumiclorac two days after application. However, flumiclorac injured corn 7%, while injury ratings were 0 for all other treatments 11 DAT (data not shown). All treated corn yielded or tended to yield more grain than did the untreated corn (Table 2). CGA-248757 and flumiclorac controlled Palmer amaranth less than 80% 11 WAT. Atrazine&dicamba (& indicates commercial prepackage mixture) alone or tank-mixed with CGA-248757 controlled the broadleaf species 95% or greater. Johnsongrass was controlled 90% or greater with nicosulfuron and primisulfuron tank-mixed with CGA-248757.

The June 16 weed control evaluations reflect the PRE herbicide treatment effects only (Table 3). No corn injury was observed in this study. Metolachlor&atrazine alone controlled Palmer amaranth and kochia 98% or greater. Metolachlor applied PRE controlled kochia 72% and Palmer amaranth 86%; however, the POST application of nicosulfuron and primisulfuron tank-mix increased the broadleaf weed control to 96% or greater. Nicosulfuron and primisulfuron tank-mix controlled johnsongrass control 98% or greater 6 WAT and controlled Palmer amaranth and kochia 88 and 92%, respectively. Corn grain yields were not reported due to variability from the flood irrigation. (SW Res. Ext. Ctr., Kansas State Univ. Agric. Exp. Sta. Garden City, KS 67846)

Table 2. CGA-248757 combinations affect on flood irrigated corn and weed control, Garden City, Kansas.

Treatment[1]	Rate	Grain Yield	Grain Moisture	Test weight	Palmer amaranth 6/14	Palmer amaranth 8/20	kochia 6/14	kochia 8/20	SORHA 6/14	SORHA 8/20	TRBTE 6/14
	(lb/a)	(bu/a)	(%)	(lb/bu)	------------	(% control)	------------				
Untreated		36	16.4	60.8	--	--	--	--	--	--	--
CGA-248757 + OC	0.0027 + 2.0 pt	102	18.1	61.5	67	63	72	53	8	33	15
CGA-248757 + OC	0.0036 + 2.0 pt	62	17.1	61.4	83	77	84	70	7	7	50
CGA-248757 + OC	0.0045 + 2.0 pt	69	16.9	61.1	84	74	87	58	19	7	45
Atra&dicamba + Activator 90	0.9&0.5 + 0.25%	96	17.6	60.2	97	99	94	99	28	47	93
CGA-248757 + Atra&dicamba + Activator 90	0.0027 + 0.9&0.5 + 0.25%	123	17.7	61.7	98	98	99	98	18	50	97
CGA-248757 + Atra&dicamba + Activator 90	0.0036 + 0.9&0.5 + 0.25%	131	18.1	61.5	99	98	99	98	27	43	95
CGA-248757 + Atra&dicamba + Activator 90	0.0045 + 0.9&0.5 + 0.25%	113	17.6	62.3	99	99	99	99	32	37	97
CGA-248757 + Primisulfuron + OC	0.0027 + 0.018 + 2.0 pt	137	17.9	61.3	92	83	83	50	92	92	74
CGA-248757 + Nicosulfuron + OC	0.0027 + 0.016 + 2.0 pt	128	17.6	61.3	95	87	83	43	95	93	75
CGA-248757 + CGA-152005 + OC	0.0027 + 0.018 + 2.0 pt	114	17.8	61.4	93	75	88	60	12	57	60
Flumiclorac + OC	0.0267 + 2.0 pt	118	17.2	61.5	80	60	78	84	37	63	8
LSD (.05)		50	1.3	1.5	6	22	7	14	18	42	43
CV		29	4.4	1.4	4	16	5	12	32	51	30
Weed density / ft²					4		6		<1		1

[1] & = commercial prepackaged mixture; atra = atrazine; OC = oil concentrate, 83% paraffin based petroleum oil; Activator 90 = nonionic surfactant applied at 25% v/v, 90% Alkyl polyoxyethylene ether and free fatty acids.
[2] pt = pints of product applied / acre.
[3] adjusted to 15.5% moisture.

Table 3. Primisulfuron and nicosulfuron tank-mixtures for johnsongrass and broadleaf weed control on flood irrigated, Garden City, Kansas.

Treatment[1]	Rate	Application time	Palmer amaranth 6/16	Palmer amaranth 7/30	kochia 6/16	kochia 7/30	SORHA 6/16	SORHA 7/30
	(lb/a)		------------		(% control)		------------	
Metolachlor&atrazine	2.0&1.0	PRE	98	99	99	99	48	51
Metolachlor + Primisulfuron + Nicosulfuron + OC	2.0 + 0.018 + 0.016 + 2.0 pt	PRE POST POST POST	86	98	72	96	13	98
Metolachlor&atra + Primisulfuron + Nicosulfuron + OC	2.0&1.0 + 0.018 + 0.016 + 2.0 pt	PRE POST POST POST	99	100	96	98	45	99
Primisulfuron + Nicosulfuron + OC	0.018 + 0.016 + 2.0 pt	POST POST POST	0	92	0	88	0	98
LSD (0.05)			4	10	23	8	23	8
CV			3	7	22	5	56	6
Weed density / ft²			10		1		15	

[1] & = commercial prepackaged mixture; atra = atrazine; OC = oil concentrate, 83% paraffin based petroleum oil.
[2] pt = pints of OC applied / acre.

Postemergence herbicides for annual weed control in corn. Evans, J.O. and R.W. Mace. Research plots were established June 22, 1994 on the Greenville Research Farm, Utah State University, Logan, Utah to evaluate the response of field corn (var. DK-656), annual grasses, and broadleaf weeds to postemergence herbicides. The soil type was a Millville silt loam with 7.9 pH and an organic matter content of less than 2%. The experimental design was a randomized complete block with three replications. Individual treatments were applied with a bicycle sprayer delivering 16 gpa at 40 psi using 8001 flatfan nozzles with 18 inch spacings. Corn plants were 8 inches high with a maximum of 5 leaves at treatment and the grassy weeds ranged in height from 1 to 4 inches and included green foxtail and wild oats. Broadleaf weeds included redroot pigweed and black mustard at 2 to 4 inches in height. Visual evaluations of corn injury, grass and broadleaf weed control, were taken twice, once when the corn was approximately 18 inches tall and again just prior to harvest, only the latter evaluation is presented. The corn silage yield was determined by harvesting two meters of a center row within each plot on September 16, 1994.

All treatments applied were effective in controlling broadleaf weeds but only the pendimethalin+nicosulfuron+primisulfuron provided excellent grass control. The primisulfuron and imazethapyr+atrazine treatments provided fair grass control. Corn yields were significantly different for the imazethapyr+atrazine treatment compared to the untreated check. All other treatments resulted in corn yields not different than untreated checks. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Table. Postemergence weed control in corn with selected herbicides.

Treatment	Rate	Weed control grass	Weed control broadleaf	Crop response injury	Crop response Yield
	lb/A	------%------		%	T/A
Bromoxynil	0.622	3	90.0	20	24.4
2,4-D amine+	0.5	0	96.7	0	23.9
dicamba	0.5				
Primisulfuron[1]	0.044	73.3	89.3	3	25.2
CGA 152005[2]	0.066	6.7	100.0	0	21.7
CGA 152005[2]	0.088	0	100.0	0	22.6
CGA 152005[1]+	0.044	6.7	100.0	7	22.3
dicamba	0.622				
Pendimethalin+	0.75	93.3	93.3	3	23.5
nicosulfuron+	0.021				
primisulfuron	0.023				
Imazethapyr+	0.063	75	100.0	0	26.6
atrazine	1.6				
Untreated		0	0	0	19.7
$LSD_{(.05)}$		13.1	7.3	5.6	5.3

[1] X77 at .25% v/v

[2] crop oil concentrate at 2 pt/A

Broadleaf weed control in field corn with metribuzin applied postemergence alone or in combination. Richard N. Arnold, Eddie J. Gregory, and Daniel Smeal. Research plots were established on May 4, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Grand Valley 1230) and annual broadleaf weeds to postemergence applications of metribuzin applied alone or in combination. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied postemergence on May 23, 1994 when corn was in the 3 to 4-leaf stage and weeds were small. Redroot and prostrate pigweed and black nightshade infestations were heavy throughout the experimental area. Visual evaluations of crop injury and weed control were made June 23, 1994. Handweeded controls were hoed starting on May 26, 1994 about every two weeks until August 25, 1994. Stand counts were made on June 23, 1994 by counting individual plants per 10 ft of the third row of each plot. Plant heights were taken on September 14, 1994 by recording and averaging the height of three plants per plot.

Metribuzin at 0.28 lb/A had the highest injury rating of 12 and had a significantly lower stand count than any other treatment. Metribuzin plus bromoxynil at 0.075 plus 0.25 lb/A gave poor control of redroot pigweed. Prostrate pigweed was excellent with all treatments except the check. Black nightshade control was poor with metribuzin alone or in combination with bromoxynil, bentazon, and dicamba.

Table. Broadleaf weed control in field corn with metribuzin applied alone or in combination.

Treatment[1]	Rate	Crop Injury	Stand Count	Crop Height	Weed Control AMARE	AMABL	SOLNI
	lb/A	--%---	no	in	--------%		---------
Metribuzin	0.28	12	13	88	100	95	30
Atrazine + dicamba	1.0	0	16	90	100	93	100
Atrazine	1.5	0	17	86	99	99	100
Metribuzin	0.19	4	17	72	99	94	27
Metribuzin + dicamba	0.094+0.25	0	16	72	98	97	77
Metribuzin + dicamba	0.094+0.25	0	17	88	98	96	80
Metribuzin	0.094	0	16	74	98	93	0
Metribuzin + Primisulfuron	0.094+0.035	0	17	76	96	99	77
Metribuzin + Nicosulfuron	0.094+0.031	0	16	80	96	96	83
Metribuzin + bentazon	0.094+0.5	0	16	90	93	100	77
Metribuzin + bromoxynil	0.094+0.25	0	18	89	89	94	83
Metribuzin +bentazon	0.094+0.5	0	17	86	86	94	70
Metribuzin + 2,4-D	0.094+0.25	0	17	82	85	93	88
Metribuzin + bromoxynil	0.075+0.25	0	17	89	67	93	77
Handweeded check		0	18	92	100	100	100
Check		0	16	72	0	0	0
Weeds/m^2					18	20	45
LSD 0.05		1	2	6	9	10	12

1. The first treatment listed of metribuzin plus bentazon was applied with 32% nitrogen solution at 1 gal/A. Atrazine was applied with X-77 at 0.25% v/v. Atrazine plus dicamba is a packaged mix.

Broadleaf weed control in field corn with postemergence herbicides. Richard N. Arnold, Eddie J. Gregory and Daniel Smeal. Research plots were established on May 4, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Grand Valley SX- 1230) and broadleaf weeds to postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 23, 1994 when corn was in the three to four leaf stage and weeds were small. Prostrate and redroot pigweed and black nightshade infestations were heavy throughout the experimental area. Visual evaluations of crop injury and weed control were made June 23, 1994. Handweeded control were hoed starting on May 26, about every two weeks until August 25, 1994. Stand counts were made on June 23, 1994 by counting individual plants per 10 ft of the third row of each plot. Plant heights were taken on September 14, 1994 by recording and averaging the height of three plants per plot.

No crop injury was observed from any of the treatments (data not presented). All treatments had a significantly higher stand count than prosulfuron plus primisulfuron plus COC and the check. All treatments were significantly taller than the check except halosulfuron plus dicamba. All treatments gave excellent control of redroot and prostrate pigweed. Prosulfuron and halosulfuron alone did not control black nightshade.

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

Treatment[1]	Rate	Stand Count	Crop Height	Weed Control AMARE	AMABL	SOLNI
	lb/A	no	in	--------%--------		
Prosulfuron[2]	0.026	18	82	100	100	3
Prosulfuron[2]	0.035	17	84	100	100	27
Prosulfuron	0.026	18	88	100	100	27
Prosulfuron	0.035	16	82	100	100	33
Prosulfuron + primisulfuron	0.018+0.018	16	84	100	99	94
Prosulfuron + atrazine + dicamba (pm)	0.018+0.4	16	83	100	100	100
Prosulfuron + atrazine	0.018+1.5	16	83	100	100	100
Atrazine + dicamba (pm)	0.8	16	89	100	100	100
Halosulfuron + dicamba	0.016+0.25	17	78	100	96	92
Prosulfuron + primisulfuron[2]	0.018+0.018	15	84	99	100	99
Halosulfuron + atrazine + dicamba (pm)	0.016+0.4	17	87	99	98	99
Prosulfuron + dicamba	0.018+0.25	17	83	98	95	93
Halosulfuron	0.064	17	82	95	97	0
Halosulfuron	0.032	17	84	93	95	0
Handweeded check		17	91	100	100	100
check		15	73	0	0	0
Weeds/m^2				20	18	30
LSD 0.05		2	5	6	6	14

1. Treatments applied with X-77 surfactant at 0.25% v/v and pm = packaged mix.
2. Treatments applied with a COC at 2 pts/A.

Postemergence applied herbicide treatments in field corn. Jack P. Orr, Ernie Roncoroni, and Larry Mitich. Plots were established under furrow irrigation at the University of California Davis research farm, Davis, California, to evaluate the efficacy of postemergence herbicides for weed control in field corn. Plots were four rows, 10 by 20 feet, with four replications arranged in a randomized complete block. The herbicide treatments were applied broadcast to the center two corn rows at the three leaf stage with a CO_2 pressurized backpack sprayer delivering 30 gpa at 30 psi on May 11, 1994. Air temperature was 80°F. The soil was a Yolo loam. Visual crop growth evaluations and visual weed control ratings were made May 27. Plots were harvested October 15, 1994. The barnyardgrass (ECHCG) population was high; velvetleaf (ABUTH) was moderate; and redroot pigweed (AMARE), common purslane (POROL), and common lambsquarters (CHEAL) were light.

The combinations of nicosulfuron plus bromoxynil, metribuzin, and 2,4-D gave excellent weed control and the highest yields, up to 10,610 pounds per acre. The broadleaf herbicides alone gave the lowest yields, as a result of not controlling barnyardgrass. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827; and University of California, Department of Agricultural Botany, Davis, CA 95616.)

Table. Postemergence applied herbicides in field corn.

Treatment[1]	Rate	Weed Control[4]							Field Corn[2]	
		ECHCG		ABUTH		AMARE	POROL	CHEAL	Phyto[3]	Yield[5]
	oz/A	%							%	lb/A
2,4-D + nico	0.5 + 0.5	100	100	100	94	100	100	100	0	10,610 A
Bromoxynil + nico	0.25+0.031	100	98	100	89	100	100	100	20	10,170 A
Metribuzin + nico	2.5 + 0.5	100	100	100	85	100	100	100	20	9,739 AB
Metribuzin + nico	3.0 + 0.5	100	100	100	90	100	100	100	20	9,612 AB
Bromoxynil + nico	0.38 + 0.5	100	100	100	68	100	100	100	38	9,528 AB
Metribuzin + nico	2.0 + 0.5	100	100	100	94	100	100	100	20	9,508 AB
Nicosulfuron+ surf	0.031+0.25%	100	75	95	81	100	100	0	0	9,481 AB
Metribuzin	3.0	18	0	100	10	100	100	100	0	7,957 ABC
Metribuzin	2.0	0	0	100	0	100	100	0	0	6,909 BCD
Bromoxynil	0.25	0	0	100	0	100	38	0	0	6,816 BCDE
Bromoxynil	0.38	0	0	100	0	100	0	100	20	5,744 CDE
Metribuzin	2.5	0	0	100	12	100	100	100	0	5,711 CDE
Control	-----	0	0	100	0	100	100	100	20	4,924 DE
2,4-D	0.5	0	0	100	0	100	100	100	0	4,888 DE
Control	-----	0	0	0	0	0	0	0	0	3,833 E
										LSD: 2,675

[1] Treatments applied on May 11, 1994; nico = nicosulfuron and surf = surfactant.
[2] Visually evaluated on May 27, 1994. There was no corn stand reduction, vigor reduction.
[3] Crop injury, necrosis, visually evaluated on May 27, 1994.
[4] Weed control visually evaluated on May 27 and August 3, 1994.
[5] Corn was hand harvested October 15, 1994.

Preplant incorporated control of barnyardgrass in cotton. S. D. Wright and M. R. Jimenez, Jr. Different formulations and rates of pendimethalin and trifluralin were evaluated for barnyardgrass control. Treatments were applied January 1, 1994, on a Traver fine sandy loam soil. Herbicides were applied with a Honda 3-wheeled sprayer delivering 20 gpa at 20 psi going 3 mph. Liquid formulations were driven by CO_2 and granular formulations were broadcast with a garden belly grinder. Temperature was 45°F with 0-3 mph. Herbicides were incorporated two times in opposite directions with a chisel plow pulling a harrow within 12 hours after application. Plot size was 20 by 75 ft and replicated three times in a randomized block design. The field was later bedded up and preirrigated. Acala "Maxxa" cotton was planted on April 5, 1994. Evaluations were taken on May 4 (30 DAP), June 7 (60 DAP), and July 27, 1994 (90 DAP).

Barnyardgrass populations were moderate to extremely high throughout the study site. Pendimethalin 3.3 EC at 1.5 lbs ai/A and pendimethalin 6.25 G at 1.0 lbs ai/A gave the highest control of barnyardgrass when evaluated at 30 days after planting (Table 1). All treatments gave improved control at 60 DAP following two cultivations with an alloway, sweep type cultivator. Increasing herbicide rates gave improved barnyardgrass control. At 70 days after planting all plots were treated with sethoxydim herbicide, applied over the top of cotton to gain control of escapes. By the 90 DAP rating barnyardgrass control dropped approximately 10% for most treatments. The higher rates of each herbicide formulation maintained slightly higher control. No treatments gave control of black nightshade; however, pendimethalin 3.3 EC at 1.0 and 1.5 lbs ai/A had significantly less black nightshade compared to the untreated check. Forty cotton seedlings per plot were collected, washed, and then had measurements taken for root length, weight, and cotyledon weight. There were minor differences, yet significant in root lengths, cotyledon weights, and root weights. Pendimethalin 60 DG at 2.5 lbs ai/A and pendimethalin 6.25 G treatments resulted in slightly longer roots and higher root weights. Pendimethalin 3.3 EC at 1.0 lb, trifluralin 5 EC at .75 and 1.0 lb, pendimethalin 6.25 G at 1.0 lbs ai/A, and the untreated check resulted in the lowest cotyledon weights.

Table 1. Preplant incorporated control of barnyard grass in cotton.

					POPULATIONS = 2/1000TH OF AN ACRE		
Treatment	Lbs AI/A	30 DAP % Control	60 DAP % Control	90 DAP % Control	Barnyard-grass	Black nightshade	Cotton
Pendimethalin 3.3 EC	1	65	90	87	64	10	63
Pendimethalin 3.3 EC	1.5	98	100	93	2	37	72
Pendimethalin 60 DG	1	45	83	68	156	92	71
Pendimethalin 60 DG	1.5	87	93	82	9	79	55
Trifluralin 5 EC	0.75	63	87	78	122	35	73
Trifluralin 5 EC	1	63	90	92	79	145	87
Pendimethalin 6.25 G	1	92	100	83	7	102	95
Pendimethalin 6.25 G	1.5	88	100	86	10	62	99
UTC	----	0	73	63	107	124	74
LSD .05		47.3	15.89	25.68	NS	110.8	26.69
% C.V.		40.92	10.12	18.22	160.48	83.97	20.14

Table 2. Effect of preplant incorporated herbicides on growth of seedling cotton (30 DAP).

Treatment	Lbs AI/A	Root length (CM)	Root weight (G)	Cotyledon weight (G)
1. Pendimethalin 3.3 EC	1	11.15	7.57	16.60
2. Pendimethalin 3.3 EC	1.5	11.29	8.10	18.40
3. Pendimethalin 60 DG	1	11.28	8.17	19.80
4. Pendimethalin 60 DG	1.5	12.49	8.70	20.27
5. Trifluralin 5 EC	0.75	11.82	8.77	20.47
6. Trifluralin 5 EC	1	11.61	7.47	17.63
7. Pendimethalin 6.25 G	1	11.16	7.33	16.53
8. Pendimethalin 6.25 G	1.5	12.36	8.97	19.97
9. UTC	----	11.26	7.67	17.63
LSD .05		1.04	0.93	2.78
% C.V.		5.18	6.65	8.65

Black nightshade control in cotton with phrithiobace, Staple. Ron Vargas and Steve Wright. A uniform stand of Maxxa cotton, heavily infested with black nightshade, was divided into plots of 8, 40 in rows that were 75 ft long and replicated three times in a randomized complete block design. Phrithiobace was applied over the top of cotton in the cotyledon to one true leaf stage on May 6 with nightshade being in the cotyledon to three true leaf stage. A second sequential application was applied on May 27 when the cotton was 6 in tall with nightshade ranging from four to ten leaves. Treatments were applied with a power driven sprayer at 30 PSI applying 20 gallons of spray solution per acre.

Evaluations indicated slow, but increasing control with all treatments. Single applications provided from 66 to 80 percent control at 21 days after treatment. Best control was being achieved with the 1.0 and 1.5 oz ai/A rates. Ninety three to 100 percent control was being achieved at 50 days after the first treatment with 100 percent control being achieved with the sequential applications. There were no differences between broadcast and band applications. Cotton injury symptoms were evident with all treatments at seven days after treatment, but nonexistent by 21 days after treatment. Cotton yield data indicated no reduction in seed cotton with any Staple treatment when compared to hand weeded plots.

Table 1. Black nightshade control.

	Oz ai/A		Percent black nightshade control		
Treatments	EP 5/6	MP 5/27	5/13 7DAT	5/27 21DAT	6/3 28DA1stT 7DA2ndT
1. Phrithiobace	1.0	--	40	66	95
2. Phrithiobace	1.5	--	46	76	100
3. Phrithiobace	3.0	--	40	80	96
4. Phrithiobace	1.0	.75	33	80	100
5. Phrithiobace	1.5	1.5	43	76	100
6. Phrithiobace	1.5	--	40	73	100
7. Phrithiobace	1.5	1.5	33	83	98
8. Control	--	--	0	0	0
LSD .05			20	15.6	5.2
% CV			29.4	11.4	3

Table 2. Cotton phytotoxicity and yield.

	Oz ai/A		Percent cotton injury			Seed cotton lbs/A
Treatments	EP 5/6	MP 5/27	5/13 7DAT	5/20 14DAT	5/27 21DAT	10/29
1. Phrithiobace	1.0	--	23	13	0	5464
2. Phrithiobace	1.5	--	33	30	3	5385
3. Phrithiobace	3.0	--	36	23	0	5476
4. Phrithiobace	1.0	.75	26	20	0	5448
5. Phrithiobace	1.5	1.5	43	33	6	5406
6. Phrithiobace	1.5	--	40	30	6	5579
7. Phrithiobace	1.5	1.5	43	26	3	5467
8. Control (hand weeded)	--	--	0	0	0	5545
LSD .05			17.3	19.2	7.9	NS
% CV			27.5	42.8	--	4.5

Weed control in cotton with metham. S. D. Wright and M. R. Jimenez, Jr. Metham rates higher than 50 gal/treated acre in some instances have stunted cotton and reduced yields. The addition of phosphate fertilizer in some studies has reduced injury, in part by maintaining soil mycorrhizal fungi. Metham was applied at different rates, with and without liquid phosphate fertilizer and Guano Plus. Guano Plus is a liquid fertilizer derived from bovine and chicken manure.

An experiment was established on a Hanford loamy fine sand soil near Pixley, California. Treatments were applied on March 28, 1994, to preformed 38-inch beds. Soil moisture was adequate following spring rains and was not preirrigated. The liquid phosphate starter, 60 lbs/A, was injected into the beds on March 27, 1994, as 10-34-0 on some treatments. Guano Plus was dribbled into the seed row at planting in some treatments at 9.4 gal/A with 15.5 lbs. Acala "Maxxa" cottonseed. Metham was applied using a single 8-inch sweep type blade injecting material at 4 to 5 inches below the surface of the bed. Furrow sweeps on the same tool bar reshaped the bed and covered the treated zone with a 6- to 8-inch soil cap. Another tractor followed immediately behind with a roller with gauge wheels to lightly pack the beds. Air temperature was 73°F, and soil temperature was 59°F. Plot size was six 38-inch rows by 1280 feet and replicated three times in a randomized complete block design.

All treatments with metham provided approximately 90 percent control of purple nutsedge in a 10-inch band for about 40 days following application. After that, nutsedge encroached from the side of the bed and infested the seed row. All treatments containing metham gave 100 percent control of black nightshade. No differences were observed between treatments for soil phosphate. All treatments had very high soil phosphate levels of approximately 20 ppm. Vapam at 50 gal. per treated acre plus starter had a slightly higher cotton plant population than treatments with 70 gal. of metham.

Table 1. Effect of metham on nightshade and nutsedge control and cotton yield.

Treatment	Rate per treated acre	% Nightshade control 31 DAT	% Nightshade control 37 DAT	% Nutsedge control 31 DAT	% Nutsedge control 37 DAT	Yield seed cotton
	gal/A					lb/A
Blade only + starter	0	0	0	0	0	3219
Metham	70	100	100	98	94	3198
Metham + starter	70	100	100	88	93	3616
Metham + Guano Plus	70	100	100	93	91	3213
Metham + Guano Plus + starter	70	100	100	97	95	3391
Metham + starter	50	100	100	93	93	3637

Note: starter = 60 lbs P_2O_5 as 10-34-0

Table 2. Effect of metham on nutsedge, nightshade, cotton populations and soil phosphate.

Treatment	Rate per treated acre	Populations = 1/1000th of an acre at 37 DAT: Nutsedge	Nightshade	Cotton	Soil P 81 DAT
	gal/A				ppm
Blade only + starter	0	37.2	1.42	41.5	19.67
Metham	70	8.0	0	41.1	19.67
Metham + starter	70	7.0	0	38.4	21.00
Metham + Guano Plus	70	0.9	0	37.0	20.00
Metham + Guano Plus + starter	70	0.5	0	35.4	18.67
Metham + starter	50	3.0	0	42.9	23.33
LSD .05		27.29	---	5.89	NS
% C.V.		159.28	---	8.22	13.69

Note: starter = 60 lbs P_2O_5 as 10-34-0

Black nightshade control in cotton with metham. Ron Vargas. A fine sandy loam field, known to be infested with black nightshade was divided into plots that were 4. 38 in rows wide by 1300 ft long and replicated four times in a randomized complete block design. Metham was applied to preirrigated, preformed beds with a spray blade in an 8 in band on top of the bed. A soil cap was applied over the top of the treated area to seal the soil, preventing volatilization losses. Twenty one days after application, on May 4, Maxxa cotton was planted.

An evaluation on May 26 indicated effective control of black nightshade was obtained with all rates of metham, with the 50 GPA rate providing best control. There was no significant difference in cotton lint yield.

Table. Black nightshade control and cotton lint yield.

Treatments	GPA	Nightshade plants 1/1000/A 5/26	Lint yield lbs/A 11/3
1. Metham	12.5	33	1301
2. Metham	25	29	1338
3. Metham	50	17	1259
4. Control	--	144	1276
LSD .05		NS	NS
% CV		39.4	9.3

Weed control in fallow with different glyphosate formulations. Terry L. Neider and Donald C. Thill. A study was established in Nez Perce county, ID to evaluate weed control in fallow with different glyphosate formulations. The experimental design was a randomized complete block with four replications and individual plots were 8 by 25 ft. Glyphosate treatments were applied postemergence on March 21, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi (air temp. 71 F, relative humidity 73%, wind calm, cloudy sky, and soil surface temp. 68 F, 2 inch 57 F and 4 inch 55 F) to 8 inch standing stubble and 6 inch tall volunteer wheat. The soil was a silt loam (30% sand, 62% silt, 8% clay, pH 5.7 and 2.3% organic mater). Volunteer wheat control was evaluated May 5 and May 22, 1994.

Volunteer wheat control with MON 65005 alone at 0.14 lb/A was significantly higher at both evaluation times (84 and 88%) compared with glyphosate alone at 0.14 lb/A (45 and 48%). However, this difference was overcome with higher herbicide rates, addition of nonionic surfactant, or addition of nonionic surfactant and ammonium sulfate. A nonionic surfactant and ammonium sulfate were required with both glyphosate and MON 65005 at the 0.14 lb/A rate to achieve greater than 90% volunteer wheat control. Volunteer wheat control was 96 to 100% with glyphosate and MON 65005 at 0.28 and 0.38 lb/A rates alone or in combination with nonionic surfactant and/or ammonium sulfate. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Volunteer wheat control with different glyphosate formulations, Nez Perce county, ID.

Treatment[1]	Rate	5/5/94	5/22/94
	lb/A	%	
Glyphosate	0.14	45	48
MON 65005	0.14	84	88
Glyphosate + NIS	0.14	78	76
MON 65005 + NIS	0.14	80	83
Glyphosate + NIS + AMS	0.14	99	100
MON 65005 + NIS + AMS	0.14	97	100
Glyphosate	0.28	95	96
MON 65005	0.28	96	100
Glyphosate + NIS	0.28	97	100
MON 65005 + NIS	0.28	95	99
Glyphosate + NIS + AMS	0.28	99	100
MON 65005 + NIS + AMS	0.28	100	100
Glyphosate	0.38	96	99
MON 65005	0.38	98	100
Glyphosate + NIS	0.38	98	100
MON 65005 + NIS	0.38	97	100
Glyphosate + NIS + AMS	0.38	98	100
MON 65005 + NIS + AMS	0.38	100	100
Untreated Check		--	--
LSD (0.05)		7.5	9.4

[1]The RT formulation was used in all glyphosate treatments; NIS is an 80% nonionic surfactant applied at 0.5% v/v; AMS is ammonium sulfate applied at 17 lb/100 gal of spray solution.

Comparison of several adjuvants with glyphosate for weed control in fallow. Terry L. Neider and Donald C. Thill. Studies were established at separate locations in Nez Perce county, ID to evaluate weed control in fallow with several glyphosate adjuvant combinations. The experimental design at both locations was a randomized complete block with four replications and individual plots were 8 by 25 ft. Glyphosate treatments were applied postemergence March 28, 1994 at site one (air temp. 60 F, relative humidity 54%, wind NE at 5 mph, clear sky, and soil surface temp. 68 F, 2 inch 52 F, and 4 inch 50 F) and March 30, 1994 at site two (air temp. 50 F, relative humidity 65%, wind E at 5 mph, cloudy sky, and soil surface temp. 50 F, 2 inch 46 F, and 4 inch 46 F) to 6 inch standing stubble and 7 inch tall volunteer wheat. All treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi. The soil at site one was a silt loam (28% sand, 52% silt, 20% clay, pH 5.6, and 2.0% organic matter) and site two was a silt loam soil (30% sand, 62% silt, 8% clay, pH 5.7 and 2.3% organic matter). Volunteer wheat control was evaluated approximately 3, 14, and 21 days after glyphosate applications.

Volunteer wheat control was 98% or better for all treatments at site one by the May 25, 1994 evaluation. There were slight treatment differences at site two, but the level of volunteer wheat control for all treatments was 93% or better. A very light rain shower one hour after application at site two (0.05 inch of precipitation over a 6 hour period) may have contributed to the differences between sites. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Volunteer wheat control with several glyphosate adjuvant combinations, Nez Perce county, ID.

Treatment[1]	Rate[2]	Site 1			Site 2		
		5/3/94	5/16/94	5/26/94	5/5/94	5/16/94	5/26/94
	lb/A	%					
Glyphosate	0.28	28	95	99	15	89	93
Glyphosate	0.38	28	98	99	11	96	97
Glyphosate + Induce	0.28 + 0.25	29	97	98	14	92	97
Glyphosate + Induce	0.38 + 0.25	30	98	100	13	98	100
Glyphosate + HM8902	0.28 + 0.06	26	96	99	13	96	97
Glyphosate + HM8902	0.28 + 0.125	30	98	98	13	97	98
Glyphosate + HM8902	0.38 + 0.06	34	98	99	15	98	99
Glyphosate + HM8902	0.38 + 0.125	25	98	100	15	95	96
Glyphosate + HM9121A	0.28 + 0.25	26	99	100	14	97	98
Glyphosate + HM9121A	0.28 + 0.5	30	100	99	14	98	99
Glyphosate + HM9121A	0.38 + 0.25	29	97	100	15	99	99
Glyphosate + HM9121A	0.38 + 0.5	31	97	100	15	99	100
Glyphosate + HM9328	0.28 + 0.06	31	99	100	11	94	96
Glyphosate + HM9328	0.28 + 0.125	25	97	98	16	93	95
Glyphosate + HM9328	0.38 + 0.06	29	96	99	14	99	98
Glyphosate + HM9328	0.38 + 0.125	30	98	100	15	99	99
Glyphosate + HM9329	0.28 + 0.125	23	95	98	9	92	96
Glyphosate + HM9329	0.28 + 0.25	28	96	99	11	91	95
Glyphosate + HM9329	0.28 + 0.5	28	98	98	13	91	95
Glyphosate + HM9329	0.38 + 0.125	30	97	98	15	97	98
Glyphosate + HM9329	0.38 + 0.25	26	98	99	18	95	97
Glyphosate + HM9329	0.38 + 0.5	31	98	99	16	96	97
Untreated Check	----------	0	0	0	0	0	0
LSD (0.05)		NS	NS	NS	NS	4.4	2.2

[1]RT formulation of glyphosate was used in all treatments.

[2]adjuvants (Induce, HM8902, HM9121A, HM9328 and HM9329) rates are expressed as %v/v.

Weed control in established Kentucky bluegrass for seed production. Kathryn A. Hamilton, Terry L. Neider, Jerry Swenson, Donald C. Thill and Glen A. Murray. Two studies were initiated in the fall of 1993 on established Kentucky bluegrass to determine the effects of a range of herbicide treatments. The sites at Worley and Nezperce, Idaho were in the third seed year of Kentucky bluegrass variety "Banff" and "Classic", respectively. The residue was cut short (height 1 to 2 inches) using a plot size grass crew cutter, prior to trial establishment. The study was arranged as a randomized complete block design, replicated four times with 8 by 20 ft plots. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi on October 5 at Worley (air temp. 84 F, relative humidity 44%, wind NW at 5 mph, soil temp. 76 F and 75% cloud cover), and on October 6 at Nezperce (air temp. 62 F, relative humidity 60%, wind N at 2 mph, soil temp. 58 F and 60% cloud cover). The major weeds present at Worley were redstem filaree (EROCI), henbit (LAMAM), and prickly lettuce (LACSE) and henbit was the predominant weed at Nezperce. Weed control and crop injury were assessed visibly on March 29 at Nezperce and on March 31 at Worley. The number of panicles and seed yield were measured on June 23 and August 25 at Nezperce and on June 15 and August 25 at Worley, respectively.

The metolachlor + metribuzin treatment injured the bluegrass 73% at Nezperce and 33% at Worley (Table 1). Yields at Nezperce were reduced by the pendimethalin + metribuzin and the metolachlor + metribuzin treatments. The seed yields were not different at Worley. Metolachlor controlled weeds 40 and 85% at Worley and 73% at Nezperce (Table 2). The other herbicides controlled weeds 95% or greater. (Idaho Agricultural Experimental Station, University of Idaho, Moscow, ID 83844)

Table 1. Kentucky bluegrass injury, yield and panicle number as affected by herbicide treatments.

Treatment	Rate	Crop injury Nezperce	Crop injury Worley	Panicles Nezperce	Panicles Worley	Yield Nezperce	Yield Worley
	lb/A	%		no./ft²		lb/A	
Terbacil	0.4	0	0	221	266	542	410
Terbacil	0.8	19	3	188	261	368	319
Metribuzin	0.5	36	11	145	247	321	475
Pendimethalin[1]	3.0	1	16	189	163	510	294
Pendimethalin	2.0	5	13	176	246	466	450
+ metolachlor	1.0						
Metolachlor	2.0	43	14	159	173	285	397
Pendimethalin	3.0	15	5	251	269	325	377
+ terbacil	0.75						
Pendimethalin	3.0	51	19	107	237	186	364
+ metribuzin	0.5						
Metolachlor	2.0	73	33	125	283	263	412
+ metribuzin	0.5						
Untreated check	-	-	-	225	206	470	355
LSD(0.05)		26	12	131	99	174	189

[1] 3.3 EC formulation of pendimethalin

Table 2. Weed control in established Kentucky bluegrass for seed production.

Treatment	Rate	Worley EROCI	Worley LAMAM	Worley LACSE	Nezperce LAMAM
	lb/A	% of control			
Terbacil	0.4	95	100	100	100
Terbacil	0.8	100	100	100	98
Metribuzin	0.5	100	100	100	98
Pendimethalin[1]	3.0	100	100	100	100
Pendimethalin	2.0	100	100	100	100
+ metolachlor	1.0				
Metolachlor	2.0	40	85	85	73
Pendimethalin	3.0	100	100	100	100
+ terbacil	0.75				
Pendimethalin	3.0	100	100	100	100
+ metribuzin	0.5				
Metolachlor	2.0	100	100	100	100
+ metribuzin	0.5				
Untreated check	-	-	-	-	-
LSD(0.05)		9	5	5	12

[1] 3.3 EC formulation of pendimethalin

Weed control in Kentucky bluegrass with primisulfuron. Terry L. Neider and Donald C. Thill. A study was established in a Kentucky bluegrass field in Lewis county, ID to evaluate the efficacy of primisulfuron for weed control in bluegrass seed production. The bluegrass (var. South Dakota) was in the 7th year of seed production on a silt loam soil (42% sand, 52% silt, 6% clay, pH 6.1 and 6.8% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Primisulfuron was applied postemergence on April 29, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi (air temp. 66 F, relative humidity 58%, wind S at 4 mph, sky mostly clear, and soil surface temp. 68 F, 2 inch 42 F and 4 inch 40 F) to 5 inches of bluegrass regrowth and 1 to 4 inch weeds. Bluegrass injury was evaluated May 16 and June 10, bluegrass panicles and weed control were evaluated June 10, and bluegrass seed was harvested July 6, 1994. Catchweed bedstraw (GALAP) infestations were moderate, and corn gromwell (LITAR), interrupted windgrass (APEIN) and ventenata (VETDU) infestations were light but uniform throughout the experimental site.

Primisulfuron controlled catchweed bedstraw 90% or more, while corn gromwell, interrupted windgrass and ventenata were only controlled 23, 28 and 19%, respectively, at the highest primisulfuron rate. Kentucky bluegrass injury (stunting) increased as primisulfuron rate increased and was apparent throughout the growing season. However, panicle counts and seed yields were not different from the untreated check. (Plant Science Division, University of Idaho, Moscow, ID 83843)

Table. Kentucky bluegrass response and weed control with primisulfuron, Lewis county, ID.

		Bluegrass							
		Injury		Panicle	Seed	Weed control			
Treatment[1]	Rate	5/16/94	6/10/94	counts	yield	GALAP	LITAR	APEIN	VETDU
	lb/A	------ % -----		ft^2	lb/A	------------------ % ------------------			
Primisulfuron	0.009	4	10	204	539	90	9	21	13
Primisulfuron	0.018	9	14	208	502	98	15	24	15
Primisulfuron	0.027	10	18	199	573	100	16	25	15
Primisulfuron	0.036	20	26	192	409	100	23	28	19
Untreated Check	------	--	--	237	491	--	--	--	--
LSD (0.05)		9.1	7.2	NS	88	7.2	12.6	6.3	6.1

[1] R-11was an 80% nonionic surfactant applied at 0.25 % v/v with all primisulfuron treatments.

The effects of various herbicide applications on grass seed production and downy brome. Tom D. Whitson, M.E. Majerus, R.D. Hall, J.D. Jenkins and R.J. Swearingen. Various cool-season perennial grasses are grown for seed production in Wyoming and Montana. Downy brome is commonly a weed problem in grass seed production because it is difficult to obtain selective control and impossible to separate from grass seed in cleaning equipment. Two studies were extablished at Powell, Wyoming at the U.W. Experiment Station and Bridger Montana at the Bridger Plant Materials Center on March 10, 1992 and May 19-20, 1993, respectively.Seeding was on bedded land on 22 inch rows at both locations. Each treatment included 4 rows of perennial grasses and 2 rows of seeded downy brome. Plots were 11 x 25 ft arranged as randomized complete blocks with 4 replications. At the Powell location the following grasses were seeded: western wheatgrass (Rosana var.), beardless wildrye (Shoshone var.), thickspike wheatgrass (Critana var.), basin wildrye (Trailhead var.), slender wheatgrass (Pryor var.), and meadow bromegrass (Regar var.). At Bridger the following species were seeded: western wheatgrass (Rosana var.), Russian wildrye (Bozoisky Select var.), meadow bromegrass (Regar var.), thickspike wheatgrass (Critana var.), slender wheatgrass (Pryor var.) and beardless wildrye (Shoshone var.). Downy brome was seeded October 15, 1992 and October 17, 1993 in Powell and October 6, 1993 in Bridger. Herbicides were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 40 psi on November 16, 1994, October 27, 1993 and April 21, 1993 at Powell and on November 19, 1993 and April 22, 1994 at the Bridger location. Application information and growth stages are listed in Table 1.

Downy brome emergence was excellent at the Bridger location and poor at Powell, therefore perennial grass tolerance and yields were the only data taken at Powell while downy brome control data was taken at Bridger along with grass tolerance and yields. Grasses were only selected for harvest when they received a good downy brome control rating or were treated with glyphosate as a non-dormant application.

When downy brome control was averaged across grass species metribuzin at 0.25, 0.38 and 0.5 lb/A controlled 69, 96 and 97%, respectively. When metribuzin at 0.25 lb/A was combined with oxyfluorfen at 1.0 lb/A control was 92% while oxyfluorfen alone at 1.0 lb/A had 68% control. The two treatments applied after grasses had started growing included paraquat at 0.7 lb/A and glyphosate at 0.25 lb/A. Downy brome control with paraquat was 99.7% while with glyphosate control averaged 39% across all grass species.

Some grass species were less tolerant to herbicides than others, when grass seed yields were compared to the untreated control. Comparisons were made during the establishment year at Bridger, MT (when grasses were established in May 1993) and the second year of establishment (when grasses were established in March 1992) at Powell, WY (Tables 2,3,4,5,6,7,8). Seed production reductions by species and percentages of that reduction for each treatment are as follows:
paraquat at 0.7 lb/A - All grass production was reduced at least 50% when applications were made the first year of establishment. Applications made the 2nd year following establishment reduced all grasses from 35 to 95% depending on species.
glyphosate at 0.25 lb/A - Western wheatgrass, beardless wildrye and meadow brome had yield reductions of 44% or more when treated during the establishment year. When glyphosate was applied the second year after establishment; Russian wildrye, beardless wildrye and thickspike wheatgrass had reductions of seed production greater than 47%.
metribuzin + oxyfluorfen at 0.25+1.0 lb/A - Reductions of seed production from meadow brome and western wheatgrass were 39 and 52%, respectively during the establishment year. The second year reductions of 18 and 21%, respectively were found in Russian wildrye and beardless wildrye.
metribuzin at 0.25 lb/A - Reductions of 35% and 19%, respectively were found the first year of establishment in western wheatgrass and meadow brome. During the second year of establishment beardless wildrye and western wheatgrass had seed reductions of 33% and 22%, respectively.
metribuzin at 0.38 lb/A - Reductions of grass seed yields were only found in the establishment year for perennial grasses. Western wheatgrass and beardless wildrye had seed reductions of 38% and 22%, respectively.
metribuzin at 0.5 lb/A - Reductions during the establishment year in grass seed production for western wheatgrass, meadow brome and slender wheatgrass were 56%, 48% and 19%, respectively. Beardless wildrye had a seed reduction of 26% during the second year following establishment. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1704).

Table 1. Application Information

	Powell, WY[1]			Bridger, MT	
Date	11/16/92	10/27/93	4/21/94	11/19/93	4/22/94
Air temp.	55F	55F	70F	45F	75F
Wind speed & direction	0	0-5 mph NW	0-7 mph S	3-5 mph N	calm
Relative humidity	30%	50%	60%	60%	70%
Soil Temp.					
surface	52F	40F	65F	41F	82F
1 inch	56F	42F	60F	40F	70F
2 inches	55F	43F	70F	39F	67F
4 inches	60F	43F	80F	35F	65F
Crop stage	dormant 4-8 inches	dormant 4-8 inches	2-3 inch growth	2-3 inch dormant	2-3 inch growth
Weed stage	preemergent	preemergent	preemerngent	downy brome seedlings	downy brome 4-6 leaf
Moisture					
surface	good	good	good	good	good
subsoil	good	good	good	good	god
Equipment	10ft backpack	10ft backpack	10ft backpack	10ft backpack	10ft backpack
Incorporation	2 times harrow	2 times harrow	none	2 times roller harrow	None

[1] All applications were applied two successive years on the same treatment areas at the Powell location.

Table 2. Grass species: Pryor Slender Wheatgrass

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression	Powell, WY Seed Yield
		%					
Paraquat	0.7	100	98	89		58	791
Glyphosate	0.25	45	6	8	849	9	1042
Trifluralin	1.0	8	0	0		0	
Clomazone	0.25	36	0	0		0	
Pronamide	0.25	51	0	0		0	
Ethofumesate	0.75	60	1	0		0	
Pendimethylin	2.0	35	0	0		0	
Ethalfluralin	1.5	63	0	0		0	
Oxyfluorfen+metribuzin	1.0+0.25	87	0	0	829	0	1243
Oxyfluorfen	1.0	89	0	0	921	0	1504
Metribuzin	0.5	97	2	0	677	3	1208
Metribuzin	0.38	85	1	0	887	0	1264
Metribuzin	0.25	71	0	0	882	0	1250
Dicamba+atrazine	0.25+0.5	3	60	0		0	
Control					839		1220

Table 3. Grass species: Shoshone Beardless Wildrye

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression	Powell, WY Seed Yield
		%			lb/A	%	lb/A
Paraquat	0.7	100	100	100		100	8
Glyphosate	0.25	20	21	36	72	33	73
Trifluralin	1.0	13	5	0		0	
Clomazone	0.25	98	9	0		0	
Pronamide	0.25	34	10	0		0	
Ethofumesate	0.75	55	8	0		0	
Pendimethylin	2.0	46	4	0		0	
Ethalfluralin	1.5	60	3	0		0	
Oxyfluorfen+metribuzin	1.0+0.25	73	4	0	144	0	132
Oxyfluorfen	1.0	60	3	0	178	0	104
Metribuzin	0.5	96	0	0	211	0	124
Metribuzin	0.38	99	4	0	121	0	228
Metribuzin	0.25	66	1	0	195	0	111
Dicamba+atrazine	0.25+0.5	88	3	0		6	
Control					155		167

Table 4. Grass species: Critana Thickspike Wheatgrass

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression	Powell, WY Seed Yield
		%			lb/A	%	lb/A
Paraquat	0.7	98	98	92		79	82
Glyphosate	0.25	49	10	23	258	11	400
Trifluralin	1.0	31	1	0		0	
Clomazone	0.25	80	0	0		0	
Pronamide	0.25	79	0	0		0	
Ethofumesate	0.75	43	0	0		0	
Pendimethylin	2.0	70	0	0		0	
Ethalfluralin	1.5	46	0	0		0	
Oxyfluorfen+metribuzin	1.0+0.25	100	0	0	405	0	686
Oxyfluorfen	1.0	55	0	0	657	0	821
Metribuzin	0.5	98	0	0	568	0	815
Metribuzin	0.38	99	1	0	513	0	775
Metribuzin	0.25	55	0	0	574	0	814
Dicamba+atrazine	0.25+0.5	65	3	0		3	
Control					380		753

Table 5. Grass species: Regar Meadow Brome

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression	Powell, WY Seed Yield
		%			lb/A	%	lb/A
Paraquat	0.7	100	89	91		35	450
Glyphosate	0.25	43	8	24	497	490	
Trifluralin	1.0	25	1	0		0	
Clomazone	0.25	90	1	0		0	
Pronamide	0.25	65	0	0		0	
Ethofumesate	0.75	69	3	0		0	
Pendimethylin	2.0	35	0	0		0	
Ethalfluralin	1.5	83	0	0		0	
Oxyfluorfen+metribuzin	1.0+0.25	99	0	0	538	0	688
Oxyfluorfen	1.0	23	0	0	577	0	572
Metribuzin	0.5	94	1	0	458	0	783
Metribuzin	0.38	98	0	0	803	0	749
Metribuzin	0.25	70	0	0	714	0	755
Dicamba+atrazine	0.25+0.5	51	0	0		0	
Control					885		730

Table 6. Grass species: Rosana Western Wheatgrass

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression	Powell, WY Seed Yield
		%			lb/A	%	lb/A
Paraquat	0.7	100	94	69		32	175
Glyphosate	0.25	30	78	11	233	0	386
Trifluralin	1.0	21	8	0		0	
Clomazone	0.25	91	8	0		0	
Pronamide	0.25	93	6	0		0	
Ethofumesate	0.75	78	10	0		0	
Pendimethylin	2.0	45	5	0		0	
Ethalfluralin	1.5	83	4	0		0	
Oxyfluorfen+metribuzin	1.0+0.25	99	9	0	290	0	392
Oxyfluorfen	1.0	88	14	0	316	0	448
Metribuzin	0.5	95	8	0	270	0	485
Metribuzin	0.38	98	14	0	376	0	501
Metribuzin	0.25	59	3	0	394	0	282
Dicamba+atrazine	0.25+0.5	55	14	13		0	
Control					610		360

Table 7. Grass species: Basin Wildrye[1]

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Powell, WY Seed Suppression	Powell, WY Seed Yield
		----------	---------- %	----------	----------	lb/A
Paraquat	0.7				63	223
Glyphosate	0.25				11	219
Trifluralin	1.0				0	
Clomazone	0.25				0	
Pronamide	0.25				0	
Ethofumesate	0.75				0	
Pendimethylin	2.0				0	
Ethalfluralin	1.5				0	
Oxyfluorfen+metribuzin	1.0+0.25				0	354
Oxyfluorfen	1.0				0	318
Metribuzin	0.5				6	386
Metribuzin	0.38				0	386
Metribuzin	0.25				0	325
Dicamba+atrazine	0.25+0.5				0	
Control						229

[1] This grass species was not included at the Bridger, MT study site.

Table 8. Grass species: Bozoisky Russian Wildrye[1]

Herbicide	Rate lb ai/A	Bridger, MT Downy Brome Control	Bridger, MT Grass Damage	Bridger, MT Seed Suppression	Bridger, MT Seed Yield	Powell, WY Seed Suppression
		----------	%	----------	lb/A	%
Paraquat	0.7	100	98	100	0	
Glyphosate	0.25	45	25	66	79	
Trifluralin	1.0	1	39	0		
Clomazone	0.25	77	0	6		
Pronamide	0.25	78	1	0		
Ethofumesate	0.75	45	1	0		
Pendimethylin	2.0	30	1	0		
Ethalfluralin	1.5	88	0	10		
Oxyfluorfen+metribuzin	1.0+0.25	94	3	0	361	
Oxyfluorfen	1.0	93	0	0	498	
Metribuzin	0.5	99	0	0	484	
Metribuzin	0.38	97	3	0	417	
Metribuzin	0.25	92	0	5	429	
Dicamba+atrazine	0.25+0.5	79	5	8		
Control					439	

[1] This grass species was not included at the Powell study site

Meadowfoam tolerance to preemergence- and postemergence-applied herbicides. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. A trial was conducted at the Hyslop Agronomy Farm near Corvallis, OR to evaluate the tolerance of 'Floral' meadowfoam to several herbicide treatments. The trial design was a randomized complete block with four replications and 8 by 25 ft plots. Meadowfoam was seeded in 6-inch rows on October 12, 1993. The trial site became infested with ivyleaf speedwell, which emerged soon after the crop. A single-wheel compressed-air sprayer was used to deliver a broadcast spray of 20 gpa at 15 psi. Preemergence treatments were applied on October 14, and postemergence treatments were applied on November 16 to 2- to 3-leaf stage meadowfoam and cotyledon stage ivyleaf speedwell. The soil was a Woodburn silt loam with an organic matter content of 2.5% and a pH of 5.8.

The higher rate of metolachlor caused excessive injury to the meadowfoam and reduced seed yield. None of the other treatments caused a reduction in seed yield. Metolachlor and F-6285 provided good control of ivyleaf speedwell. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table. Meadowfoam injury and seed yield and ivyleaf speedwell control following herbicide applications, Corvallis, OR.

Treatment	Rate	Timing[1]	Meadowfoam Injury[2]	Meadowfoam Seed yield[3]	Ivyleaf speedwell control[2]
	(lb/A)		(%)	(lb/A)	(%)
metolachlor	1.0	PES	24	854	96
metolachlor	2.0	PES	63	562	99
F-6285	0.06	PES	9	841	91
F-6285	0.12	PES	13	837	97
ethofumesate	0.75	EPOE	0	846	10
ethofumesate	1.5	EPOE	0	863	10
clopyralid	0.125	EPOE	0	774	0
clopyralid	0.25	EPOE	0	788	0
check	0		0	792	0
			$LSD_{(0.05)}$	88	
			CV (%)	18.5	

[1] PES = preemergence surface, October 14, 1993
EPOE = early postemergence, November 16, 1993
[2] Visual evaluations February 7, 1994
[3] Harvested July 10, 1994

Weed control efficacy and peppermint tolerance of fertilizer-impregnated oxyfluorfen. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. Several spring and summer-germinating broadleaf weed species are not controlled consistently by registered soil-active herbicides in peppermint in Oregon. Although not fully documented, some of the problem seems to be herbicide resistance in some populations. Oxyfluorfen is registered on dormant mint, but may injure the crop if rates are sufficiently high to control summer-germinating weeds or if the mint is growing. Research was conducted to evaluate the efficacy and crop safety of oxyfluorfen applied on dry fertilizer in actively growing peppermint. The fertilizer was applied with a hand-held spin-spreader when the foliage was dry to allow it to drop through the mint canopy and, therefore, prevent foliar uptake.

Seven trials were conducted in Western and Central Oregon to evaluate the safety of impregnated-oxyfluorfen at 0.2 lb/A when applied in April when the mint was emerging to 6 inches tall. A trial at the Hyslop Agronomy Farm near Corvallis, OR was conducted to evaluate higher rates of oxyfluorfen applied on June 1. Two trials at the Hyslop Agronomy Farm were conducted to evaluate the control of broadleaf weeds in the absence of mint. The design for all of the trials was a randomized complete block with three replications. Plots were 8 ft by 20 or 25 ft. All but one furrow-irrigated trial were sprinkler irrigated. Soils ranged from clay loam to sandy loam and were moist to slightly muddy when the treatments were applied. Four hundred pounds of 16-16-16 fertilizer per acre were applied alone to the check plots or with oxyfluorfen to the treated plots.

Applications of fertilizer-impregnated oxyfluorfen did not affect the growth of mint foliage or mint oil yield at any of the seven sites in Western and Central Oregon (Table 1). No injury symptoms nor reduction in mint foliage or oil yield occurred following applications of oxyfluorfen at rates as high as 0.8 lb/A at the Hyslop Agronomy Farm (Table 2). Weed control varied by species (Table 3). Annual bluegrass was not controlled, and shepherdspurse and annual sowthistle were less effectively controlled than the other broadleaf species. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table 1. Mean peppermint fresh weight and oil yield from seven locations in Western and Central Oregon following application of oxyfluorfen as an impregnated treatment on fertilizer, 1994.

Treatment[1]	Rate	Peppermint[2] Fresh weight	Oil yield
	(lb/A)	(T/A)	(lb/A)
oxyfluorfen	0.2	17.3	67.2
check	0	17.2	67.0
	$LSD_{(0.05)}$	n.s.	n.s.

[1] Applied in April, 1994
[2] Harvested in July or August, 1994

Table 2. Peppermint fresh weight and oil yield following applications of oxyfluorfen impregnated on dry fertilizer, Corvallis, OR, 1994.

Treatment[1]	Rate	Peppermint Injury[2]	Fresh weight[3]	Oil Yield
	(lb/A)	(%)	(T/A)	(lb/A)
oxyfluorfen	0.2	0	16.8	55.7
oxyfluorfen	0.4	0	19.7	61.8
oxyfluorfen	0.8	0	17.2	62.8
check	0	0	18.4	61.5
		$LSD_{(0.05)}$	n.s.	n.s.

[1] Applied June 1, 1994; peppermint 18 to 24 inches tall.
[2] Evaluated June 21, 1994
[3] Harvested July 8, 1994

Table 3. Visual evaluations of weed control from oxyfluorfen at 0.2 lb/A applied on dry fertilizer in two trials near Corvallis, OR, 1994.

Weed control: Trial[1] (species)	(%)	Trial[2] (species)	(%)
Shepherdspurse	80	Powell amaranth	100
Annual sowthistle	85	Common lambsquarters	95
Lesser snapdragon	100	Lesser snapdragon	100
Annual bluegrass	13	Hairy nightshade	100
		Mayweed chamomile	100

[1] Applied April 12, 1994, weeds cotyledon to 1-leaf stage, evaluated June 1.
[2] Applied May 27, 1994; AMAPO cotyledon to 8 leaf, CHEAL 2 to 4 inches tall, ANTCO 2 inch diameter, SOLSA cotyledon to 4 leaf, ANTOR 4 to 6 leaf; evaluated June 20.

Broadleaf weed control in field potatoes. Richard N. Arnold, Eddie J. Gregory and Daniel Smeal. Research plots were established in April 18, 1994 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of potatoes (var. Snowden) and annual broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied after drag-off on May 10, 1994, and were immediately incorporated with 0.75 in of sprinkler applied water. Black nightshade, redroot and prostrate pigweed infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made June 10, 1994. Handweeded controls were hoed starting on May 20, about every two weeks until August 26, 1994. Potatoes were harvested on September 27, 1994 by harvesting 2 rows 5 ft long from the center of each plot, with a tractor-driven power digger. The harvested potatoes were then weighed and graded into sizes of 1 7/8 to 3 in and 3 in and bigger. Culls such as diseased or less than 1 7/8 in were not included.

Dimethenamid plus metribuzin at 1.25 plus 0.3 lb/A caused the highest injury rating of 6. Redroot pigweed control was excellent with all treatments except the check. Metolachlor II at all three rates gave poor control of prostrate pigweed. Black nightshade control was good to excellent with all treatments except metolachlor II at 0.975 lb/A and the check. All treatments yielded significantly more total cwt/A of total yield and 1 7/8-3 in than the check. All treatments had a significantly higher specific gravity than the check.

Table. Broadleaf weed control in field potatoes.

Treatment[1]	Rate	Crop Injury	Weed Control AMARE	AMABL	SOLNI	Total Yield	1 7/8-3 in	>3 in	SpGr[2]
	lb/A	------------%------------				----------cwt/A---------			no
Dimethenamid	0.75	0	100	79	88	640	407	165	1.097
Dimethenamid	1.0	0	100	87	97	678	470	131	1.096
Metolachlor	1.95	0	100	52	93	598	444	111	1.093
Dimethenamid + metribuzin	0.75+0.3	0	100	100	100	587	454	106	1.097
Dimethenamid + metribuzin	1.0+0.3	3	100	98	99	629	497	97	1.099
Dimethenamid + metribuzin	1.25+0.3	6	100	100	100	584	454	91	1.093
Metolachlor + metribuzin	1.46+0.3	0	100	100	100	598	443	57	1.095
Metolachlor + metribuzin	1.95+0.3	2	100	100	100	644	466	92	1.093
Metribuzin	0.3	0	100	98	93	584	515	66	1.091
Metribuzin	0.6	3	100	97	98	650	480	97	1.096
Dimethenamid	1.25	0	99	88	97	655	455	108	1.097
Metolachlor + metribuzin	0.975+0.3	0	99	100	100	629	490	58	1.098
Metolachlor	1.46	0	93	47	85	584	452	106	1.098
Metolachlor	0.975	0	92	20	77	598	432	108	1.097
Handweeded check		0	100	100	100	607	427	109	1.097
Check		0	0	0	0	303	254	8	1.085
Weeds/m^2			18	21	22				
LSD 0.05		2	3	18	11	126	98	77	0.005

1. The herbicide used was Metolachlor II.
2. SpGr = specific gravity.

Grain sorghum response to CGA-152005 tank-mixtures applied pre-emergence in a no-till system. Curtis R. Thompson and Alan J. Schlegel. Producers in southwest Kansas that use grain sorghum in dryland crop rotations can increase sorghum yields by planting no-till into wheat stubble. However, weed problems often discourage producers from utilizing a no-till system. This study was established near Tribune, Kansas to evaluate CGA-15005 as a pre-emergence (PRE) herbicide in no-till. Atrazine at 0.6 lb/a was broadcast applied to wheat stubble on September 10, 1993. Atrazine residual controlled all weed species, thus, no weed control rating were made. Plots were 10 by 25 ft with four replications arranged in a randomized complete block design. Herbicide treatments were applied with a CO_2 pressurized sprayer calibrated to deliver 20 gpa. Mycogen 'TE Edin' sorghum, CGA 92194 'Concept II' treated, was planted no-till with a John Deere Maximerge row crop planter May 20, 1994. Treatments were applied on May 22 (Table 1). Sorghum heading date was evaluated visually during August. Sorghum plants and heads were counted in two 20-ft rows of each plot October 10 and the same rows were harvested for grain yield October 26.

Table 1. Application, soil, and precipitation data.

Application date	5/22/94		
Application timing	Pre-emergence surface		
Air temperature (F)	55		
Soil surface moisture	Dry		
Soil pH	8.0		
OM (%)	1.0		
CEC	18.4 me/100g		
Texture	Silt loam		
Classification	Richfield, Aridic argiustolls		
Rainfall events > 0.25 in.	May	29	0.39
	June	9	0.73
		11	1.29
		19	0.26
		22	1.07
		23	0.37
		30	0.25

Rainfall events after June 30 are not presented.

Sorghum injury was not evident two weeks after herbicide application; however, injury was evident by late June (data not shown). Herbicide treatments had little affect on emergence and final plant stand (Table 2). This may be attributed to the delayed rainfall and herbicide activation following herbicide application. Rain received June 9 and 11 likely moved herbicides into the soil and activated the herbicides. All treatments that contained CGA-152005 delayed sorghum heading compared to untreated sorghum (Table 2). All sorghum treated with herbicides, except metolachlor&atrazine (& indicates commercial prepackaged mixture) at 1.8&0.9 lb applied alone, produced fewer heads than the did untreated sorghum. Sorghum untreated or treated with metolachlor&atrazine at 1.8&0.9 lb, metolachlor at 1.8 lb, or alachlor at 2.0 lb yielded more than did sorghum treated with CGA-152005. Grain from sorghum treated with CGA-152005 had lower test weight than did grain from untreated sorghum.

The May 20th planting date is an early planting date for grain sorghum. CGA-152005 delayed sorghum heading, which may have contributed to the lower sorghum test weight and yield. However, few heads were produced indicating that herbicide injury affected yield components. Alachlor&atrazine at 2.0&1.2 lb and metolachlor&atrazine at 1.8&1.4 lb without CGA-152005 reduced sorghum yield compared to alachlor or metolachlor indicating that atrazine at 1.2 lb or greater also injured sorghum. The soil characteristics, high pH and low organic matter, likely were a contributing factor to the sorghum response to CGA-152005. The results of this study suggest that further study is needed to determine the effects of soil characteristics on sorghum response to CGA-152005. (SW Res. Ext. Ctr., Kansas State Univ. Agric. Exp. Sta. Garden City, KS 67846)

Table 2. Grain sorghum response to CGA-152005 tank-mixtures applied pre-emergence in a no-till system, Tribune, Kansas.

Treatment[1]	Rate	Grain Yield[2]	Grain Moisture	Test weight	heads/ acre	plants/ acre	August heading date
	lb/a	bu/a	%	lb/bu	--- (X 1000) ---		
Untreated		76.3 a	14.7 de	58.3 ab	37 a	24 ab	12 e
Metolachlor	1.8	73.4 a	14.8 de	58.5 a	32 b	22 a-d	13 de
Meto + CGA-152005	1.8 0.009	61.9 b	15.7 bcd	57.4 bc	27 cd	24 abc	16 cd
Meto + CGA-152005	1.8 0.018	38.7 cd	16.4 b	57.3 bc	23 de	22 a-d	18 bc
Meto + CGA-152005	1.8 0.027	45.7 cd	16.7 b	57.0 cd	26 cde	25 a	19 ab
Meto&atra	1.8&1.4	49.0 c	16.0 bc	57.6 abc	22 e	21 bcd	14 de
Meto&atra	1.8&0.9	77.3 a	14.9 de	58.3 ab	34 ab	20 d	11 e
Meto&atra+ CGA-152005	1.8&0.9 0.009	35.7 d	16.6 b	57.1 cd	22 e	21 a-d	18 bc
Meto&atra+ CGA-152005	1.8&0.9 0.018	46.3 cd	16.8 b	56.6 cd	25 cde	23 a-d	19 ab
Alachlor	2.0	68.4 ab	14.5 e	58.5 a	30 bc	22 a-d	12 de
Alachlor+ CGA-152005	2.0 0.027	45.2 cd	17.8 a	56.2 d	24 de	22 a-d	22 a
Alac&atra	2.0&1.2	43.2 cd	15.2 cde	58.2 ab	26 cde	21 a-d	14 de
Alachlor+ Alac&atra CGA-152005	0.5 1.5&0.9 0.018	35.7 d	16.5 b	56.8 cd	24 de	20 cd	18 bc
LSD(.05) =		•	1.0	0.9	4	3	3
CV =		•	4.2	1.1	11	10	14

[1] & = commercial prepackaged mixture; meto = metolachlor; atra = atrazine; alac = alachlor.
[2] Yields were adjusted to 12.5% moisture. A covariate for bird damage and the LSmeans procedure was used for yield mean separations, thus, LSD and CV are not provided.

Economics of chemical and hand weeding combinations in sugarbeets. Don W. Morishita and Robert W. Downard. Combinations of chemical and hand weeding were compared for weed control efficacy and economic return in sugarbeets (var. WS-91). The experiment was conducted at the University of Idaho Kimberly Research and Extension Center on a silt loam soil with a pH of 8.0; 1.9% om. and CEC of 15 meq/100 g soil. Plots were 4 rows by 30 feet with four replications and treatments arranged in a randomized complete block design. Herbicides were applied in a 10-inch band with a CO_2 pressurized bicycle wheel plot sprayer. Additional application information is shown in Table 1. Visual evaluations for crop injury and weed control were made May 30 and June 23. 1994. Hand weeding cost for each treatment was determined by sampling the weed population density in each plot prior to hoeing and recording the time to hoe each plot. Hand weeding cost was then calculated by multiplying the hoeing time by a $5.50/hr wage. The cost per acre was determined from these calculations. Two center rows of each plot were harvested with a plot harvester October 11.

Table 1. Herbicide application information.

Application date	5/9	5/14	5/16	5/21
Application timing[1]	Cotyledon	2 leaf	Cotyl 7 d ltr	2 leaf 7 d ltr
Air temperature (F)	83	73	55	63
Soil temperature (F)	76	54	59	50
Relative humidity (%)	42	44	70	60
Wind speed (mph)	0-4	0	4-6	4-6
Weed species	common lambsquarters		kochia	hairy nightshade
Density (plants/ft^2)	5		4	1

[1]Cotyl- 7 d ltr = 7 days after cotyledon application; 2 leaf- 7 d ltr = 7 days after 2 leaf application.

Several herbicide treatments injured the sugarbeets. Greatest injury to the crop was with combinations of ethofumesate applied preemergence (PRE) followed by postemergence (POST) applications of phenmedipham & desmedipham. By the second evaluation date, crop injury ratings of all herbicide treatments were 5% or less. Common lambsquarters control, at the first evaluation, ranged from 80 to 100% with all herbicide treatments. Only ethofumesate applied PRE followed by hand weeding and phenmedipham & desmedipham applied POST with EPTC applied layby controlled common lambsquarters less than 80% at the second evaluation. Kochia was the most difficult weed to control in this experiment. At the first evaluation control ranged from 58 to 100%, while at the second evaluation, kochia control was as low as 18%. Where hand weeding was not included the most consistent kochia control was with combinations of a ethofumesate applied PRE followed by POST applications of phenmedipham & desmedipham. Redroot pigweed and hairy nightshade control ranged from 89 to 100% with all weed control treatments compared to the untreated check. Because of high weed pressure most treatments that did not include hand weeding had low yields. Ethofumesate applied PRE followed by two phenmedipham & desmedipham POST applications with or without EPTC layby were the only treatments without hand weeding that did not have low yields. All of the hand weeded treatments were among the highest yielding treatments. The treatments with the highest net dollar return included ethofumesate applied PRE followed by phenmedipham & desmedipham POST as all or part of the treatment. These data show that economic weed control can be achieved with total chemical weed control or combinations of chemical and hand weeding, but not hand weeding alone. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83303)

Table 2. Effect of chemical and hand weeding combinations on weed control, sugarbeet yield and net return, near Kimberly, Idaho.

					Weed control[1]							
Treatment[2]	Rate	Applic. timing	Crop injury 5/30	Crop injury 6/23	CHEAL 5/30	CHEAL 6/23	KCHSC 5/30	KCHSC 6/23	AMARE 6/23	SOLSA 6/23	Root yield	Net return
	(lb/A)		%								ton/A	$/A
Check			0	0	0	0	0	0	0	0	2	82
Hand weed			0	3	0	94	0	97	91	93	23	343
Ethofumesate	1.12	PRE	10	3	80	65	80	66	94	100	22	390
Hand weed												
Ethofumesate	1.12	PRE	15	1	100	100	97	100	100	100	27	860
Phen & Desm	0.33	1-2 leaf										
Hand weed												
Ethofumesate	1.12	PRE	20	5	100	100	100	96	100	100	25	845
Phen & Desm	0.33	1-2 leaf										
Phen & Desm	0.33	7 d later										
Ethofumesate	1.12	PRE	15	3	100	100	100	100	100	100	25	854
Phen & Desm	0.33	1-2 leaf										
Phen & Desm	0.33	7 d later										
EPTC	3.0	Layby										
Ethofumesate	1.12	PRE	3	1	98	98	91	100	100	100	26	789
Phen & Desm	0.33	1-2 leaf										
EPTC	3.0	Layby										
Hand weed												
Phen & Desm	0.33	Cotyl	8	1	94	84	78	58	100	93	10	317
Phen & Desm	0.33	7 d later										
Phen & Desm	0.20	Cotyl	3	0	100	93	95	76	100	95	16	554
Ethofumesate	0.20											
Phen & Desm	0.20	7 d later										
Phen & Desm	0.33	Cotyl	0	3	90	99	70	95	99	100	22	517
Phen & Desm	0.33	7 d later										
Hand weed												
Phen & Desm	0.33	Cotyl	0	1	85	78	68	53	96	89	8	257
Phen & Desm	0.33	7 d later										
EPTC	3.0	Layby										
Phen & Desm	0.33	Cotyl	0	1	86	95	69	96	99	100	21	480
Phen & Desm	0.33	7 d later										
EPTC	3.0	Layby										
Hand weed												
Phen & Desm	0.33	Cotyl	5	0	89	81	58	18	99	99	1	15
Phen & Desm	0.33	7 d later										
Trifluralin	0.5	Layby										
Phen & Desm	0.33	Cotyl	1	3	94	97	66	95	100	99	23	508
Phen & Desm	0.33	7 d later										
Trifluralin	0.5	Layby										
Hand weed												
LSD (.05)			7	4	6	9	12	19	6	6	6	294

[1]Weeds evaluated for control were common lambsquarters (CHEAL), kochia (KCHSC), redroot pigweed (AMARE), and hairy nightshade (SOLSA).
[2]Phen & Desm = phenmedipham and desmedipham preformulated mixture.

Weed control in sugarbeets with fall and spring preplant herbicides. Don W. Morishita and Robert W. Downard. A field experiment was established near Kimberly, Idaho to determine the effect of soil-applied herbicide applications on crop tolerance and weed control in sugarbeets (var. WS-91). The experimental design was a randomized complete block with four replications. Plots were 4 rows by 30 ft. Soil type was a silt loam with a pH 8.0, CEC of 15 meq/100 g soil, and 1.9% o.m. content. Fall preplant incorporated (PPI) treatments were applied November 11, 1993 and spring PPI applications were made April 15, 1994. All PPI treatments were incorporated with an Alloway band incorporator. Two sequential postemergence (POST) applications of desmedipham, phenmedipham, and ethofumesate tank mixture were made May 23 and 30 over all treatments except the check. All herbicides were applied in a 10-inch band with a CO_2 pressurized bicycle wheel sprayer. Application information is shown in Table 1. Crop injury and weed control were evaluated visually two times. The first evaluation was made before the POST applications on May 19. The second evaluation was taken June 23. Two rows from each plot were harvested with a plot harvester October 11.

Table 1. Application data information.

Application date	11/11/93	4/15/94
Air temperature (F)	41	58
Soil temperature (F)	37	44
Relative humidity (%)	100	58
Soil moisture	moist	dry

None of the treatments injured the crop more than 5% at either evaluation date. Prior to the POST application, common lambsquarters and kochia control ranged from 36 to 81%. Cycloate at 4.0 lb /A and metham sodium at 70 lb /A did not control common lambsquarters or kochia. Ethofumesate alone and in combination with cycloate applied in the fall most consistently controlled these two weed species. After the POST applications, all herbicide treatments controlled common lambsquarters 85 to 97%. Kochia control following the POST applications was variable. Metham sodium did not satisfactorily control kochia. Kochia control with all other treatments was not significantly different and ranged from 64 to 75%. Control of later emerging redroot pigweed and hairy nightshade ranged from 80 to 100% with all treatments. Sugarbeet root yields ranged from 4 ton/A in the check to 22 ton/A. All herbicide treatments yielded higher than the untreated check. There were no differences in yield among the herbicide treatments. (Dept. of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83303).

Table 2. Soil-applied herbicide applications for weed control in sugarbeets, near Kimberly, Idaho.

Treatment	Rate	Applic. timing	Crop injury 5/19	Crop injury 6/23	Weed control[1] CHEAL 5/19	CHEAL 6/23	KCHSC 5/19	KCHSC 6/23	SOLSA 6/23	AMARE 6/23	Root yield
	(lb/A)		%								ton/A
Check			0	0	0	0	0	0	0	0	4
Ethofumesate	0.75	fall	0	3	63	94	63	73	100	98	17
cycloate	2.0										
Ethofumesate	1.0	fall	0	3	69	95	71	66	98	99	17
cycloate	1.0										
Ethofumesate	1.0	fall	0	3	63	97	69	69	100	100	21
cycloate	1.5										
Ethofumesate	1.0	fall	0	4	73	93	71	71	100	100	18
cycloate	2.0										
Ethofumesate	1.5	fall	0	3	81	97	78	75	100	100	22
cycloate	1.0										
Ethofumesate	1.5	fall	1	4	80	93	75	73	100	100	16
cycloate	1.5										
Ethofumesate	2.0	fall	0	4	80	95	80	74	100	100	22
Cycloate	4.0	fall	0	0	40	93	36	68	99	99	18
Cycloate	4.0	fall	0	5	68	90	68	68	99	97	18
metham sodium	70										
Metham sodium	70	fall	1	0	63	85	43	48	95	80	14
Cycloate	3.0	spring	0	3	76	95	69	73	100	94	16
Ethofumesate	2.0	spring	0	3	80	94	70	69	100	100	19
Ethofumesate	1.0	spring	0	4	78	95	60	64	100	98	17
cycloate	2.0										
LSD (0.05)			NS	NS	14	7	17	17	5	5	6

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

Weed control in sugar beets with premixes of phenmedipham, desmedipham, and ethofumesate. Robert W. Downard and Don W. Morishita. A study near Aberdeen, Idaho was established to compare phenmedipham and desmedipham premix to phenmedipham, desmedipham and ethofumesate premix. Common lambsquarters (CHEAL) and hairy nightshade (SOLSA) were the weed species evaluated. Sugar beets (var. 'WS-91') were grown under sprinkler irrigation and planted April 18 on 22-inch rows. Soil type was a sand with a pH of 8.0 and 1.06% o.m. Plots were 4 rows wide by 30 ft. with four replications arranged in a randomized complete block design. A bicycle wheel sprayer applied the treatments in a 10 inch band at 20 gpa. Table 1 shows additional application data. Visual weed control and crop injury ratings were taken 2 and 4 weeks after the last treatment was applied.

On June 6 the premix phenmedipham, desmedipham and ethofumesate injury ranged from 1 to 6%, but was not significantly higher than the phenmedipham and desmedipham treatments. No treatments showed no injury 4 weeks after application (Table 2). All treatments resulted in good (86 to 97%) common lambsquarters control and excellent (90 to 99%) hairy nightshade control. Phenmedipham, desmedipham and ethofumesate premix did not control these weeds better than phenmedipham and desmedipham premix, when applied at the cotyledon growth stage. A single application of phenmedipham and desmedipham premix at the 2 leaf growth stage resulted in lower, but acceptable hairy nightshade control. (Department of Plant, Soil, and Entomological Science, University of Idaho, Twin Falls, ID 83301).

Table 1. Application information.

Application timing	Cotyledon		7 days later & 2 leaf	
Application date	5/10		5/18	
Air temperature (F)	79		64	
Soil temperature (F)	66		61	
Relative humidity (%)	42		50	
Wind velocity (mph)	0-10		8-12	
Weed species	CHEAL	SOLSA	CHEAL	SOLSA
Growth stage	cotyl-4 lf	cotyl-2 lf	1-2 in	cotyl-4 lf
Density (ft^2)	4	7	3	9

Table 2. Weed control and crop injury with phenmedipham, desmedipham and ethofumesate combinations, near Aberdeen, Idaho.

					Weed control[1]			
			Crop injury		CHEAL		SOLSA	
Treatment[2]	Rate	Growth stage	6/6	6/21	6/6	6/21	6/6	6/21
	lb/A		%					
Check			-	-	-	-	-	-
Pmp & Dmp	0.25	Cotyl	6	0	93	91	96	95
Pmp & Dmp	0.33	7d ltr						
Pmp & Dmp	0.33	Cotyl	4	0	96	95	98	99
Pmp & Dmp	0.33	7d ltr						
Pmp & Dmp	0.33	Cotyl	5	0	96	93	98	99
Pmp & Dmp	0.40	7d ltr						
Pmp & Dmp & Ethfmst	0.25	Cotyl	6	0	94	93	98	98
Pmp & Dmp & Ethfmst	0.33	7d ltr						
Pmp & Dmp & Ethfmst	0.33	Cotyl	6	0	94	97	93	97
Pmp & Dmp & Ethfmst	0.33	7d ltr						
Pmp & Dmp & Ethfmst	0.33	Cotyl	1	0	94	93	95	98
Pmp & Dmp & Ethfmst	0.40	7d ltr						
Pmp & Dmp + Ethofumesate	0.167 + 0.083	Cotyl	4	0	90	88	96	96
Pmp & Dmp + Ethofumesate	0.22 + 0.11	7d ltr						
Pmp & Dmp + Ethofumesate	0.22 + 0.11	Cotyl	3	0	94	93	96	96
Pmp & Dmp + Ethofumesate	0.266 + 0.133	7d ltr						
Pmp & Dmp	0.75	2 leaf	1	0	88	86	91	90
Pmp & Dmp + Ethofumesate	0.50 + 0.25	2 leaf	4	0	91	90	96	94
LSD (0.05)			NS	NS	NS	NS	NS	5

[1]CHEAL and SOLSA are Bayer codes for common lambsquarters and hairy nightshade, respectively.
[2]Pmp & Dmp - Phenmedipham and desmedipham premix
Pmp & Dmp & Ethfmst - phenmedipham and desmedipham and ethofumesate premix.
[3]Cotyl - cotyledon, 7d ltr - 7 days later

Velvetleaf control with herbicides for use in sugarbeets. R. F. Norris and J. A. Roncoroni. Velvetleaf is becoming a serious weed in sugarbeets and other crops in the Central Valley of California. Herbicides currently registered for selective weed control in sugarbeets do not control the weed. DPX-66037 has provided control of velvetleaf and sugarbeets have shown excellent tolerance to the herbicide. This trial was conducted to further evaluate herbicide mixtures and type of application on efficacy of velvetleaf control.

The experiment was conducted at the University of California farm on a Reiff fine sandy loam soil in which high population of velvetleaf existed. Beds, 30 in on center, were prepared and irrigated. In addition to velvetleaf the experiment also had a uniform population of common purslane and redroot pigweed. There were also scattered plants of black nightshade, tomatillo groundcherry, and common lambsquarters. Herbicide treatments (see tables) were applied with a hand held CO_2 pressurized sprayer applying 30 gal/A of spray solution. The experiment was laid out using a randomized complete block design. Plot size was 2 beds by 15 ft, and treatments were replicated 4 times. Treatments were initiated when the velvetleaf was in the cotyledon to very early 2-leaf stage of growth. Split applications were retreated after 5 days, and multiple applications were treated after a further 7 and 14 days. Irrigations following the first application caused a second cohort of velvetleaf to germinate, which was evaluated separately from the initial cohort. The velvetleaf growth stages were 1-3 leaf at the second application (7/26), and were up to 6 in tall (8/3) and up to 8 in tall (8/10) at the last two applications; previously treated plants were less than 4 in tall and had fewer than 3 to 4 leaves at these latter applications. The whole experiment was treated uniformly with 0.5 lb/A of sethoxydim to control grass weeds. Weed control was visually estimated on August 18, and counts and biomass samples were obtained from 1 m by 15 cm quadrats from each bed between August 25 and 28. Samples were oven dried and weighed.

Phenmedipham plus desmedipham, alone or tank-mixed with ethofumesate, did not control velvetleaf. Control of common purslane and redroot pigweed approached 100%. All rates of DPX-66037 provided almost complete control of the initial velvetleaf cohort. The single application of 0.5 oz/A did not completely kill the velvetleaf. DPX-66037 provided partial control of redroot pigweed, but showed minimal activity against common purslane. Any treatment that provided control of the initial cohort of weeds resulted in release of the later germinating cohort of velvetleaf, as demonstrated by negative control values in table 2. Multiple applications of DPX-66037 totalling 2.0 oz/A was the only treatment that controlled this late emerging cohort of velvetleaf. Split application of a tank-mix of DPX-66037 with a full label rate of phenmedipham plus desmedipham was the only treatment that provided complete control of the weed spectrum present. Based on previous work on selectivity of these herbicides to sugarbeets, the results of this experiment indicate that selective control of velvetleaf may be feasible in sugarbeets.

Vegetable Crops Department, Weed Science Program, University of California, Davis, CA 95616.

Table 1. Control of early germinating velvetleaf (ABUTH 1st), later germinating velvetleaf (ABUTH 2nd), and common purslane (POROL) by phenmedipham plus desmedipham or DPX-66037 alone or tank-mixed, or with phenmedipham plus desmedipham tankmixed with ethofumesate.

	Dates of herbicide treatments.				Visually estimated weed control (8/19)			Velvetleaf density	
Herbicide treatment	7/21	7/26	8/3	8/10	ABUTH (1st)	ABUTH (2nd)	POROL	ABUTH (1st)	ABUTH (2nd)
	Rate[a]				%			Plants/m	
Phenmedipham + desmedipham	0.425	0.425			0±0	63±8	99±1	10.0±4.1	6.8±1.7
Phenmedipham + desmedipham	0.65	0.65			8±5	33±12	98±3	11.0±2.1	7.8±1.4
(Phenmedipham + desmedipham) + ethofumesate	0.425 + 0.21	0.425 + 0.21			5±5	53±9	98±3	13.3±2.5	12.3±2.9
(Phenmedipham + desmedipham) + ethofumesate	0.65 + 0.325	0.65 + 0.325			23±9	60±10	96±2	6.8±1.1	9.3±2.3
DPX-66037	0.5				92±2	3±3	43±8	3.5±1.2	16.5±3.8
DPX-66037	0.25	0.25			96±2	38±17	10±7	0.0±0.0	17.5±4.7
DPX-66037	0.125	0.125	0.125	0.125	97±2	45±13	28±9	0.0±0.0	14.5±2.8
DPX-66037	1.0				98±2	45±17	13±8	0.3±0.3	14.8±2.8
DPX-66037	0.5	0.5			100±0	55±20	28±21	0.0±0.0	14.8±2.7
DPX-66037	0.25	0.25	0.25	0.25	100±0	90±4	53±11	1.3±1.3	9.5±3.0
DPX-66037	2.0				99±1	59±12	23±13	0.0±0.0	9.5±1.6
DPX-66037	1.0	1.0			100±0	65±9	33±14	0.0±0.0	18.8±4.6
DPX-66037	0.5	0.5	0.5	0.5	100±0	96±1	60±10	0.0±0.0	3.8±0.9
DPX-66037 + (phenmedipham + desmedipham)	0.5 + 0.45	0.5 + 0.45			93±5	20±12	73±21	1.0±0.4	14.5±3.5
DPX-66037 + (phenmedipham + desmedipham)	0.5 + 0.65	0.5 + 0.65			98±1	0±0	97±2	2.0±1.1	18.3±7.4
Untreated control	-				43±8	63±13	25±14	11.5±3.3	7.5±1.9
	$LSD_{0.05}$				10	32	31	4.6	9.1

[a] = Rates of DPX-66037 are in oz/A; rates of all other herbicides are in lb/A. All DPX-66037 treatments included 1 qt/A Scoil[R]

Table 2. Response of early germinating velvetleaf (ABUTH 1st), later germinating velvetleaf (ABUTH 2nd), common purslane (POROL), and redroot pigweed plus other weeds (AMARE +) to phenmedipham plus desmedipham or DPX-66037 alone or tank-mixed, or with phenmedipham plus desmedipham tankmixed with ethofumesate.

Herbicide treatment	Dates of herbicide treatments. 7/21	7/26	8/3	8/10	ABUTH (1st) Biomass	control	ABUTH (2nd) Biomass	control	POROL Biomass	control	AMARE + Biomass	control	Total weeds Biomass	control
	Rate[a]				g/m	%	g/m	%	g/m	%	g/m	%	g/m	
Phenmedipham + desmedipham	0.425	0.425			89.8 ± 45.3	-445	1.0 ± 0.2	15	0.8 ± 0.4	99	1.2 ± 1.1	99	192.7 ± 45.9	19
Phenmedipham + desmedipham	0.65	0.65			184.2 ± 63.0	-429	1.3 ± 0.3	-13	0.0 ± 0.0	100	1.5 ± 1.5	99	187.0 ± 62.5	22
(Phenmedipham + desmedipham) + ethofumesate	0.425 + 0.21	0.425 + 0.21			145.6 ± 33.2	-318	1.6 ± 0.5	-35	0.0 ± 0.0	100	0.5 ± 0.2	100	147.7 ± 33.1	38
(Phenmedipham + desmedipham) + ethofumesate	0.65 + 0.325	0.65 + 0.325			117.1 ± 23.4	-236	1.7 ± 0.9	-50	0.6 ± 0.6	99	5.3 ± 5.3	96	124.7 ± 21.0	48
DPX-66037	0.5				7.8 ± 3.0	78	3.9 ± 1.1	-238	34.3 ± 4.3	59	53.5 ± 29.1	55	99.5 ± 33.1	58
DPX-66037	0.25	0.25			0.0 ± 0.0	100	10.7 ± 4.6	-830	84.2 ± 20.8	-1	27.8 ± 12.4	77	122.6 ± 21.6	49
DPX-66037	0.125	0.125	0.125	0.125	0.0 ± 0.0	100	4.9 ± 1.7	-326	48.1 ± 23.1	42	25.2 ± 13.8	79	78.2 ± 31.5	67
DPX-66037	1.0				0.8 ± 0.8	98	3.3 ± 1.2	-185	73.2 ± 22.6	12	36.1 ± 16.7	70	113.4 ± 24.7	52
DPX-66037	0.5	0.5			0.0 ± 0.0	100	2.1 ± 0.5	-80	88.0 ± 39.2	-6	7.6 ± 2.9	94	97.7 ± 37.3	59
DPX-66037	0.25	0.25	0.25	0.25	0.1 ± 0.1	100	2.5 ± 1.5	-117	36.3 ± 4.6	56	5.4 ± 3.0	95	44.3 ± 5.8	81
DPX-66037	2.0				0.0 ± 0.0	100	1.6 ± 0.6	-35	50.5 ± 9.6	39	6.9 ± 5.6	94	58.9 ± 7.2	75
DPX-66037	1.0	1.0			0.0 ± 0.0	100	3.1 ± 0.9	-170	58.2 ± 11.2	30	14.7 ± 5.3	88	75.9 ± 13.1	68
DPX-66037	0.5	0.5	0.5	0.5	0.0 ± 0.0	100	0.4 ± 0.1	70	31.3 ± 13.2	62	8.2 ± 3.1	93	39.8 ± 11.7	83
DPX-66037 + (phenmedipham + desmedipham)	0.5 + 0.45	0.5 + 0.45			14.1 ± 7.5	59	7.1 ± 2.7	-520	17.0 ± 15.8	80	2.4 ± 1.7	98	40.6 ± 19.4	83
DPX-66037 + (phenmedipham + desmedipham)	0.5 + 0.65	0.5 + 0.65			9.4 ± 4.2	73	12.1 ± 2.6	-954	0.2 ± 0.2	100	0.2 ± 0.1	100	22.0 ± 6.7	91
Untreated control	-				34.8 ± 9.5	0	1.2 ± 0.6	0	83.1 ± 23.7	0	119.2 ± 57.6	0	238.2 ± 48.5	0
	$LSD_{0.05}$				58.4		4.4		46.5		44.9		78.7	

[a] = Rates of DPX-66037 are in oz/A; rates of all other herbicides are in lb/A. All DPX-66037 treatments included 1 qt/A Scoil®

Herbicide combinations for sugarbeets. Carl E. Bell and Phil Odom. This project was an evaluation of combinations of desmedipham/phenmedipham and DPX-66037 compared to each herbicide applied alone for postemergence weed control and phytotoxicity in sugarbeets. Research was conducted in a cooperative grower's field near Brawley, CA.

Experimental design was a randomized complete block with four replications. Plot size was 2 beds, each 0.75 m wide, by 4.6 m. The crop was sown in one seedline per bed in early October, 1993 and irrigated by furrow for germination. Soil type was clay loam. Herbicide treatments were made sequentially, when the crop was in the 2 to 4 leaf stage and 7 days later on October 20 and 27, 1993. Applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 280 L/ha. DPX-66037 treatments, when applied alone, included crop oil concentrate surfactant at 1% v/v. Weeds present at treatment were nettleleaf goosefoot, curly dock, little mallow, annual yellow sweetclover, and junglerice. Visual estimates of curly dock control were made on October 28 and November 2, 1993 and April 18, 1994; little mallow and annual yellow sweetclover control on October 28, 1993; crop phytotoxicity on October 22, October 28, and November 2, 1993; and crop vigor on November 17, 1993. Results are shown in the Table below.

According to the visual evaluations, all herbicide treatments controlled curly dock, little mallow, and annual yellow sweetclover very well throughout the season. Crop injury, evaluated as phytotoxicity and crop vigor, was excessive for the higher dosage rate treatments of desmedipham/phenmedipham, with and without DPX-66037. (Cooperative Extension, University of California, Holtville, CA 92250 and AgrEvo Chemical Co., Phoenix, AZ 85044.)

Table. Combinations of desmedipham/phenmedipham and DPX-66037 for postemergence weed control in sugarbeet.

Treatment[1]	rate	Weed control[2] RUMCR 10/28	RUMCR 11/2	RUMCR 4/18/94	MALPA 10/28	LOTSC 10/28	Phytotoxicity[3] 10/22	10/28	11/2	Vigor[4] 11/17
	g ha^{-1}	%								
DPX-66037	7	79	91	93	79	79	1.75	1.0	0.5	9.5
DPX-66037	14	76	98	95	91	83	1.75	0.75	1.0	9.0
Des/Phen	280	88	100	93	79	93	2.25	1.25	1.25	8.5
Des/Phen	560	95	100	79	83	93	2.5	2.5	3.25	6.25
Des/Phen + DPX-66037	280 / 7	91	100	93	93	95	2.25	1.5	1.5	8.0
Des/Phen + DPX-66037	280 / 14	96	100	83	79	93	2.25	2.5	3.25	6.75
Des/Phen + DPX-66037	560 / 7	96	99	79	91	96	2.25	1.75	3.0	8.25
Des/Phen + DPX-66037	560 / 14	96	100	61	95	95	2.75	2.75	3.25	5.75
Untreated control		0	0	0	0	0	0	0	0	9.0

[1] Treatment; Des/Phen - desmedipham + phenmedipham.

[2] RUMCR - curly dock; MALPA = little mallow; LOTSC = annual yellow sweetclover.

[3] Phytotoxicity, 0 = no injury, 10 = all plants dead.

[4] Vigor, 10 = most vigorous crop growth, 0 = no growth.

DPX-66037 and desmedipham/phenmedipham combinations in sugarbeets. Carl E. Bell and Jeff Pacheco. This project was an evaluation of desmedipham/phenmedipham and DPX-66037 applied alone or in various combinations for postemergence weed control and phytotoxicity in sugarbeets. Research was conducted at the University of California Desert Research and Extension Center in Holtville, CA.

Experimental design was a randomized complete block with four replications. Plot size was 2 beds, each 1 m wide, by 7.6 m. The crop was sown in two seedlines per bed on September 15, 1993 and irrigated with sprinklers on the same day. Initial crop germination was good, but damping off killed many of the emerged sugarbeet seedlings in a random pattern. Herbicide treatments were made twice: when the crop was in the cotyledon to 2 leaf stage on September 27 and 7 days later on October 4. Applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 280 L/ha. DPX-66037 treatments, when applied alone, included crop oil concentrate surfactant at 1% v/v. Soil type was a clay loam. Weeds present at treatment were nettleleaf goosefoot and junglerice. Data collected were: visual estimates of weed control and crop phytotoxicity on October 4 and 11. Results are shown in the Table below.

According to visual evaluations, all herbicide treatments controlled nettleleaf goosefoot very well. Junglerice control was more variable, although the combination treatments appeared to work better than either herbicide applied alone. Crop phytotoxicity was evident, but not commercially unacceptable from any treatment, however, it did increase with increasing rate. (Cooperative Extension, University of California, Holtville, CA 92250 and DuPont Chemical Co., Phoenix, AZ 85044.)

Table. Desmedipham/phenmedipham and DPX-66037 applied alone or in combination for postemergence weed control in sugarbeet.

		Weed control[2]					
		CHEMU control		ECHCO control		Phytotoxicity[3]	
Treatment[1]	rate	Oct. 4	Oct. 11	Oct. 4	Oct. 11	Oct. 4	Oct. 11
	$g\ ha^{-1}$	----	----	% ----	----		
DPX-66037	7	99	100	96	66	1.75	0.75
DPX-66037	11	98	100	95	91	1.5	1.0
DPX-66037	14	99	99	93	73	2.0	1.0
Des/Phen	280	100	100	79	73	1.75	1.25
Des/Phen	560	100	100	85	85	3.0	2.25
Des/Phen + DPX-66037	280+ 7	100	100	95	85	1.5	1.5
Des/Phen + DPX-66037	280+11	100	100	95	85	1.75	1.5
Des/Phen + DPX-66037	280+14	100	100	91	98	2.75	2.5
Des/Phen + DPX-66037	560+ 7	100	100	98	99	2.5	2.25
Des/Phen + DPX-66037	560+11	100	100	95	98	2.5	2.0
Des/Phen + DPX-66037	560+14	100	100	95	98	2.5	2.25
Untreated control		0	0	0	0	0	0

[1] Treatment; Des/Phen - desmedipham + phenmedipham.

[2] CHEMU - nettleleaf goosefoot; ECHCO = junglerice.

[3] Phytotoxicity, 0 = no injury, 10 = all plants dead.

Combinations of DPX-66037, desmedipham/phenmedipham, and cycloate in sugarbeets. Carl E. Bell and Jeff Pacheco. This project was designed to evaluate the possible interaction of a preplant incorporated application of cycloate combined with the postemergence applications of desmedipham/phenmedipham and DPX-66037 on weed control and phytotoxicity in sugarbeets. Research was conducted at the University of California Desert Research and Extension Center in Holtville, CA.

Experimental design was a randomized complete block with four replications. Plot size was 4 beds, each 1 m wide, by 7.6 m. Cycloate was applied at 4.4 kg ha^{-1} to the bed tops and mechanically incorporated with a power-driven tiller to a depth of 8 cm immediately prior to sowing. The crop was sown in two seedlines per bed on September 15, 1993 and irrigated with sprinklers on the same day. Initial crop germination was good, but damping off killed many of the emerged sugarbeet seedling in a random pattern. Postemergence herbicide treatments were made twice when the crop was in the cotyledon to 2 leaf stage on September 27, and 8 days later on October 5. All applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 280 L/ha. DPX-66037 treatments, when applied alone, included either a non-ionic surfactant at 0.5% v/v or crop oil concentrate at 1% v/v. Soil type was clay loam. Weeds present were nettleleaf goosefoot and junglerice. Data collected were visual estimates of weed control and crop phytotoxicity on October 4 and 11. Results are shown in the Table below.

According to visual evaluations, all herbicide treatments controlled nettleleaf goosefoot very well. Junglerice control was more variable, although the cycloate treatments appeared to work better than either postemergence herbicide applied alone. Crop phytotoxicity was evident, particularly the treatments that included both cycloate and desmedipham/phenmedipham. (Cooperative Extension, University of California, Holtville, CA 92250 and DuPont Chemical Co., Phoenix, AZ 85044.)

Table. Desmedipham/phenmedipham and DPX-66037 applied alone, in combination, and with cycloate for postemergence weed control in sugarbeet.

Treatment[1]	Rate	Weed control[2] CHEMU control Oct. 4	Oct. 11	ECHCO control Oct. 4	Oct. 11	Phytotoxicity[3] Oct. 4	Oct. 11
	g ha^{-1}	%					
Cycloate + DPX-66037 + NI	11	100	100	100	99	1.5	1.75
Cycloate + DPX-66037 + CO	11	100	100	99	100	2.25	1.75
Cycloate + Desmedipham/phenmedipham + DPX-66037	370 11	100	100	100	100	3.0	3.25
Cycloate + Desmedipham/phenmedipham	370	100	100	99	99	3.5	3.0
DPX-66037 + NI	11	96	99	85	76	1.25	0
DPX-66037 + CO	11	100	100	93	93	2.25	1.25
Desmedipham/phenmedipham + DPX-66037	370 11	100	100	98	99	2.25	2.25
Desmedipham/phenmedipham	370	100	100	85	79	1.5	1.25
Untreated control		0	0	0	0	0	0

1 Treatment; Cycloate was applied at 4.4 kg ha^{-1} prior to planting and mechanically incorporated with a power-driven tiller to 8 cm; NI = nonionic surfactant 0.5% v/v, CO = crop oil concentrate at 1% v/v.

2 CHEMU - nettleleaf goosefoot; ECHCO = junglerice

3 Phytotoxicity, 0 = no injury, 10 = all plants dead.

Combinations of DPX-66037, endothall, and desmedipham/phenmedipham in sugarbeets. Carl E. Bell and Jeff Pacheco. This project was an evaluation of DPX-66037, endothall, and desmedipham/phenmedipham applied alone or in various combinations for postemergence weed control and phytotoxicity in sugarbeets. Research was conducted in a cooperative grower's field near El Centro, CA.

Experimental design was a randomized complete block with four replications. Plot size was 2 beds, each 1 m wide, by 7.6 m. The crop was sown in two seedlines per bed in late September, 1993 and irrigated by furrows for germination. Herbicide treatments were made once when the crop was in the 4 leaf stage on October 12. Applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 170 L/ha. DPX-66037, applied alone, included crop oil concentrate surfactant at 1% v/v. Soil type was clay loam. Weeds present at treatment were little mallow and nettleleaf goosefoot. Data collected were visual estimates of weed control, crop vigor, and crop phytotoxicity on October 18 and November 17. Results are shown in the Table below.

According to visual evaluation, herbicide treatments that included desmedipham/phenmedipham and the combination treatment of DPX-66037 plus endothall controlled nettleleaf goosefoot very well. Neither DPX-66037 nor endothall controlled nettleleaf goosefoot when applied alone. Little mallow control was more variable, although the combination treatments appeared to work better than any herbicide applied alone. Crop phytotoxicity was evident, but not commercially unacceptable from any treatment, except the combination of desmedipham/phenmedipham plus DPX-66037. Crop vigor was not reduced unacceptably by any treatment. (Cooperative Extension, University of California, Holtville, CA 92250 and DuPont Chemical Co., Phoenix, AZ 85044.)

Table. Combinations of DPX-66037, endothall, and desmedipham/phenmedipham for postemergence weed control in sugarbeet.

		Weed control[2]				
		MALPA		CHEMU	Phyto[3]	Vigor[4]
Treatment[1]	rate	Oct. 18	Nov.17	Nov.17	Oct. 18	Nov. 17
	g/ha	%				
Des/Phen	840	50	85	100	1.75	8.25
DPX-66037	14	58	79	0	0.75	9.25
Endothall	840	31	21	35	1.0	9.0
Des/Phen	840					
+ DPX-66037	14	93	95	100	3.0	8.5
Des/Phen	840					
+ Endothall	840	27	95	99	1.25	9.0
DPX-66037	14					
+ Endothall	840	58	82	99	1.5	8.5
Untreated control		0	0	0	0	9.25

[1] Treatment; Des/Phen - desmedipham + phenmedipham.

[2] MALPA - little mallow, CHEMU - nettleleaf goosefoot

[3] Phyto = Phytotoxicity; 0 = no injury, 10 = all plants dead.

[4] Vigor; 10 = most vigorous growth, 0 = no growth.

Broadleaf herbicides applied postemergence in sugarbeets. Carl E. Bell and Phil Odom. This project was an evaluation of desmedipham/phenmedipham compared to co-formulations of desmedipham/phenmedipham with ethofumasate and DPX-66037 for postemergence weed control and phytotoxicity in sugarbeets. NA307 and NA308 are co-formulations of desmedipham, phenmedipham, and ethofumasate; CQ1451 is a co-formulation of Desmedipham/Phenmedipham + ethofumasate + DPX-66037. Research was conducted in a cooperative grower's field near Brawley, CA.

Experimental design was a randomized complete block with four replications. Plot size was 2 beds, each 0.75 m wide, by 4.6 m. The crop was sown in one seedline per bed in early October, 1993 and irrigated by furrow for germination. Soil type was clay loam. Herbicide treatments were made in two schemes: sequentially, when the crop was in the 2 to 4 leaf stage and 7 days later on October 20 and 27; or once, when the crop was in the 4 leaf stage on October 27. Applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 280 L/ha. Weeds present at treatment were nettleleaf goosefoot, curly dock, annual sweetclover, wild beet (*Beta maritima*) and junglerice. Visual estimates of curly dock control were made on October 28 and November 2, 1993 and April 18, 1994; junglerice control on October 28, 1993; crop phytotoxicity on October 22, October 28, and November 2, 1993; and crop vigor on November 17, 1993. Results are shown in the Table below.

According to the visual evaluations, all herbicide treatments which began at the early stage of growth (2 to 4 leaf) controlled curly dock very well throughout the season. Treatments at the later stage did not work as well, even though the application rate was higher. Junglerice control was more variable. Sugarbeet phytotoxicity was evident, but not commercially unacceptable from most treatments. Three treatments which utilized the higher application rates of NA305, NA308 and CQ1451 were the most phytotoxic. Crop vigor appeared to be inversely proportional to phytotoxicity ratings. (Cooperative Extension, University of California, Holtville, CA 92250 and AgrEvo Chemical Co., Phoenix, AZ 85044.)

Table. Desmedipham/phenmedipham and co-formulations of desmedipham/phenmedipham with ethofumasate and DPX-66037 for postemergence weed control in sugarbeet.

			Weed control[4]				Phytotoxicity[5]			Vigor[6]
			RUMCR			ECHCO				
Treatment[1]	Rate[2]	Timing[3]	10/28	11/2	4/18/94	10/28	10/22	10/28	11/2	11/17
	g ha^{-1}		%							
Des/Phen	280,370	1	95	98	99	58	2.75	1.0	1.75	8.75
Des/Phen	420,560	1	85	98	99	46	1.75	2.0	2.5	7.0
NA305	280,370	1	98	99	99	69	2.0	1.5	2.0	8.5
NA305	420,560	1	98	100	99	61	3.0	2.75	3.5	6.0
NA307	280,370	1	88	98	98	42	2.0	1.25	1.25	9.0
NA307	420,560	1	95	100	99	58	2.5	1.25	1.5	8.0
NA308	280,370	1	91	100	92	21	2.75	1.25	2.25	8.75
NA308	420,560	1	98	100	99	66	2.5	2.25	3.25	6.75
CQ1451	280,370	1	93	100	99	35	2.5	1.5	2.0	7.5
CQ1451	420,560	1	91	100	99	76	2.5	2.0	3.0	6.75
Des/Phen +	187,247									
ethofum	93,123	1	98	100	96	66	2.25	1.25	2.25	8.5
Des/Phen +	280,370									
ethofum	140,185	1	96	100	99	58	3.25	2.5	3.0	6.5
Des/Phen	840	2	0	91	58	0	0	0	1.0	9.0
Des/Phen +	560									
ethofum	280	2	0	100	38	0	0	0	2.0	8.25
Untreated control			0	0	0	0	0	0	0	9.5

[1] Treatment; Des/Phen - desmedipham + phenmedipham; NA307 and NA308 are co-formulations of desmedipham, phenmedipham, and ethofumasate; CQ1451 is a coformulation of Desmedipham/Phenmedipham + ethofumasate + DPX-66037.

[2] First value is rate for the first application, second is for the sequential application.

[3] Timing: 1 = applied at the 2 to 4 leaf stage of growth on October 20, 1993, followed by a treatment 7 days later on October 27; 2 = Applied at the 2-4 leaf stage of growth on October 27, 1993.

[4] RUMCR - curly dock; ECHCO = junglerice.

[5] Phytotoxicity, 0 = no injury, 10 = all plants dead.

[6] Vigor, 10 = most vigorous crop growth, 0 = no growth.

Postemergence broadleaf herbicide evaluation in sugarbeets. Carl E. Bell and Phil Odom. This project was an evaluation of desmedipham/phenmedipham compared to co-formulations of desmedipham/phenmedipham with ethofumasate and DPX-66037 for postemergence weed control and phytotoxicity in sugarbeets. NA307 and NA308 are co-formulations of desmedipham/phenmedipham, and ethofumasate; CQ1451 is a co-formulation of desmedipham/phenmedipham + ethofumasate + DPX-66037. Research was conducted at the University of California Desert Research and Extension Center in Holtville, CA.

Experimental design was a randomized complete block with four replications. Plot size was 4 beds, each 1 m wide, by 7.6 m. The crop was sown in two seedlines per bed on September 15, 1993 and irrigated with sprinklers on the same day. Initial crop germination was good, but damping off killed many of the emerged sugarbeet seedlings in a random pattern. Herbicide treatments were made under two schemes; sequentially, when the crop was in the cotyledon to 2 leaf stage on September 27 and 7 days later on October 4; or once, when the crop was in the 2 to 4 leaf stage on October 8. Applications were made with a CO_2 pressured sprayer at 140 kPa, using 8003LP nozzles for a spray volume of 280 L/ha. Soil type was a clay loam. Weeds present at treatment were nettleleaf goosefoot and junglerice. Data collected were visual estimates of weed control and phytotoxicity to sugarbeet on October 4 and 11. Results are shown in the Table below.

According to visual evaluations, all herbicide treatments which began at the early stage of growth (cotyledon) controlled nettleleaf goosefoot very well. Treatments at the later stage did not work as well, even though the application rate was higher. Junglerice control was more variable, although the same efficacy pattern was apparent from the early treatments. Crop injury was evident, but not commercially unacceptable from any treatment. (Cooperative Extension, University of California, Holtville, CA 92250 and AgrEvo Chemical Co., Phoenix, AZ 85044.)

Table. Desmedipham/phenmedipham and co-formulations of desmedipham/phenmedipham with ethofumasate and DPX-66037 for postemergence weed control in sugarbeet.

			Weed control[4]					
			CHEMU control		ECHCO control		Phytotoxicity[5]	
Treatment[1]	rate[2]	Timing[3]	Oct. 4	Oct. 11	Oct. 4	Oct. 11	Oct. 4	Oct. 11
	g ha^{-1}		%					
Des/Phen	280,370	1	100	100	93	93	1.25	1.5
Des/Phen	420,560	1	100	100	96	88	2.0	1.5
NA305	280,370	1	100	100	88	91	1.5	1.5
NA305	420,560	1	100	100	95	99	2.5	2.5
NA307	280,370	1	100	100	69	58	1.75	1.25
NA307	420,560	1	100	100	73	79	1.5	1.5
NA308	280,370	1	100	100	93	91	1.75	1.25
NA308	420,560	1	100	100	66	95	1.5	1.5
CQ1451	280,370	1	100	100	38	88	1.5	1.5
CQ1451	420,560	1	100	100	42	95	2.0	1.75
Des/Phen + ethofumasate	187,247 93,123	1	100	100	69	50	2.25	1.25
Des/Phen + ethofumasate	280,370 140,185	1	100	100	58	91	2.0	2.0
NA308	216,216,216	1,2	100	100	35	88	1.5	0.75
NA308	327,327,327	1,2	100	100	38	98	2.25	1.75
Des/Phen	840	2	0	76	0	45	0	1.75
Des/Phen + ethofumasate	560 280	2	0	58	0	21	0	1.75
Untreated control			0	0	0	0	0	0

[1] Treatment; Des/Phen - desmedipham + phenmedipham; NA307 and NA308 are co-formulations of desmedipham, phenmedipham, and ethofumasate; CQ1451 is a co-formulation of desmedipham/phenmedipham + ethofumasate + DPX-66037.

[2] First value is rate for the first application, second is for the sequential application.

[3] Timing: 1 = applied at the cotyledon stage of growth on September 27, 1993, followed by a treatment 7 days later on October 4; 2 = Applied at the 2-4 leaf stage of growth on October 8, 1993.

[4] CHEMU - nettleleaf goosefoot; ECHCO = junglerice.

[5] Phytotoxicity, 0 = no injury, 10 = all plants dead.

Canada thistle control in spring wheat with F-8426 and clopyralid. Katheryn M. Christianson, Calvin G. Messersmith, and Rodney G. Lym. Canada thistle is an important weed problem in North Dakota. Canada thistle is increasing in North Dakota following wet growing conditions in both 1992 and 1993. The purpose of this research was to evaluate F-8426 and various herbicide combinations for Canada thistle control and effect on crop yield.

The experiment was established at Fargo in a moderately dense Canada thistle stand. Fertilizer was added according to soil test and incorporated. 'Vance' hard red spring wheat was seeded on May 12, 1994. Herbicides were applied when Canada thistle plants were in the 4- to 6-leaf rosette stage using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 ft, and the experiment was in a randomized complete block design with four replications. Canada thistle control evaluations were based on a visual estimate of percent stand reduction as compared to the control. Wheat was harvested on August 18, 1994.

		Days after treatment			
Treatment	Rate	15	30	60	Yield
	— lb/A —		% control		lb/A
F-8426	0.031	13	10	7	1290
F-8426 + X-77 + 28% N	0.031+0.25%+2%	0	0	0	1280
Clopyralid + 2,4-D[a]	0.09+0.50	76	80	72	1440
Clopyralid + 2,4-D[a]	0.13+0.67	89	94	93	1440
F-8426 + clopyralid + 2,4-D[a]	0.023+0.09+0.50	84	89	88	1460
F-8426 + clopyralid + 2,4-D[a]	0.0231+0.13+0.67	78	85	83	1415
F-8426 + clopyralid + 2,4-D[a]	0.031+0.09+0.50	76	76	69	1410
F-8426 + clopyralid + 2,4-D[a]	0.031+0.13+0.67	84	94	90	1420
F-8426 + 2,4-D ester	0.023+1	73	53	38	1290
F-8426 + 2,4-D ester	0.031+1	82	73	65	1295
2,4-D ester	1	73	73	75	1215
Control		0	0	0	1265
LSD (0.05)		16	23	25	191

[a]Commercial formulation - Curtail.

F-8426 applied alone or with an adjuvant did not control Canada thistle or increase yield compared to the untreated control (Table). F-8426 applied with clopyralid plus 2,4-D provided similar control to clopyralid plus 2,4-D alone. Treatments that included clopyralid plus 2,4-D averaged greater than 80% Canada thistle control, and wheat yield increased nearly 200 lb/A compared to the control. Canada thistle control with 2,4-D ester was not enhanced when applied with F-8426. Treatments that included 2,4-D ester averaged 67% control, but wheat yield was similar to the control. No crop injury was observed with any treatment. Wheat yield was reduced compared to the long-term average for the county due to head blight. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Difenzoquat soluble granule formulation and adjuvant study in spring wheat. Robert W. Downard and Don W. Morishita. Research plots were located near Declo, Idaho to evaluate crop tolerance and wild oat (AVEFA) control in spring wheat (var. 'Penewawa'). The crop was planted on April 28. Soil type was a silt loam with a pH of 7.8, CEC 18 meq/100 g soil and 1.65% o.m. A bicycle wheel sprayer broadcast applied the herbicides at 10 gpa. Table 1 shows additional application data. Wild oat densities at application were 25 plants/ft^2 at the 2 to 4 leaf growth stage. Plot size was 8 by 25 feet with four replications arranged in a randomized complete block design. Visual crop injury and wild oat control evaluations were taken on June 9 and July 11 and plots were harvested on August 18.

Slight crop injury ranging from 4 to 6%, was observed at the June 9 evaluation. However, wheat injury was not visible in any treatment on July 11 (Table 2). On June 9 wild oat control with imazamethabenz at 0.23 lb/A plus difenzoquat SG at 0.5 lb/A with either nonionic surfactant or Sun-it II controlled wild oat better than either difenzoquat formulation. This difference in control also was seen on July 11. These two treatments were also the highest yielding. The difenzoquat SG forumulation, alone or in combination with broadleaf herbicides, had lower wild oat control than the liquid concentrate difenzoquat or diclofop. This may partly be due to the excessive agitation required to get the granules into solution. Wild oat control with diclofop was poor due to a short rain storm shortly after application. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83301).

Table 1. Application data.

Application date	5/16	5/25
Application timing	1-3 leaf	3-5 leaf
Air temperature (F)	56	74
Soil temperature (F)	52	60
Relative humidity (%)	78	43
Wind velocity (mph)	0	3

Table 2. Crop injury, wild oat control, and wheat yield near Declo, Idaho.[1]

Treatment	Rate	Applic. timing	Crop injury 6/9	Crop injury 7/11	AVEFA control 6/9	AVEFA control 7/11	Grain yield
	lb/A		%				bu/A
Check			0	0	0	0	36
Difenzoquat	1.0	3-5 lf	6	0	43	60	47
Difenzoquat SG + NIS[2]	1.0 +	3-5 lf	4	0	13	5	34
Difenzoquat SG + Sun-it II[3]	1.0 +	3-5 lf	0	0	18	16	34
Imazamethabenz+ difenzoquat SG + NIS	0.23+ 0.5 +	3-5 lf	0	0	68	86	51
Imazamethabenz + difenzoquat SG + Sun-it II	0.23 + 0.5 +	3-5 lf	0	0	64	84	48
Difenzoquat SG + thif & trib[4] + MCPA-Ester + NIS	1.0 + 0.25 + 0.25 +	3-5 lf	0	0	8	6	33
Diclofop	1.0	1-3 lf	1	0	44	66	50
LSD (0.05)			3	NS	20	14	9

[1]AVEFA is the Bayer code for wild oat.
[2]NIS = nonionic surfactant added at 0.5% v/v.
[3]Sun it II added at 1 q/A.
[4]thif & trib = thifensulfuron and tribenuron.

Wild oat control with diclofop and broadleaf herbicide tank mixtures. Robert W. Downard and Don W. Morishita. This study evaluated the effect growth regulator and benzo nitrile herbicides had on wild oat control when tank mixed with diclofop and thifensulfuron. Plots were 8 by 25 feet with four replications arranged in a randomized complete block design. Soil type was a silt loam with a pH of 7.8, CEC of 16 meq/100 g soil, and 1.65% o.m. A bicycle wheel sprayer broadcast applied the herbicides at 10 gpa. Table 1 shows additional application information. Wild oat density at the time of application was 23 plants/ft^2. They were at the 1- to 3-leaf growth stage. Visual weed control and crop injury evaluations were taken on June 9 and July 11 and the crop was harvested on August 18 with a small-plot combine.

No treatment injured the wheat more than 3% (Table 2). All treatments had poor to fair (30 to 71%) wild oat control. This was partly due to a rain storm one-half hour after application. Wild oat control on the June 9 evaluation was reduced with diclofop at 1.0 lb/A plus thifensulfuron at 0.0188 lb/A and dicamba at 0.058 lb/A compared to most other treatments. The lower rate of this combination also reduced wild oat control. The reduction in wild oat control was a result of adding dicamba to the tank mixture. All diclofop plus thifensulfuron and MCPA tank mixtures, except for diclofop plus thifensulfuron at 0.0187 lb/A and MCPA at 0.0818 lb/A, increased wild oat control on June 9. On the second evaluation only two tank mixtures of diclofop plus thifensulfuron and MCPA increased wild oat control. Diclofop plus thifensulfuron at 0.0156 lb/A and bromoxynil at 0.27 lb/A also increase wild oat control on July 11. All treatments except diclofop at 1.0 lb/A plus thifensulfuron at 0.0188 lb/A and dicamba at 0.058 lb/A had yields higher than the check. Dicamba at 0.058 lb/A plus thifensulfuron at 0.0156 lb/A reduced wild oat control enough to lower grain yields when compared to diclofop alone or in combination with thifensulfuron. All other treatments did not substantially reduce or increase yields when compared to diclofop alone. The tank mixtures of diclofop plus thifensulfuron and MCPA or diclofop plus bromoxynil did not have a negative effect on wild oat control. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83301).

Table 1. Application information.

Application date	5/16
Air temperature (F)	56
Soil temperature (F)	52
Relative humidity (%)	78
Wind velocity (mph)	0

Table 2. Crop injury, wild oat control, and wheat yield near Declo, Idaho.

Treatment	Rate	Crop injury 6/9	Crop injury 7/11	AVEFA control[1] 6/9	AVEFA control[1] 7/11	Grain yield
	lb/A	%	%	%	%	bu/A
Check		0	0	0	0	32
Diclofop	1.0	0	0	56	69	49
Diclofop + thifensulfuron	1.0 + 0.0156	0	0	50	61	45
Diclofop + thifensulfuron + MCPA DF	1.0 + 0.0156 + 0.0343	3	0	58	65	46
Diclofop + thifensulfuron + MCPA DF	1.0 + 0.0156 + 0.0681	0	0	66	70	49
Diclofop + thifensulfuron + MCPA DF	1.0 + 0.0187 + 0.0412	0	0	66	71	50
Diclofop + thifensulfuron + MCPA DF	1.0 + 0.0187 + 0.0818	0	0	55	66	45
Diclofop + thifensulfuron + dicamba	1.0 + 0.0156 + 0.0493	0	0	39	59	43
Diclofop + thifensulfuron + dicamba	1.0 + 0.0188 + 0.058	0	0	30	55	39
Diclofop + thifensulfuron + bromoxynil gel	1.0 + 0.0071 + 0.125	0	0	55	68	44
Diclofop + thifensulfuron + bromoxynil gel	1.0 + 0.0156 + 0.27	0	0	53	74	45
LSD (0.05)		1	NS	18	NS	8

[1]AVEFA is Bayer code for wild oat.

Weed control in winter wheat with bentazon. Terry L. Neider and Donald C. Thill. A study was established in Nez Perce county, ID to evaluate the efficacy of bentazon for weed control in winter wheat. Triallate was applied at 1.25 lb/A and incorporated with a tillage operation prior to seeding winter wheat (var. Stevens) on October 20, 1993. The soil was a silt loam (34% sand, 56% silt, 10% clay, pH 5.4, and 5.7% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied postemergence on April 4, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi to 4 leaf wheat with 2 tillers and 1 to 2 inch weeds. Environmental conditions were as follows: air temp. 60 F; relative humidity 63%; wind calm; sky mostly clear; and soil surface temp. 65 F, 2 inch 58 F, and 4 inch 50 F. Winter wheat injury, and field pennycress (THLAR), mayweed chamomile (ANTCO) and volunteer pea (PISSA) control were evaluated visually April 21 and May 22, 1994. Winter wheat was harvested with a small plot combine on July 22, 1994.

All herbicide treatments controlled mayweed chamomile 99 to 100%. Bentazon applied at 1.0 lb/A with crop oil concentrate and bentazon plus bromoxynil combinations controlled field pennycress 98 to 100% by May 22, 1994, whil bentazon applied at 0.5 or 0.75 lb/A alone or in combination with crop oil concentrate controlled field pennycress 83 to 96%. Bentazon alone had little effect on volunteer pea, but bentazon plus bromoxynil combinations controlled voluntee pea 80 to 100%. Wheat was injured 5% or less on April 21, 1994 and wheat grain yields from bentazon plus bromoxyn treated plots tended to be the lowest. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Winter wheat response and weed control with bentazon treatments, Nez Perce county, ID.

		Wheat			Weed Control					
		Injury		Grain	THLAR		ANTCO		PISSA	
Treatment[1]	Rate	4/21/94	5/22/94	yield	4/21/94	5/22/94	4/21/94	5/22/94	4/21/94	5/22/94
	lb/A	%		bu/A	%					
Bentazon	0.5	0	0	79	50	83	100	100	8	0
Bentazon	0.75	0	0	77	86	94	100	100	3	0
Bentazon	1.0	0	0	80	89	96	98	100	5	3
Bentazon + coc	0.5	0	0	77	65	89	100	99	8	0
Bentazon + coc	0.75	1	0	80	80	91	100	100	15	0
Bentazon + coc	1.0	1	0	82	96	99	100	100	10	0
Bentazon + bromoxynil	0.5 0.19	4	0	78	98	98	100	100	84	80
Bentazon + bromoxynil	0.75 0.19	1	0	77	94	100	100	100	93	95
Bentazon + bromoxynil	1.0 0.19	5	0	79	100	100	100	100	93	100
Bentazon + bromoxynil	0.5 0.25	3	0	79	99	100	100	100	95	100
Bentazon + bromoxynil	0.75 0.25	4	0	79	97	100	100	100	71	100
Bentazon + bromoxynil	1.0 0.25	5	0	79	100	100	100	100	93	100
Thifen/triben + bromoxynil	0.016 0.25	5	0	82	96	100	100	100	96	100
Untreated check		--	--	76	--	--	--	--	--	--
LSD (0.05)		NS	NS	NS	14.5	4.8	NS	NS	20.3	10.3
plants/ft²					6		2		4	

[1]Crop oil concentrate (coc) was applied at 2.5% v/v; Thifen/triben was applied as a commercial formulation of thifensulfuron/tribenuron with an 80% nonionic surfactant applied at 0.25% v/v.

Broadleaf weed control in winter-wheat with bromoxynil combinations. Terry L. Neider and Donald C. Thill. A study was established in Whitman county, WA to evaluate broadleaf weed control in winter wheat with different bromoxynil combinations. Triallate was applied at 1.25 lb/A and incorporated with a tillage operation prior to seeding winter whea (var. Madsen) on October 14, 1993. The soil was a silt loam (20% sand, 70% silt, 10% clay, pH 6.1 and 3.9% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 l 30 ft. Herbicides were applied April 16, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi to 5 leaf wheat with 3 tillers and 1 inch weeds. Environmental conditions were as follows: air temp. 86 F; relative humidi 50%; wind calm; partly cloudy sky; and soil surface temperature 88 F, 2 inch 56 F, and 4 inch 54 F. Field pennycress, (THLAR), shepherd's purse (CAPBP), and henbit (LAMAM) control, and wheat injury were evaluated visually on Ma 3 and June 2, 1994. Winter wheat was harvested with a small plot combine on August 8, 1994.

Bromoxynil plus metribuzin wheat injury (8% chlorosis) was visable May 3, but the injury was not visible by June 2, 1994. All herbicide treatments controlled field pennycress 100% by June 2, 1994. Bromoxynil/MCPA plus metribuzin and thifensulfuron/tribenuron treatments effectively controlled shepherd's purse and henbit. Shepherd's purse and henb control was less with bromoxynil applied alone than all other treatments. Wheat yields were variable and yields from herbicide treated plots were not different from the untreated check. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Winter wheat response and weed control with herbicide treatments, Whitman county, WA.

		Wheat			Weed control					
		Injury		Grain	THLAR		CAPBP		LAMAM	
Treatment[1]	Rate	5/3/94	6/2/94	yield	5/3/94	6/2/94	5/3/94	6/2/94	5/3/94	6/2/94
	lb/A	%		bu/A	%					
Bromoxynil	0.375	0	0	112	98	100	87	80	74	75
Bromoxynil/MCPA	0.75	0	0	103	99	100	94	91	76	83
Thifen/triben	0.016	0	0	109	95	100	86	98	84	90
Bromoxynil + thifen/triben	0.187 0.016	0	0	106	98	100	94	100	79	91
Bromoxynil + thifen/triben	0.25 0.016	0	0	101	100	100	98	98	85	89
Bromoxynil/MCPA + thifen/triben	0.375 0.016	0	0	111	100	100	95	100	85	94
Bromoxynil/MCPA + thifen/Triben	0.5 0.016	0	0	106	100	100	97	100	83	91
MCPA ester + thifen/Triben	0.23 0.016	0	0	98	97	100	93	100	88	93
Bromoxynil/MCPA metribuzin	0.25 0.14	8	1	112	100	100	100	95	99	95
Untreated check	------	--	--	103	--	--	--	--	--	--
LSD (0.05)		1.4	NS	NS	NS	NS	7.4	8.4	10.7	6.8
plants/ft					4		6		4	

[1]Bromoxynil/MCPA was applied as a commercial formulation, Thifen/triben was applied as a commercial formulation of thifensulfuron/tribenuron with an 80% nonionic surfactant applied at 0.25% v/v.

Safening of winter wheat to chloroacetamide herbicides with a herbicide antidote. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. Chloroacetamide herbicides control many grass weed species, but can cause too much injury to wheat when applied as a preemergence treatment. Two trials were conducted at the Hyslop Agronomy Farm near Corvallis, OR to evaluate the safening effect of fluxofenim seed treatment on wheat treated preemergence with three chloroacetamides. The first trial was seeded on October 12, 1993, and the second on November 8. The second trial was seeded late to insure cool, wet soil conditions to obtain maximum injury from the herbicides. The trial design was a split block with three replications and 8 by 45 ft plots. Fluxofenim-treated and non-treated wheat seeds were planted in strips across each replication. A single-wheel, compressed-air sprayer was used to deliver a broadcast spray of 20 gpa at 15 psi. The soil was a Woodburn silt loam with a pH of 5.3%, an organic matter content of 2.5, and a CEC of 20. The main weeds that infested the trial sites--annual bluegrass, shepherdspurse, and common chickweed--were largely controlled by all of the herbicide treatments, but were dense enough to reduce yields in the untreated check in the October-seeded trial.

Visual injury ratings were higher in the later-seeded trial regardless of whether or not the antidote was used (Table 1). Wheat grown from antidote-treated seed was injured less than wheat grown from untreated seed with all herbicide treatments in both trials. The greatest benefit in grain yield from the seed treatment occurred at the higher rates in the later seeding (Table 2). Wheat yield in plots treated with metolachlor at 4 lb/A was over 100 bu/A higher with antidote than without in the November 8 seeding. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table 1. Visual evaluations of wheat injury from chloroacetamide herbicides applied preemergence to seed treated with the antidote fluxofenim, Corvallis, OR, 1993-94.

		Wheat injury			
		October 12 seeding[1]		November 8 seeding[2]	
Treatment	Rate	Antidote[3]	No antidote	Antidote[3]	No antidote
	lb/A	(%)			
acetochlor[4]	0.25	3	17	10	18
acetochlor	0.5	12	25	20	50
acetochlor	1	20	40	27	82
acetochlor	2	32	57	65	98
dimethenamid	0.375	17	25	10	25
dimethenamid	0.75	25	43	18	43
dimethenamid	1.5	40	57	43	83
dimethenamid	3	67	82	60	95
metolachlor	0.5	7	20	0	10
metolachlor	1	10	23	13	42
metolachlor	2	27	50	15	83
metolachlor	4	47	73	38	96
check	0	0	0	0	0

[1] Evaluated February 8, 1994
[2] Evaluated February 28, 1994
[3] Wheat seed treated with fluxofenim at 0.03% w/w
[4] Acetochlor formulated with dichlormid

Table 2. Grain yield from two seedings of wheat, with and without seed treatment with the herbicide antidote fluxofenim, following applications of chloroacetamide herbicides, Corvallis, OR, 1993-94.

		Wheat grain yield[1]			
		October 12 planting		November 8 planting	
Treatment	Rate	Antidote[2]	No antidote	Antidote[2]	No antidote
	lb/A	(%)			
acetochlor[3]	0.25	148	153	152	137
acetochlor	0.5	152	152	153	135
acetochlor	1	149	149	143	79
acetochlor	2	148	148	127	37
dimethenamid	0.375	149	148	145	126
dimethenamid	0.75	149	142	141	118
dimethenamid	1.5	134	122	131	73
dimethenamid	3	106	69	91	13
metolachlor	0.5	146	153	152	147
metolachlor	1	151	149	139	121
metolachlor	2	144	134	144	88
metolachlor	4	139	113	128	22
check	0	112	127	139	141
$LSD_{(0.05)}$ for seed treatment for same or different herbicide treatment		13		20	

[1] Wheat harvested July 17, 1994
[2] Wheat seed treated with fluxofenim at 0.03% w/w
[3] Acetochlor formulated with dichlormid

Comparison of dicamba formulations applied in combination with sulfonylurea herbicides in winter wheat. Terry L. Neider and Donald C. Thill. Studies were established in Benewah and Latah county, ID to evaluate different dicamba formulations applied in combination with sulfonylurea herbicides. Triallate was applied at 1.25 lb/A and incorporated with a tillage operation prior to seeding winter wheat on October 12 at site one and October 14, 1993 at site two. The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft at both locations. Herbicide treatments were applied postemergence with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi (Table 1). Wheat injury was evaluated visually two and five weeks after treatment, and weed control was evaluated visually five weeks after treatment at both locations. The dominant weeds species at site one were field pennycress (THLAR), mayweed chamomile (ANTCO), volunteer lentils (LENCU), and henbit (LAMAM); and field pennycress, henbit, and common lambsquarters (CHEAL) at site two. Winter wheat was harvested with a small plot combine on August 5 at site one and August 11, 1994 at site two.

Table 1. Application and soil data.

	Site one	Site two
County	Benewah	Latah
Crop stage	5 leaf/2 tiller	4 leaf/3 tiller
Variety	Madsen	Stevens
Weed stage	1 to 2 inch	1 to 2 inch
Air temp. (F)	66	64
Relative humidity (%)	45	58
wind (mph/direction)	3/W	3/NW
Sky	mostly clear	partly cloudy
Soil surface temp. (F)	68	72
2 inch	62	66
4 inch	58	58
Soil texture	silt loam	silt loam
Sand (%)	26	29
Silt (%)	62	59
Clay (%)	12	12
Organic matter (%)	3.2	4.4
pH	4.9	5.8

Winter wheat was injured (chlorosis) 6% or less two weeks after treatment and the injury was not visible five weeks after treatment. All herbicide treatments controlled common lambsquarters and field penneycress 95 to 100%. SAN-854H treatments were comparable to dicamba treatments. Yields from herbicide treated plots ranged from 76 to 82 bu/A and were not different from the untreated check. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table 2. Winter wheat response and weed control with herbicide treatments, Benewah and Latah county, ID.

		Wheat[2]							
		Injury	Injury	Grain	Weed Control[2]				
Treatment[1]	Rate	2 WAT	5 WAT	yield	THLAR	LAMAM	ANTCO	LENCU	CHEAL
		------ % ------		bu/A	--------------------------- %			-------------------------	
Dicamba + 2,4-D	0.125 + 0.356	4	0	76	99	85	90	100	99
Dicamba + MCPA	0.125 + 0.375	2	0	81	100	84	91	98	98
SAN-854H + 2,4-D	0.125 + 0.356	4	0	80	100	90	98	99	100
SAN-854H + MCPA	0.125 + 0.375	3	0	80	100	90	100	100	98
Thifen/triben	0.0078	1	0	78	99	94	98	94	100
Thifen/triben	0.0156	1	0	79	100	93	100	93	95
Tribenuron	0.006	0	0	82	99	95	98	94	95
Tribenuron	0.012	0	0	81	100	94	96	93	99
Dicamba + thifen/triben	0.125 + 0.0078	3	0	77	100	92	94	95	99
Dicamba + thifen/triben	0.125 + 0.0156	2	0	80	99	95	100	100	100
Dicamba + tribenuron	0.125 + 0.006	3	0	80	98	94	95	96	99
Dicamba + tribenuron	0.125 + 0.012	4	0	78	100	96	100	100	100
SAN-854H + thifen/triben	0.125 + 0.0078	4	0	78	99	94	98	100	99
SAN-854H + thifen/triben	0.125 + 0.0156	6	0	77	100	94	99	99	100
SAN-854H + tribenuron	0.125 + 0.006	3	0	77	100	92	96	98	100
SAN-854H + tribenuron	0.125 + 0.012	4	0	77	100	96	99	99	100
Thifen/triben + bromoxynil	0.0156 + 0.25	0	0	79	100	96	100	99	99
Untreated check		--	--	72	--	--	--	--	--
LSD (0.05)		3.2	NS	NS	NS	5.6	5.7	5.1	2.7
plants/ft					4	6	6	4	12

[1] Dicamba is the SGF formulation; MCPA and 2,4-D are amine formulations; Thifen/triben was applied as a commercial formulation of thifensulfuron/tribenuron; Thifen/triben and tribenuron were applied with an 80% nonionic surfactant applied at 0.25% v/v.

[2] Winter wheat, field pennycress, and henbit evaluations were combined over locations, mayweed chamomile and volunteer lentils were present only at site one, and common lambsquarters was present only at site two.

Weed control in winter wheat with F8426. Terry L. Neider and Donald C. Thill. A study was established in Benewah county, ID to evaluate the efficacy of F8426 for weed control in winter wheat. Triallate was applied at 1.25 lb/A and incorporated with a tillage operation prior to seeding winter wheat (var. Madsen) on October 12, 1993. The soil was a silt loam (26% sand, 62% silt, 12% clay, pH 4.9 and 3.2% organic matter). Plots were 8 by 30 ft with four replications arranged in a randomized complete block design. Herbicide treatments were applied postemergence on April 29, 1994 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 40 psi (air temp. 66F, relative humidity 45%, wind W at 4 mph, sky mostly clear, and soil surface temp. 68 F, 2 inch 62 F and 4 inch 58 F) to 5 leaf wheat with 2 tillers and 1 to 2 inch weeds. Wheat injury was evaluated May 6, May 17 and June 3, weed control was evaluated May 17 and June 30, and wheat was harvested August 5, 1994. Field pennycress (THLAR), mayweed chamomile (ANTCO), henbit (LAMAM) and volunteer lentils (LENCU) infestations were moderate and uniform throughout the experimental site.

F8426 applied with any of the 2,4-D, X-77, or bromoxynil combinations injured wheat 21 to 33% (chlorotic and necrotic tissue) by the early evaluation on May 5, 1994. However, this injury was not visible when wheat injury was evaluated on the June 6, 1994. The addition of nitrogen with any of the F8426 treatments did not affect the level of wheat injury or weed control. F8426 applied with any of the 2,4-D, X-77, or bromoxynil combinations controlled field pennycress, henbit, and volunteer lentils 90 to 100% by June 3, 1994, and mayweed chamomile control was variable (43 to 93%). Wheat grain yields from all herbicide treated plots were not different from the untreated check and ranged from 71 to 81 bu/A. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table. Winter wheat response and weed control with F8426 treatments, Benewah county, ID.

		Winter Wheat				Weed control							
		Injury				THLAR		ANTCO		LAMAM		LENCU	
Treatment[1]	Rate	5/6/94	5/17/94	6/3/94	Yield	5/17/94	6/3/94	5/17/94	6/3/94	5/17/94	6/3/94	5/17/94	6/3/94
	lb/a	%			bu/A	%							
F8426	0.031	6	5	0	81	98	100	50	45	70	78	90	75
F8426 + N	0.031	1	5	0	79	94	100	33	48	53	83	81	65
F8426 + X-77	0.031	23	11	0	75	99	100	45	43	79	90	91	90
F8426 + N + X-77	0.031	25	9	0	76	99	100	25	28	68	75	90	70
F8426 +	0.031	21	10	0	81	100	100	65	73	84	91	95	95
2,4-D	0.238												
F8426 +	0.031	23	9	0	75	99	100	65	86	84	94	95	94
2,4-D + N	0.238												
F8426 +	0.031	30	13	0	78	98	100	81	85	90	93	98	98
2,4-D + X-77	0.238												
F8426 +	0.031	29	9	0	73	99	100	83	91	96	98	99	100
2,4-D + N + X-77	0.238												
2,4-D + X-77 + N	0.238	1	3	0	79	80	98	30	56	20	58	68	91
F8426 +	0.031	33	9	0	71	100	100	84	93	96	100	99	98
bromoxynil + X-77	0.25												
Thifen/Triben +	0.016	0	0	0	78	88	99	73	98	73	91	75	93
bromoxynil + X-77	0.25												
Untreated check	-----	--	--	--	76	--	--	--	--	--	--	--	--
LSD (0.05)		5.3	3.1	NS	7.2	3.0	2.4	24.1	30.7	19.4	15.8	13.7	18.1
plants/ft²						4		6		4		4	

[1] X-77 a nonionic surfactant applied at 0.25 % v/v, N a 28% aqueous nitrogen fertilizer applied at 2% v/v, 2,4-D was an ester formulation, and Thifen/triben was a package mix of thifensulfuron + tribenuron.

Bioeconomic evaluation of weed control in winter wheat. Terry L. Neider and Donald C. Thill. Studies were established at separate locations in Latah county, ID to evaluate the economics of weed control in winter wheat. Winte wheat (variety Cashup) was seeded on October 5 at site one and variety 'Stevens' on October 14, 1993 at site two. Th experimental design was a randomized complete block with four replications and each block was 90 by 150 ft. Weed densities were determined prior to applying herbicide treatments on April 27 at site one and April 3, 1994 at site two. Thifensulfuron/tribenuron plus diclofop was applied at 0.019 plus 1.0 lb/A to one third of each block, a reduced rate (70% of the above treatment) was applied to the second one third, and the last one third was left untreated. All treatments were applied with a motorized sprayer traveling 3 mph and delivering 10 gpa at 40 psi (Table 1). Wheat injury and weed control were evaluated visually May 22 at site one and May 28, 1994 at site two. Winter wheat was harvested from a single strip out of the center of each plot with a small plot combine on August 4 at site one and Augus 11, 1994 at site two.

Table 1. Application and soil data.

	Site one	Site two
Crop stage	5 leaf/3 tiller	4 leaf/2 tiller
Weed stage	1 to 3 inch	1 to 2 inch
Air temp. (F)	70	56
Relative humidity (%)	50	72
wind (mph/direction)	5/NE	2/N
Sky	mostly clear	mostly clear
Soil surface temp. (F)	68	54
2 inch	58	52
4 inch	58	52
Soil texture	silt loam	silt loam
Sand (%)	34	26
Silt (%)	60	64
Clay (%)	6	10
Organic matter (%)	5.4	4.4
pH	5.3	5.8

Winter wheat was not injured by either of the herbicide treatments at both locations. Weed control at site one was not different between herbicide treatments (Table 2). There were initially 0.1 wild oat plants/ft^2 at site one, but the wild oat plants were suppressed by the wheat and control was not evaluated. There was no difference in grain yield and net return at site one. Furthermore, the diclofop was not needed at site one and net return would have been $326.54 and $321.64 for the 0.019 and 0.013 lb/A thifensulfuron/tribenuron treatments, respectively, if diclofop had not been applie Both herbicide treatments equally controlled field pennycress and wild oat at site two (Table 3). Common lambsquarte and henbit control with the 70% rate was less than the full rate. Grain yield was not different between treatments and the untreated check return was $20.70/A more, on the average, than the treated plots. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339)

Table 2. Winter wheat response, weed control, and dollars returned with herbicide treatments at site one.

		Wheat		Weed control			
Treatment[1]	Rate	Yield	Return[2]	Field pennycress	Prickly lettuce	Mayweed chamomile	Henbit
	lb/A	bu/A	$/A	%			
Thifen/triben + diclofop	0.019 1.0	104	304.50	95	89	91	89
Thifen/triben + diclofop	0.013 0.7	102	306.21	91	88	85	85
Untreated check	------	101	326.03	--	--	--	--
Prob. > F		0.75	0.23	0.21	0.64	0.19	0.22
plants/ft^2				1.2	0.3	1.4	0.2

[1]Thifen/triben was applied as a commercial formulation of thifensulfuron/tribenuron with an 80% nonionic surfactant applied at 0.25% v/v.

[2]Return was determined for each treatment based on local 5 year average wheat price ($3.22/bu) minus herbicide treatment cost, which included local costs for application at $4.50/A, Thifen/triben at $190.20/lb ai, diclofop at $22.04/lb ai and surfactant at $18.64/gal.

Table 3. Winter wheat response, weed control, and dollars returned with herbicide treatments at site two.

		Wheat		Weed control			
Treatment[1]	Rate	Yield	Return[2]	Field pennycress	Common lambsquarters	Henbit	Wild oat
	lb/A	bu/A	$/A	%			
Thifen/triben + diclofop	0.019 1.0	97	282.77	94	94	84	100
Thifen/triben + diclofop	0.013 0.7	97	289.39	83	84	71	93
Untreated check	------	95	306.79	--	--	--	--
Prob. > F		0.49	0.01	0.04	0.09	0.03	0.18
LSD (0.05)		-----	13.6	-----	-----	-----	-----
plants/ft^2				1.9	1.9	5.5	2.2

[1]Thifen/triben was applied as a commercial formulation of thifensulfuron/tribenuron with an 80% nonionic surfactant applied at 0.25% v/v.

[2]Return was determined for each treatment based on local 5 year average wheat price ($3.22/bu) minus herbicide treatment cost, which included local costs for application at $4.50/A, Thifen/triben at $190.20/lb ai, diclofop at $22.04/lb ai and surfactant at $18.64/gal.

Italian ryegrass control in winter wheat with pre- and post- emergence herbicides. Traci A. Brammer, Carol A. Mallory-Smith and Donald C. Thill. A study was established near Potlatch, Idaho in the fall of 1993 to evaluate herbicide treatments to control diclofop resistant Italian ryegrass (LOLMU) in winter wheat. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 20 gpa at 41 psi for preemergence treatments and 10 gpa at 38 psi for postemergence treatments. Preemergence treatments were applied October 25, 1993 (Table 1). Triallate was incorporated twice (in perpendicular directions) with a harrow immediately after application to a depth of 1 in.. Postemergence treatments were applied to 2 to 5 leaf wheat and 2 to 3 leaf Italian ryegrass on May 16, 1994. Italian ryegrass control was evaluated visually on June 7, 1994. Wheat was not harvested to prevent spread of possible herbicide-resistant Italian ryegrass.

Table 1. Application data and soil analysis.

Application date	October 25	October 25	May 16
Application timing[1]	POPI	PRE	POST
Wheat growth stage	-	-	2-5 lf
LOLMU growth stage	-	-	2-3 lf
Air temperature (F)	50	50	54
Relative humidity (%)	65	65	69
Wind speed (mph, direction)	1-3,SE	1-3,SE	3-7,W
Soil temperature at 2 in (F)	42	42	60
pH		5.6	
OM (%)		3.0	
CEC (meg/100g soil)		15.7	
Texture		silt loam	

[1]POPI = post plant incorporated; PRE = preemergence; POST = postemergence.

Italian ryegrass control was 95% or better with triasulfuron or chlorsulfuron applied preemergence and 87% with the post plant incorporated treatment of diclofop (Table 2). Diclofop applied postemergence and triallate plus metribuzin treatments controlled Italian ryegrass 41% or less. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho 83844-2339)

Table 2. Effects of pre- and post-emergence herbicides on Italian ryegrass in winter wheat.

Treatment	Rate	Application Timing	LOLMU
	lb /A		% control
Untreated check	--	--	--
Triallate +	1.25	POPI	
metribuzin	0.14	POST	41
Diclofop	1.00	POPI	87
Triasulfuron	0.027	PRE	98
Chlorsulfuron	0.027	PRE	95
Diclofop	1.00	POST	34
LSD(0.05)			15

Italian ryegrass control with early postemergence applications of acetochlor, EPTC, and triallate in winter wheat. Bill D. Brewster, William S. Donaldson, and Carol A. Mallory-Smith. Mechanical incorporation of herbicides is not feasible on certain highly erodible soils in Western Oregon. Because Western Oregon is in a winter rainfall zone, delaying herbicide application would increase the probability of rainfall soon after application, but would also increase the probability of weeds emerging prior to application. To test the efficacy of this delayed timing, a trial was conducted at the Hyslop Agronomy Farm near Corvallis, OR. Italian ryegrass seed was broadcast over the trial site prior to seeding the wheat; the ryegrass stand density that developed was 52 plants per sq ft. The trial design was a randomized complete block with three replications and 8 by 22 ft plots. The soil was a Woodburn silt loam with an organic matter content of 2.5%, a pH of 5.3, and a CEC of 20. The soil was moist when the herbicides were applied, but the only precipitation in the 10 days following application occurred 4 days later and totalled 0.04 inch. Herbicide treatments were applied with a single-wheel, compressed-air sprayer that delivered 20 gpa at 15 psi in a broadcast spray. When herbicides were applied on October 20, eight days after the wheat was seeded, both the wheat and the ryegrass had begun to emerge, and the first leaf of each species was up to 1 in tall.

All herbicide treatments affected the ryegrass (Table). EPTC, the most volatile of the three herbicides, was the least effective, while acetachlor provided 100% ryegrass control. The addition of a nonionic surfactant improved ryegrass control with triallate and EPTC, and resulted in higher wheat yields compared to the two herbicides applied without surfactant. Acetochlor caused minor stunting of the wheat, but increased grain yield by over 130 bu/A. (Dept. of Crop and Soil Science, Oregon State Univ., Corvallis, OR 97331-3002.)

Table. Visual evaluation of wheat injury and Italian ryegrass control and wheat yield following early postemergence applications of herbicides, with and without surfactant, Corvallis, OR, 1993-94.

		Visual evaluations[1]		
Treatment[2]	Rate	Wheat injury	Italian ryegrass control	Wheat yield[3]
	(lb/A)	(%)	(%)	(bu/A)
triallate	1.5	0	77	36
triallate + nis	1.5	0	87	62
EPTC	2.0	0	43	23
EPTC + nis	2.0	0	53	32
acetochlor	1.0	10	100	147
acetochlor + nis	1.0	10	100	145
check	0	0	0	11
			$LSD_{(0.05)}$	10

[1] February 8, 1994
[2] Applied October 20, 1993; nis = nonionic surfactant; acetochlor formulated with dichlormid.
[3] July 21, 1994

Evaluation of tillage and herbicides in an integrated management approach for the control of jointed goatgrass in winter wheat. T. M. Price and J. O. Evans. Jointed goatgrass has become an especially troublesome weed in winter wheat. The current herbicides do not selectively control jointed goatgrass in winter wheat because the two plants are genetically similar. The objective of this study was to investigate the integration of common tillage regimes and herbicides for jointed goatgrass management. The experiment was initiated in the fall prior to a summer fallow season. Three common tillage regimes were evaluated: no-till, conservation tillage, and conventional tillage. Two herbicides were evaluated for jointed goatgrass control. Clomazone was applied in the fall as a preemergence herbicide. A 2,4-D plus glyphosate combination was applied in the spring as a postemergence herbicide at the three to five leaf stage of jointed goatgrass. Control plots were not treated with herbicide and followed a no-till regime. The experiment was set up as a split-split plot design with tillage in strips and herbicide treatments in strips across the tillage treatments. This design allowed for common tillage equipment to be pulled through the plots at normal speeds.

Winter wheat was planted in the fall after the fallow season. No jointed goatgrass control strategies were implemented during the crop season. Wheat was harvested with an 8 foot wide plot combine. The combine was designed to determine harvest weights and distribute a sample for analysis from each plot. The percent of wheat and jointed goatgrass seed in the harvest bags was measured. Wheat yields and percentages were statistically analyzed. Wheat yields were five times higher in the conventional plots than in either no-till or conservation tillage plots. The samples consisted of approximately 5 to 10 percent jointed goatgrass in the conventional tillage, 55 to 75 percent jointed goatgrass in the conservation tillage, and 50 to 60 percent in the no-till regime. Conventional tillage treatments, which included three rodweedings at 3 week intervals during the summer fallow, provided the greatest control of jointed goatgrass. No statistical difference was found among herbicide treatments.

Table. Percent jointed goatgrass in winter wheat harvest and wheat yields following three tillage regimes.

Tillage Regime	Clo[a] 0.5 lb/A	Gly[a]+2,4-D 40 oz/A	Control	Wheat Yield
	---------- % ----------			-----bu/A-----
No-till				
Non-tilled	52.86	49.89	53.23	5.58
Conservation tillage				
Chisel plow (F[b]) Skewtreader (Sp[b])	60.36	58.41	60.24	6.29
Subsoiler (F) Skewtreader (Sp)	71.36	73.70	73.73	6.92
Conventional tillage				
Chisel plow (F) Rodweeder[c] (Su[b])	8.54	8.03	12.27	30.32
Chisel plow (Sp) Rodweeder (Su)	8.54	5.58	5.96	34.69
Subsoiler (F) Rodweeder (Su)	9.57	7.00	5.40	30.52
LSD@0.05		11.31		6.86

[a]Clo=Clomazone. Gly=Glyphosate.
[b]F=Fall. Sp=Spring. Su=Summer 1993.
[c]Three summer rodweedings.

Wheat variety responses to herbicide applications at 3 timings. T.J. D'Amato and P. Westra. A study was established near Akron, Colorado to assess the effect of broadleaf herbicide treatments applied at 3 timings, to five winter wheat varieties commonly grown in dryland areas of eastern Colorado. Five wheat varieties; TAM 107, TAM 200, Lamar, Yuma, and Scout 66 were planted in blocks 80 feet wide and 100 feet long per variety per replication. Herbicide treatments were applied over plots 6.7 feet wide and 30 feet long, thus each block could accommodate 8 treatments and 3 application timings. Treatments were arranged in a randomized complete block with three replications. Treatments were applied with a CO_2 powered backpack sprayer, delivering 13 gallons per acre through 11001LP flat fan nozzles. Soil texture at the study site was a loam with an organic matter content of 1.3% and pH 6.7.

Wheat was planted in 12 in. rows with a disk drill on September 17, 1993. The study site was treated with bromoxynil (0.2 lbs ai/A) on April 30, 1994 to help keep the area weed free. Wheat was 1.5 to 3 in. tall at the first timing; 4 to 6 in. and fully tillered at the second timing; and 8 to 10 in. tall and jointed at the third timing (see table). There were no varietal differences in maturity at any application timing.

On April 27 to 28, 1994 the study site was exposed to an extended cold spell of 20 °F. nighttime low temperatures and 30 °F. daytime highs, over a 48 hour period. Immediately following the cold period, wheat in all those plots treated with dicamba (treatments 2,5,6,8) in the first 2 timings showed a spraddled, or matted injury symptom. The matted injury symptom was still evident, though less severe, across all varieties treated at the first or second timing when evaluated on May 18, 1994. No injury was observed in any plots treated at the third timing, during the May evaluation. On July 6, 1994 plots were harvested and yield measured. A visual evaluation prior to combining the wheat showed plots treated with dicamba in the third timing were reduced in height by 10%. No injury symptoms or height reduction were evident in plots treated at the first or second timing. There was little variation in test weights (55 lb/bu average) or grain moisture percentage (11.2% average) between plots. Wheat yields were not significantly different across treatments or timings. Wheat that showed the spraddled injury symptom in the spring did not yield less than untreated check plots, and wheat stunted from the third application timing did not yield less than untreated checks. No wheat variety stood out as more sensitive than others to herbicide treatments or timing application. (Department of Plant Pathology and Weed Science, Colorado State University, Ft. Collins, CO 80523.)

Table. Winter wheat yields 7/6/94 - Akron, CO
yields in bushels/acre, average of 3 reps

	Treatments							
Variety[1]	T1	T2	T3	T4	T5	T6	T7	T8
Yuma-1	28	26	30	31	29	32	32	26
Yuma-2	27	26	29	36	28	30	29	26
Yuma-3	30	30	32	30	28	26	30	29
Scout 66-1	31	30	28	40	26	28	28	25
Scout 66-2	26	27	28	29	24	24	27	25
Scout 66-3	30	27	27	30	22	21	26	24
TAM 107-1	30	29	32	33	30	27	26	26
TAM 107-2	30	38	33	29	30	32	29	26
TAM 107-3	30	28	31	28	26	25	28	30
TAM 200-1	29	27	29	28	28	27	24	22
TAM 200-2	26	27	24	23	25	21	21	24
TAM 200-3	27	29	28	30	23	25	27	22
Lamar-1	23	27	23	32	26	27	22	23
Lamar-2	28	27	27	28	25	32	25	24
Lamar-3	27	26	28	28	24	21	29	21

[1]wheat varieties followed by application timing
ex: Yuma-1 = yield of Yuma treated on first timing date 3/18/94

Treatments
(lbs ai/A)
1. untreated check
2. Dicamba - 0.125
3. 2,4-D - 0.375
4. Metsulfuron[2] - 0.004
5. Dicamba - 0.125
   2,4-D - 0.375
6. Dicamba - 0.125
   Metsulfuron - 0.004
7. Metsulfuron - 0.004
   2,4-D - 0.375
8. Dicamba - 0.125
   2,4-D - 0.375
   Metsulfuron - 0.004

[2]0.25% v/v nonionic surfactant with all metsulfuron treatments.

Timings
1. dormancy break - 3/18/94
2. fully tillered - 4/4/94
3. joint stage - 5/3/94

PROJECT 4

EXTENSION, EDUCATION AND REGULATORY

Chairperson: Richard Zollinger
North Dakota State University
Fargo, ND

1994 weed identifications for county extension and weed control programs in Idaho. Robert H. Callihan, Timothy W. Miller and Sherri L. Carson. The extension weed identification program at the University of Idaho provides a service to those desiring authoritative identifications on plant specimens. The reasons people submit specimens vary from mild curiosity to a bona fide need by a property manager to control a species that is unknown. The data generated in this program are useful in determining educational needs as well as documenting changes in the Idaho weed flora. Information obtained in this program enable: (1) compiling of weed species present in Idaho, (2) determining distribution of weeds, (3) recording weed dispersal into new areas, (4) detecting new alien species (5) recognizing the season(s) that particular weed identification problems arise, (6) identifying education deficiencies to assist in planning programs for extension and regulatory personnel on weed identification, and (7) compiling of an available historical data base. This report serves the important function of advising research, extension, and regulatory personnel in Idaho, as well as other states, of weed distributions in Idaho that may significantly affect those states.

A total of 233 plants were submitted for identification or verification in the reporting period December 1, 1993 to November 30, 1994. Two hundred ten of these were from the state of Idaho, with twenty-three submitted from other Pacific Northwest states. One hundred fifty-nine of these data (listed below) are from identification requests submitted to weed identification personnel by county extension agents and county weed superintendents in the state of Idaho; sixty-one were from other sources. This list indicates species of interest that warrant development of educational material and instruction. In addition, many samples are submitted because of unusual circumstances (novelty, growth stage, specimen condition or specimen inadequacy) that call for specialist capabilities. Many of these are native species, some are crops, and some are ornamentals submitted by homeowners for curiosity rather than weed concerns. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844).

Identification	County	Date
Abutilon theophrasti, Malvaceae	Minidoka	Aug 19, 1994
Achillea millefolium, Asteraceae	Kootenai	Aug 16, 1994
Agropyron cristatum, Poaceae	Ada	Apr 01, 1994
Agropyron intermedium, Poaceae	Ada	Jun 15, 1994
Agrostis scabra, Poaceae	Idaho	Jul 21, 1994
Ambrosia artemisiifolia, Asteraceae	Minidoka	Jul 13, 1994
Ambrosia artemisiifolia, Asteraceae	Gem	Sep 06, 1994
Amsinckia retrorsa, Boraginaceae	Kootenai	Jun 14, 1994
Antennaria anaphaloides, Asteraceae	Kootenai	Aug 08, 1994
Apera interrupta, Poaceae	Idaho	Jul 20, 1994
Armoracia rusticana, Brassicaceae	Twin Falls	Jun 08, 1994
Armoracia rusticana, Brassicaceae	Custer	Jun 15, 1994
Artemisia ludoviciana, Asteraceae	Jerome	Sep 06, 1994
Artemisia vulgaris, Asteraceae	Boundary	Mar 30, 1994
Aster pansus, Asteraceae	Boundary	Aug 16, 1994
Atriplex patula hastata, Chenopodiaceae	Boundary	Sep 14, 1994
Atriplex rosea, Chenopodiaceae	Twin Falls	Jul 26, 1994
Barbarea orthoceras, Brassicaceae	Boundary	May 16, 1994
Barbarea orthoceras, Brassicaceae	Idaho	Jun 02, 1994
Barbarea vulgaris, Brassicaceae	Teton	Jun 08, 1994
Bidens cernua, Asteraceae	Latah	Jun 23, 1994
Boisduvalia stricta, Onagraceae	Idaho	Aug 16, 1994
Bromus commutatus, Poaceae	Washington	Jun 30, 1994
Bromus inermis, Poaceae	Ada	Jun 06, 1994
Bromus tectorum, Poaceae	Latah	May 09, 1994
Bryonia alba, Cucurbitaceae	Bannock	May 05, 1994
Calochortus macrocarpus, Liliaceae	Gem	Jun 17, 1994
Campanula rapunculoides, Campanulaceae	Ada	Jun 24, 1994
Campsis radicans, Bignoniaceae	Ada	Aug 29, 1994
Carex lasiocarpa, Cyperaceae	Idaho	Jun 02, 1994
Centaurea cyanus, Asteraceae	Lewis	Jan 11, 1994
Centaurea maculosa, Asteraceae	Lewis	Jan 11, 1994
Cerastium vulgatum, Caryophyllaceae	Washington	Apr 20, 1994
Chenopodium ambrosioides, Chenopodiaceae	Lewis	May 09, 1994
Chenopodium botrys, Chenopodiaceae	Boundary	Aug 31, 1994
Chenopodium botrys, Chenopodiaceae	Idaho	Oct 06, 1994
Chenopodium botrys, Chenopodiaceae	Clearwater	Oct 27, 1994
Chenopodium capitatum, Chenopodiaceae	Caribou	Jul 11, 1994
Chenopodium foliosum, Chenopodiaceae	Lewis	Jul 14, 1994
Chenopodium foliosum, Chenopodiaceae	Lewis	Sep 19, 1994
Chrysanthemum parthenium, Asteraceae	Idaho	May 17, 1994
Cichorium intybus, Asteraceae	Bannock	Jul 20, 1994
Cirsium arvense, Asteraceae	Lewis	Jan 11, 1994
Cirsium vulgare, Asteraceae	Ada	Mar 10, 1994
Clematis ligusticifolia, Ranunculaceae	Idaho	Oct 28, 1994
Cleome serrulata, Capparidaceae	Minidoka	Sep 16, 1994
Collinsia parviflora, Scrophulariaceae	Idaho	Apr 28, 1994
Conyza canadensis, Asteraceae	Idaho	Sep 23, 1994
Cotoneaster acutifolia, Rosaceae	Ada	Apr 29, 1994
Crepis capillaris, Asteraceae	Boundary	Jul 19, 1994
Cuscuta indecora, Convolvulaceae	Gem	Oct 05, 1994
Cynodon dactylon, Poaceae	Ada	Mar 25, 1994
Cynodon dactylon, Poaceae	Gem	Jun 17, 1994
Cytisus praecox, Fabaceae	Ada	Apr 21, 1994
Datura stramonium, Solanaceae	Twin Falls	Sep 16, 1994
Descurainia sophia, Brassicaceae	Nez Perce	May 10, 1994
Echium vulgare, Boraginaceae	Ada	Jul 05, 1994
Eleocharis obtusa, Cyperaceae	Kootenai	Aug 19, 1994
Elymus giganteus, Poaceae	Boundary	Feb 09, 1994
Elytrigia repens, Poaceae	Ada	May 31, 1994
Elytrigia repens, Poaceae	Ada	Jun 06, 1994
Epilobium minutum, Onagraceae	Idaho	Jul 27, 1994
Epilobium paniculatum, Onagraceae	Camas	Sep 06, 1994

Eriophyllum lanatum integrifolium, Asteraceae	Latah	Jun 23, 1994
Euphorbia serpyllifolia, Euphorbiaceae	Idaho	Sep 07, 1994
Frasera fastigiata, Gentianaceae	Idaho	Jun 15, 1994
Galium aparine, Rubiaceae	Bannock	Jul 11, 1994
Gaura parviflora, Onagraceae	Gem	Jun 23, 1994
Glechoma hederacea, Lamiaceae	Valley	Jun 15, 1994
Gnaphalium palustre, Asteraceae	Kootenai	Jul 15, 1994
Grindelia squarrosa, Asteraceae	Bannock	Jun 27, 1994
Helianthus maximilianii, Asteraceae	Canyon	Aug 02, 1994
Hesperis matronalis, Brassicaceae	Idaho	Jun 15, 1994
Hesperis matronalis, Brassicaceae	Ada	Aug 08, 1994
Hieracium albertinum, Asteraceae	Idaho	Jun 15, 1994
Hieracium albiflorum, Asteraceae	Latah	Jul 20, 1994
Hyoscyamus niger, Solanaceae	Caribou	Jul 05, 1994
Hypericum perforatum, Clusiaceae	Latah	Jun 23, 1994
Hypericum perforatum, Clusiaceae	Kootenai	Oct 28, 1994
Impatiens glandulifera, Balsaminaceae	Kootenai	Oct 10, 1994
Iva axillaris, Asteraceae	Twin Falls	May 18, 1994
Juncus effusus gracilis, Juncaceae	Latah	Jun 30, 1994
Koelreuteria paniculata, Sapindaceae	Canyon	Oct 27, 1994
Lactuca pulchella, Asteraceae	Kootenai	Jun 14, 1994
Ledum glandulosum glandulosum, Ericaceae	Idaho	Dec 08, 1993
Lepidium latifolium, Brassicaceae	Ada	Jun 17, 1994
Lepidium latifolium, Brassicaceae	Minidoka	Jul 08, 1994
Leptochloa fascicularis, Poaceae	Minidoka	Aug 16, 1994
Linaria vulgaris, Scrophulariaceae	Clark	Jul 26, 1994
Lithospermum arvense, Boraginaceae	Nez Perce	Feb 11, 1994
Lolium perenne, Poaceae	Kootenai	Aug 09, 1994
Lonicera maackii, Caprifoliaceae	Ada	Nov 21, 1994
Lotus corniculatus, Fabaceae	Canyon	Jun 20, 1994
Lotus corniculatus, Fabaceae	Kootenai	Aug 08, 1994
Lycium halimifolium, Solanaceae	Jefferson	Jul 08, 1994
Matricaria perforata, Asteraceae	Frémont	Jun 16, 1994
Medicago lupulina, Fabaceae	Latah	Jun 24, 1994
Mentzelia laevicaulis parviflora, Loasaceae	Gem	Jun 08, 1994
Montia linearis, Portulacaceae	Kootenai	May 26, 1994
Myriophyllum exalbescens, Haloragaceae	Latah	Aug 26, 1994
Nepeta cataria, Lamiaceae	Lewis	Apr 07, 1994
Nicotiana attenuata, Solanaceae	Camas	Sep 23, 1994
Oenothera biennis, Onagraceae	Boundary	Mar 07, 1994
Oenothera biennis, Onagraceae	Canyon	Jun 20, 1994
Oenothera biennis, Onagraceae	Butte	Aug 30, 1994
Oenothera pallida pallida, Onagraceae	Ada	Jun 06, 1994
Orobanche uniflora minuta, Orobanchaceae	Idaho	May 19, 1994
Osmorhiza chilensis, Apiaceae	Bannock	Jul 11, 1994
Panicum dichotomiflorum, Poaceae	Lewis	Nov 08, 1994
Penstemon venustus, Scrophulariaceae	Boundary	May 27, 1994
Phacelia glandulosa, Hydrophyllaceae	Butte	Jul 12, 1994
Phacelia heterophylla heterophylla, Hydrophyllaceae	Benewah	Jul 11, 1994
Picea abies, Pinaceae	Ada	Jun 27, 1994
Pinus sylvestris, Pinaceae	Ada	Jun 27, 1994
Plagiobothrys scouleri penicillatus, Boraginaceae	Idaho	Jan 04, 1994
Poa annua, Poaceae	Bonneville	Apr 18, 1994
Poa annua, Poaceae	Washington	Apr 25, 1994
Poa annua, Poaceae	Latah	May 09, 1994
Poa annua, Poaceae	Canyon	Aug 29, 1994
Poa annua, Poaceae	Kootenai	Aug 31, 1994
Polygonum cuspidatum, Polygonaceae	Gem	Apr 29, 1994
Polygonum cuspidatum, Polygonaceae	Owyhee	May 09, 1994
Polygonum cuspidatum, Polygonaceae	Butte	Jul 27, 1994
Polygonum lapathifolium, Polygonaceae	Kootenai	Aug 16, 1994
Potentilla norvegica, Rosaceae	Bannock	Jul 01, 1994
Potentilla recta, Rosaceae	Idaho	Jun 15, 1994
Prinsepia uniflora, Rosaceae	Ada	May 02, 1994
Prunus persica, Rosaceae	Ada	Aug 23, 1994
Rhamnus cathartica, Rhamnaceae	Butte	Sep 06, 1994
Rosa rubiginosa, Rosaceae	Kootenai	May 20, 1994
Rumex acetosella, Polygonaceae	Latah	Apr 19, 1994
Sambucus cerulea, Caprifoliaceae	Bannock	Sep 22, 1994
Sambucus racemosa, Caprifoliaceae	Twin Falls	May 04, 1994
Sanguisorba minor, Rosaceae	Oneida	Jun 13, 1994
Saponaria officinalis, Caryophyllaceae	Twin Falls	Jul 20, 1994
Saponaria officinalis, Caryophyllaceae	Washington	Aug 11, 1994
Sarcobatus vermiculatus, Chenopodiaceae	Power	Oct 11, 1994
Satureja douglasii, Lamiaceae	Kootenai	May 03, 1994
Scleranthus annuus, Caryophyllaceae	Kootenai	Jul 15, 1994
Secale cereale, Poaceae	Ada	Jun 06, 1994
Senecio hydrophilus, Asteraceae	Power	Jan 18, 1994
Senecio jacobaea, Asteraceae	Bonner	Aug 03, 1994
Silene vulgaris, Caryophyllaceae	Twin Falls	Aug 24, 1994
Smilacina stellata, Liliaceae	Gem	May 11, 1994
Solanum dulcamara, Solanaceae	Gem	May 04, 1994
Solanum dulcamara, Solanaceae	Butte	Aug 16, 1994
Solanum dulcamara, Solanaceae	Lewis	Sep 14, 1994
Solanum melanocerasum, Solanaceae	Ada	Oct 24, 1994
Sorghum bicolor, Poaceae	Canyon	Sep 19, 1994
Sorghum bicolor, Poaceae	Gem	Oct 14, 1994
Spergularia rubra, Caryophyllaceae	Kootenai	Jul 15, 1994
Thelypodium integrifolium, Brassicaceae	Canyon	Aug 02, 1994
Tragopogon pratensis, Asteraceae	Latah	Jun 23, 1994
Trifolium arvense, Fabaceae	Idaho	Aug 09, 1994
Urtica dioica, Urticaceae	Lewis	Apr 07, 1994
Valerianella locusta, Valerianaceae	Kootenai	Jun 14, 1994
Verbena bracteata, Verbenaceae	Owyhee	Aug 08, 1994
Veronica chamaedrys, Scrophulariaceae	Ada	May 06, 1994
Veronica officinalis, Scrophulariaceae	Kootenai	Jun 14, 1994
Vicia villosa, Fabaceae	Power	Jan 18, 1994

Thirteen specimens identified only to genus are not included in this list.

Newly reported weed species; potential weed problems in Idaho. Robert H. Callihan, Timothy W. Miller and Sherri L. Carson. The occurrence and distribution of weed species is a dynamic phenomenon. Weed science works within a framework of ecological plant geography. Few programs devote resources to systematically surveying weed floras or documenting changes in weed species distributions. The distribution of weed species in Idaho submitted from all sources for identification by weed science diagnostic personnel, and of weed species in Idaho otherwise called to our attention, were examined to discover recent changes in distributions. As in previous years the distribution was categorized into three groups. No species were found to be new to the Pacific Northwest (Idaho, Oregon and Washington) in 1994. Three species were found to be new records for Idaho in 1994. Extensions of the ranges of several species that have been present in Idaho for several years were also recorded. Twenty-four species were found to be new records for individual counties in 1994. As this diagnostic service continues to build the data base, as extension weed identification programs increase, and as county staff and consultants gain in diagnostic ability, fewer questions are submitted, and fewer unrecorded species are reported. This is considered to be a measure of successful state and county extension programs. These new records document the reporting and verification of the presence of these species, not necessarily their time of entry into the state or county. Not all are recognized weeds; some are native to the continent, region, state or district; others are simply escaped ornamentals or crops; none are native to the location reported. The reporting period for these data was December 1, 1993 to November 30, 1994. The following lists cite the scientific name, Bayer code (when extant), Weed Science Society of America common name (or common name from other references when WSSA common name is not available), family name and location(s) of each new record. Additional data are maintained on permanent file. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844)

GROUP I: New regional records: species not previously documented for Idaho, nor currently listed in Flora of the Pacific Northwest (new regional as well as state and county records). None reported.

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

1. *Chloris verticillata* Nutt. (CHRVE) tumble windmillgrass; Poaceae
County: Canyon
2. *Datura stramonium* L. (DATST) jimsonweed; Solanaceae
County: Twin Falls
3. *Hypericum majus* (Gray) Britt. (*) larger Canadian St. Johnswort; Clusiaceae
County: Bonner

GROUP III: New county records: species not previously reported in the county listed, although previously reported in one or more counties in Idaho.

1. *Abutilon theophrasti* Medicus (ABUTH) velvetleaf; Malvaceae
County: Minidoka
2. *Barbarea vulgaris* R. Br. (BARVU) yellow rocket; Brassicaceae
County: Teton
3. *Chenopodium botrys* L. (CHEBO) Jerusalem-oak goosefoot; Chenopodiaceae
County: Clearwater
4. *Chenopodium foliosum* (Moench) Asch. (*) leafy goosefoot; Chenopodiaceae
County: Lewis
5. *Echium vulgare* L. (EHIVU) blueweed; Boraginaceae
County: Ada
6. *Galium aparine* L. (GALAP) catchweed bedstraw; Rubiaceae
County: Bannock
7. *Gaura parviflora* Dougl. (*) small-flowered gaura; Onagraceae
County: Gem
8. *Glechoma hederacea* L. (GLEHE) ground ivy; Lamiaceae
County: Valley
9. *Lepidium latifolium* L. (LEPLA) perennial pepperweed; Brassicaceae
County: Minidoka
10. *Leptochloa fascicularis* (Lam.) Gray (LEFFA) bearded sprangletop; Poaceae
County: Minidoka
11. *Lycium halimifolium* Mill. (LYUHA) matrimonyvine; Solanaceae
County: Jefferson
12. *Matricaria perforata* Merat (MATIN) scentless chamomile; Asteraceae
County: Fremont
13. *Panicum dichotomiflorum* Michx. (PANDI) fall panicum; Poaceae
County: Lewis
14. *Polygonum cuspidatum* Sieb. & Zucc. (POLCU) Japanese knotweed; Polygonaceae
County: Butte
15. *Polygonum lapathifolium* L. (POLLA) pale smartweed; Polygonaceae
County: Kootenai
16. *Potentilla norvegica* L. (PTLNO) rough cinquefoil; Rosaceae
County: Bannock
17. *Potentilla recta* L. (PTLRC) sulfur cinquefoil; Rosaceae
County: Boise
18. *Rosa rubiginosa* L. (ROSRB) sweetbriar rose; Rosaceae
County: Kootenai
19. *Sanguisorba minor* Scop. (SANMI) salad burnet; Rosaceae
County: Oneida
20. *Scleranthus annuus* L. (SCRAN) knawel; Caryophyllaceae
County: Kootenai
21. *Senecio jacobaea* L. (SENJA) tansy ragwort; Asteraceae
County: Bonner
22. *Silene vulgaris* (Moench) Garcke (SILVU) bladder campion; Caryophyllaceae
County: Twin Falls
23. *Sorghum bicolor* (L.) Moench (SORVU) shattercane; Poaceae
County: Canyon
24. *Veronica chamaedrys* L. (VERCH) germander speedwell; Scrophulariaceae
County: Ada

(*) No Bayer Code listed in WSSA Composite List of Weeds.

PROJECT 5

WEEDS OF AQUATIC, INDUSTRIAL AND NON-CROP AREAS

Chairperson: Barbara Mullin
Montana Department of Ag
Helena, MT

Comparison of imazapyr and glyphosate for saltcedar control. Keith W. Duncan. Saltcedar is an introduced phreatophyte which dominates millions of acres of riparian areas throughout the western United States. Saltcedar is an aggressive competitor and often grows in near monoculture stands.

Previous research at New Mexico State University has shown that saltcedar may be controlled with ground applications of imazapyr applied alone or in combination with glyphosate. Also, one previous trial suggested that saltcedar could be controlled with aerial applications of imazapyr. Much of the saltcedar in the Pecos River Valley of eastern New Mexico is inaccessible to ground-based application of herbicides. Therefore, trials were established in September, 1992 and August, 1993 to evaluate the efficacy of aerial applications of imazapyr and glyphosate applied alone or in combination for control of saltcedar.

In the 1992 trial, herbicides were applied with a helicopter in a total volume of seven gpa with 0.25% v/v surfactant. Swath width was 30 ft. Two of the thirteen treatments were applied as invert solutions. In the 1993 trial, herbicides were applied with a fixed-wing aircraft. Total spray solution was 7 gpa or 3 gpa with 0.25% v/v surfactant and 0.25% v/v Nalcotrol. Swath width was 45 ft.

Table. Saltcedar mortality 22 or 11 months after helicopter or fixed-wing aerial application of imazapyr and glyphosate applied alone or in combination near Artesia, New Mexico.

Treatment	Rate	Mortality Helicopter	Mortality Fixed-Wing
	-- lb/a --	- % -	- % -
glyphosate	8.0	50	
glyphosate + imazapyr	1.0 + 0.5	38	
glyphosate + imazapyr	3.0 + 0.25	37	
glyphosate + imazapyr	2.63 + 0.25	31	
glyphosate + imazapyr	1.5 + 0.5	49	
glyphosate + imazapyr	1.5 + 0.25	65	
glyphosate + imazapyr	2.25 + 0.5	84	
glyphosate + imazapyr[1]	3.0 + 0.5	62	
glyphosate + imazapyr[1]	1.5 + 0.5	26	
glyphosate + imazapyr	3.0 + 0.5	62	
glyphosate + imazapyr	0.75 + 0.5	44	
glyphosate + imazapyr	0.5 + 0.5	65	
imazapyr	1.0	83	
glyphosate + imazapyr	0.5 + 0.5		94
glyphosate + imazapyr	0.375 + 0.375		100
glyphosate + imazapyr	0.375 + 0.5		88
glyphosate + imazapyr	0.25 + 0.5		100
imazapyr	0.75		43
glyphosate + imazapyr[2]	0.5 + 0.5		66
imazapyr[2]	0.75		71

[1]invert spray solution
[2]3 gpa total solution

Treatments applied by helicopter generally resulted in less mortality of saltcedar than treatments applied by fixed-wing aircraft. Saltcedar mortality was generally higher in plots where imazapyr was applied at 0.5 lb/a regardless of the rates of glyphosate. Thus indicating that lower rates of glyphosate are equally effective as higher rates in the tank-mix provided imazapyr is applied at 0.5 lb/a. Saltcedar mortality was generally higher in plots where the herbicides were applied in 7 gpa total volume as compared to 3 gpa total volume.

Mortality was determined by stem counts in July, 1994. A replicate of the 1993 trial was applied in August, 1994 for comparison purposes. Additional mortality will be determined in summer 1995. (Coop. Ext. Serv., New Mexico State Univ. Artesia, NM 88210).

PROJECT 6

BASIC SCIENCES, ECOLOGY, BIOLOGY, PHYSIOLOGY,
GENETICS AND CHEMISTRY

Chairperson: Carol Mallory-Smith
Oregon State University
Corvallis, OR

NO REPORTS SUBMITTED

PROJECT 7

ALTERNATIVE METHODS OF WEED CONTROL

Chairperson: Bruce Maxwell
Montana State University
Bozwman, MT

Cover crops for weed suppression in established strawberries. Diane Kaufman. The following small grains were seeded between strawberry rows at the North Willamette Research and Extension Center (NWREC) in Aurora, Oregon: 'Juan' triticale (seeded August 30, 1993); 'Celia' triticale and 'Cayuse' oat (seeded on September 9, 1993.) Each was seeded at density of 45 seeds per ft^2. Plots were 20 ft. long and 80 inches wide (the width of three strawberry rows), with five replications in a randomized complete block design. A herbicide control (napropamide at 4.0 lb. ai/A applied September 10, 1993) and native vegetation control were also included.

The purpose of this study was to evaluate selected cover crops for their effect on weed suppression and yield in a second year planting of 'Totem' strawberries. The 'Juan' triticale was selected for trial because it is day-length dependent and often tends to produce sterile seed and die in winter when planted before September 1. Such a quality is valuable because it makes application of sethoxydim herbicide unnecessary while reducing the threat of the cover crop becoming a weed. 'Celia' is a low-growing, winter-hardy triticale. It was selected for trial on the premise that its low-growing, mat-like habit might suppress weeds without competing with strawberries for light. 'Cayuse' spring oat was chosen on the chance that it might winter-kill, thereby making application of sethoxydim unnecessary.

Because the winter was relatively mild and the 'Cayuse' oat did not winter-kill, sethoxydim herbicide was applied to both the 'Cayuse' oat and 'Celia' triticale on February 14, 1994 at the maximum rate of 0.48 lb. ai/A. The 'Cayuse' oat had died back uniformly by the end of March. However, the 'Celia' triticale outgrew the initial damage from sethoxydim in some areas of the planting, resulting in an uneven kill. Where the 'Celia' had died back, there was too little biomass to continue suppressing weeds. The end result was an unsatisfactory mix of weeds among occasional 'Celia' triticale plants. The 'Cayuse' oat had produced adequate biomass to continue providing acceptable weed suppression up to the beginning of strawberry harvest (June 1, 1994).

Although some of the 'Juan' triticale plants set sterile seed in late December- January, the majority of the plants continued to grow vegetatively through the winter and were three feet high by April, when they began to flower and produce fertile seed. Weed suppression in the 'Juan' triticale was equal to that in the herbicide control; however, there was concern that the cover itself was being too competitive with the strawberries.

Weed species were identified, counted, and percent weed cover within each plot evaluated on April 20, 1994 (Tables 1 and 2). Weeds in all plots were then hoed on April 22, with the cover crops left intact. The 'Juan' triticale plots had significantly fewer weeds than the herbicide control or 'Cayuse' oat plots, which were similar. The 'Celia' triticale had not produced adequate biomass to suppress weeds as well as the other cover crops, but it did have significantly less weed cover than the native vegetation control.

Fruit was harvested from a ten foot length of the middle row of each plot on June 1, 8, and 15, 1994 (Table 2). Though there were no significant differences in total marketable yield among treatments when analyzed at a significance level of 0.05, both the herbicide and native vegetation controls had significantly greater yields than any of the cover crop treatments when analyzed at a significance level of 0.10. These results agree with those of a previous cover crop trial in strawberries at NWREC in which plots, each seeded to different small grains in late August between strawberry rows and later killed with sethoxydim, had 18-22% lower yields than the native vegetation control. (Extension Service, Oregon State University, North Willamette Research and Extension Center, Aurora, OR 97002).

Table 1. Effect of cover crop on percent weed cover between strawberry rows and strawberry yield, NWREC, 1994.

Treatment	% Weed Cover[1] April 20, 1994	Total Marketable Yield grams/10 feet of row	lb/A
'Celia' triticale	15.5 c[2]	5812.6 a[3]	13,385
'Cayuse' oat	3.1 b	5944.4 a	13,689
'Juan' triticale	0.4 a	6131.8 a	14,120
Native vegetation control	72.0 d	7313.2 b	16,975
Herbicide control	5.2 b	7405.8 b	17,054

[1] Based on visual evaluation of percent of plot area covered by weeds
[2] Significance level = 0.05
[3] Significance level = 0.10
NS at = 0.05

Table 2. Number of weeds between strawberry rows[1] at NWREC, April 20, 1994.

	Weed Number				
Predominant Weed Species	'Celia' triticale	'Cayuse' oat	'Juan' triticale	Native vegetation	Herbicide Control
Common groundsel	66	1	0	284	10
Prickly lettuce	8	10	0	29	2
Little bittercress	14	9	0	15	2
Annual bluegrass	24	10	0	61	1
False dandelion	5	2	0	12	2
Annual Sowthistle	8	0	0	8	1
Common dandelion	5	2	0	14	1

[1] Based on an area of 665 ft^2

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HERBICIDE INDEX

(by common name or code designation)

This table was compiled from nomenclature approved by the Weed Science Society of America Terminology Committee (Published in each issue of Weed Science) and the Herbicide Handbook of the WSSA (6th edition). "Page" refers to the page where a report about the herbicide begins; actual mention may be on a following page.

cycloate	S-ethyl cyclohexylethylcarbamothioate	99,104
desmedipham	ethyl[3[[(phenyamino)carbonyl]oxy] phenyl]carbamate	98,100,101,102,103, 104,105,106,107
dicamba	3,6-dichloro-2-methoxybenzoic acid	10,11,27,30,37,38, 39,40,41,42,79,80, 81,82,92,110,114,121
dichlormid	N,N-diallyl-2,2-dichloroacetamid	44,87,119
diclofop	(±)-2-[4(2,4-dichlorophenoxy) phenoxy]propanoic acid	58,59,60,109,110, 117,118
difenzoquat	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	59,60,109
dimethenamid	2-chloro-N-(2,4-dimethyl-3-thienyl) -N-(2-methoxy-1-methylethyl)-acetamide	44,47,49,69,74,76, 95,113
DPX-66037	2-[[[[[(4-dimethylamino)-6-(2,2,2-trifluoroethoxy)-13,5-triazin-2-yl]amino] carbonyl]amino]sulfonyl]-3-methylbenzoic acid	101,102,103,104
endothall	7-oxabicyclo[2.2.1]heptane-2, 3-dicarboxylic acid	105
EPTC	S-ethyl dipropylcarbamothioate	55,77,98,119
ethafluralin	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine	48,92
ethofumesate	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate	92,93,98,99,100, 106,107
F 6285	Not available	93
F 8426	ethyl-2-chloro3-[2-chloro-4-fluoro-5-(4-difluoromethyl)4,5-dihydro-3 methyl-5-oxo-1H-1,2,4-triazol-lyl[phenyl-propanoate	108,115
fenoxaprop	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid	59
flumetsulam	N-[2,6-difluorophenyl]-5-methyle (1,2,4)triazolo-[1,5a]-pyrimidine-2-sulfonamide	75
flumiclorac	[2-chloro-4-fluoro-5-(1,3,4,5,6,7-hexa-hydro-1,3-dioxo-2H-isoindol-2-yl)phenoxy]acetic acid	79
fluroxypyr	[(4-amino-3,5-dichloro-6-fluorophyridinyl)oxy]acetic acid	18,29,41,42
fluxofenim	1-(4-chlorophenyl)-2,2,2-trifluoroethanone-0-(1,3-dioxolan-2-ylmethyl)axime	113

glyphosate	N-(phosphonomethyl)glycine	7,9,23,27,33,39, 87,88,92,120,127
halosulfuron	methyl-3-chloro-5-(4,6-dimethoxy pyrimidin-2yl-carbamoylsulfamoyl)-1-methyl pyrazole-4-carboxylate	82
imazamethabenz	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxy-1H-imidazol-2-yl]-4(and 5)-methylbenzoic acid (3:2)	57,58,59,60,109
imazapyr	(±)-2-[4,5-dihydro-4-methyl-4-(1,-emthylethyl)-5-oxo-1H-imidazol-2-yl]4(and 5)-methylbenzoic acid (3:2)	2,127
imazaquin	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-quinolinecarboxylic acid	19
imazethapyr	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-1-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid	19,26,53,54,55, 67,68,69,80
lactofen	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy}-2-nitrobenzoate	47
MCPA	(4-chloro-2-methylphenoxy) acetic acid	59,61,63,109, 110,112,114
metham	methylcartbamodithioic acid	86,87,99
metolachlor	2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(2-methoxy-1-methyl-ethyl)acetamide	44,47,49,67,73,74, 75,76,79,89,93,95, 96,113
metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5 (4H)-one	81,83,89,92,95, 118
metsulfuron	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]	9,10,11,13,14,30, 37,38,39,40,41,42, 121
MON 65005	N-(phosphonomethyl)glycine	87
NA 305	coformulation of desmedipah, ethofumesate and phenmedipham	106,107
NA 307	coformulatin of desmidipham, ethofumesate and phenmedipham	106,107
NA 308	Same as above	106,107
napropamide	N,N-diethyl-2-(1-napthalenyloxy) propanamide	50,130
napthalam	2-[(1-napthalenylamino)carbonyl] benzoic acid	48

nicosulfuron	2-[[[[(4,6-dimethoxy-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl]-N,N-dimethyl-3-pyridinecarboxamide	44,77,79,80,83
oxyfluorfen	2-chloro-3-(3-ethoxy-4-nitro-phenoxy)-4-(trifluoromethyl)benzene	92,94
paraquat	1,1'-dimethyl-4,4'bipyridinium ion	7,92
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	67,80,84,89,92
phenmedipham	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate	98,100,101, 102,103,104,105, 106.107
phrithiobace	Not available	85
picloram	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	9,10,11,13,14,16,17, 18,19,21,22,23,26, 27,29,30,31,32,33, 37,38,39,40,41,42
primisulfuron	2-[[[[[4,6-bix(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl] amino]sulfonyl]benzoic acid	79,80,81,82,90
pronamide	3,5-dichloro(N-1,1-dimethyl-2-propynyl)benzamide	92
prosulfuron	See CGA 152005	82
pyridate	O-(6-chloro-3-phenyl-4-pyridazinyl) -S-octyl carbamothiate	54
quinclorac	3,7-dichloro-8-quinoline-carboxylic acid	17,22,26,31,33
quizalofop	±-2-[4-[6-chloro-2-quinoxalinyl) oxy]phenoxy]propanoic acid	72
rimsulfuron	N-[[(4,6-dimethoxy-2-pyrimidinyl) carbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide	45
SAN 845	3,6-dichloro-2-methoxy benzoic acid	114
sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	71,72,130
sulfometuron	2-[[[[(4,6-dimethyl-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl] benzoic acid	2,5
terbacil	5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione	89
thifensulfuron	3-[[[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] amino]sulfonyl]-2-thiophene-carboxylic acid	61,62,63,70,109,110, 111,112,114,115,117

triallate	S-(2,3,3-trichloro-2-propenyl)bis (1-methylethyl)carbamothioate	118,119
triasulfuron	2-(2-chloroethoxy)-N-[[4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]benzene-sulfonamide	118
thiazophyr	methyl 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl) -6-trifluoromethyl-3-pyridinecarboxylate	56
tralkoxydim	2-cyclohexen-1-one-2-[1-ethoxyimino) propyl]-3hydroxy-5-(2,4,6-trimethylphenyl)-propanoate	58,59,60
tribenuron	2-[[[[(4-methoxy-6-menthyl-1,3,5-traizin-2-yl)methylamino]carbonyl] amino]sulfonyl]benzoic acid	61,62,63,70,109,111, 112,114,115,117
triclopyr	[(3,5,6-trichloro-2-pyridinyl) oxy]acetic acid	8,21,30,31,40
trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine	84,92,98
triflusulfuron	See DPX-66037	
2,4-D	(2,4-dichlorophenoxy)acetic acid	8,9,10,11,13,16,17, 18,19,21,22,23,26, 27,29,30,32,38,39, 40,41,42,58,59,80,81, 83,108,114,115,120, 121
2,4-DB	4-(2,4-dichlorophenoxy)butanic acid	54

ABBREVIATIONS

+	plus
>	greater than
%	percent
#	number
A, a, or ac	acres(s)
ae	acid equivalent
AEGCY	jointed goatgrass
Ag or Agric.	Agriculture
AGRSM	Agropyron smithii
ai or a.i.	active ingredient
ai/a	active ingredient per acre
AMABL	prostrate pigweed
AMARE	redroot pigweed
AMMN	ammonium nitrate
ANCVR	spurred anoda
ANOVA	analysis of variance
ANTCO	mayweed chamomile
APEIN	interrupted windgrass
APHDE	toothed spurge
Appl.	application
ARLU	Alnus rubra
AT	air temperature
Aug.	August
AVEFA	wild oats
AVESA	oats
AZ	Arizona
Bare G	Bare ground
BETVU	sugar beet
BOUGR	Bouteloua gracilis
BRANI	black mustard
BROMUS	brumus species
BROTC	Bromus tectorum
BROTE	downy brome
bu/A	bushel(s) per acre
C	degrees Celsius
CA	California
CAPBP	shepherd's purse
CARFI	Carex filifolia
CEC	cation exchange capacity
CENCY	cornflower
CENTRE	Centaurea repens
CHEAL	common lambsquarter
CHEMU	nettleleaf goosefoot
CIRAR	Cirsium arvense
cm	centimeter(s)
CO	Colorado
CO2 or CO_2	carbon dioxide
COC	crop oil concentrate
Cotyl or coty.	cotyledon
CRP	Conservation Reserve Program
CRUAC	Carduus acanthoids
CV or cv	coefficient of variation
cwt	one hundred weight
cwt/A	hundred weight per acre
CYWOF	Cynoglossum officinale
DAT	days after treatment
DBP	days before planting
Dept	Department
DESSO	flixweed
Dev	deviation
DF	dry flowable

E . . . . east
E post or EPOST . . . . early postemergence
EB . . . . early bloom
EC . . . . emulsifiable concentrate
ECHCO . . . . junglerice
ECHCG . . . . barnyardgrass
Ent . . . . entomology
EPHES . . . . Euphorbia esula
EROCI . . . . redstem filaree
Exp . . . . Experiment
Ext. . . . . extension
F . . . . value of statistical test
F . . . . degrees Fahrenheit
ft of ' . . . . foot or feet
ft^2 . . . . square feet
g ha^{-1} or g/ha . . . . gram(s) per hectare
g . . . . gram(s)
G/A, GPA or gpa . . . . gallon(s) per acre
G . . . . granule
GALAP . . . . catchweed bedstraw
gpa or gal/a . . . . gallon(s) per acre
ha . . . . hectare
HALGL . . . . Galogeton glomeratus
HORVU . . . . barley
hr . . . . hour(s)
ID . . . . Idaho
in or " . . . . inch(es)
IR . . . . imidazolionone resistant
IT . . . . imidazolinone tolerant
Jun . . . . June
K . . . . potassium
KCHSC . . . . kochia
kg . . . . kilogram
kg/m . . . . kilogram(s) per meter
kg/ha . . . . kilogram(s) per hectare
km/h . . . . kilometer(s) per hour
kPa . . . . kilopascal
L ha^{-1} or L/ha . . . . liter(s) per hectare
L . . . . litre(s)
L . . . . liquid
LACSE . . . . prickly lettuce
LAMAM . . . . henbit
lb ai/A . . . . pound(s) active ingredient per acre
lb or lbs . . . . pound(s)
lb ai/gal . . . . pound(s acid equivalent per gallon
lb/A or lbs/A . . . . pound(s) per acre
lb . . . . pound(s)
LC . . . . liquid concentrate
LENCU . . . . lentil
lf . . . . leaf
LOLMU . . . . Italian ryegrass
LP . . . . low pressure
LPOST . . . . late postemergence
LSD . . . . Least Significant Difference
LVE . . . . low volatile ester
m . . . . meter(s)
m^2 . . . . square meters
MAFT . . . . months after first treatment
MALPA . . . . little mallow
MAT or mat . . . . months after treatment
meq . . . . millequivalent
MIF . . . . modified in furrow
misc . . . . miscellaneous
MONLI . . . . narrowleaf montia

mph	miles per hour
MPOST	periodic contact type postemergence treatment
MSO	methylated seed oil
N	nitrogen or north
ND	North Dakota
NIS	nonionic surfactant
NM	New Mexico
NMSU	New Mexico State University
NS or ns	non significant
NW	northwest
Oct	October
OM or o.m.	organic matter
OPUPO	Opuntia polycantha
OR	Oregon
oz/A	ounce(s) per acre
oz	ounce
p or %	percent
P	probability
PANMI	wild proso millet
PDIR	post-directed
PEI	preemergence incorporated
pH	(-) log hydrogen ion concentration
plts/ft^2 or plants/ft^2	plants per square foot
PM or pm	package mix
PNW	Pacific Northwest
POLCO	wild buckwheat
POPES	postplant preemergence surface
POPI	postplant incorporated
POST, Post, post or POE	postemergence
PPI or ppi	preplant incorporated
PRE, pree or pre	preemergence
psi	pounds per square inch
PSME	Pseudotsuga menziesii
pt/A	pint(s) per acre
PTO	power take-off
qt/A	quart(s) per acre
RCB	randomized complete block
RES	research
RH	relative humidity
S	south
SASKR	Russian thistle
Sci	Science
SE	southeast
SECCE	volunteer rye
SENVU	common grundsel
SEP	September
SETVI	green foxtail
SG	soluble granule
SGF	soluble granule formulation
SOLNI	black nightshade
SOLSA	hairy nightshade
SOLTR	cutleaf nightshade
SONAS	spiny sowthistle
SONOL	sowthistle
SSYAL	tumble mustard
SSYIR	London rocket
ST	soil temperature
Sta	Station
STEME	common chickweed
STICO	Stipa comata
SW	southwest
T/A, tpa or t/A	ton(s) per acre
Temp	temperature
THLAR	field pennycress

TRIAE	volunteer wheat
Univ	university
USA	United State of America
UT	Utah
v/v	volume per volume
var	variety or varieties
var	variation
vars	varieties
w/w	weight to weight
W	west
WA	Washington
WAT	weeks after treatment
WG	water dispersible granule
wks	weeks
WP	wettable powder
wsp	water soluble powder
WY	Wyoming