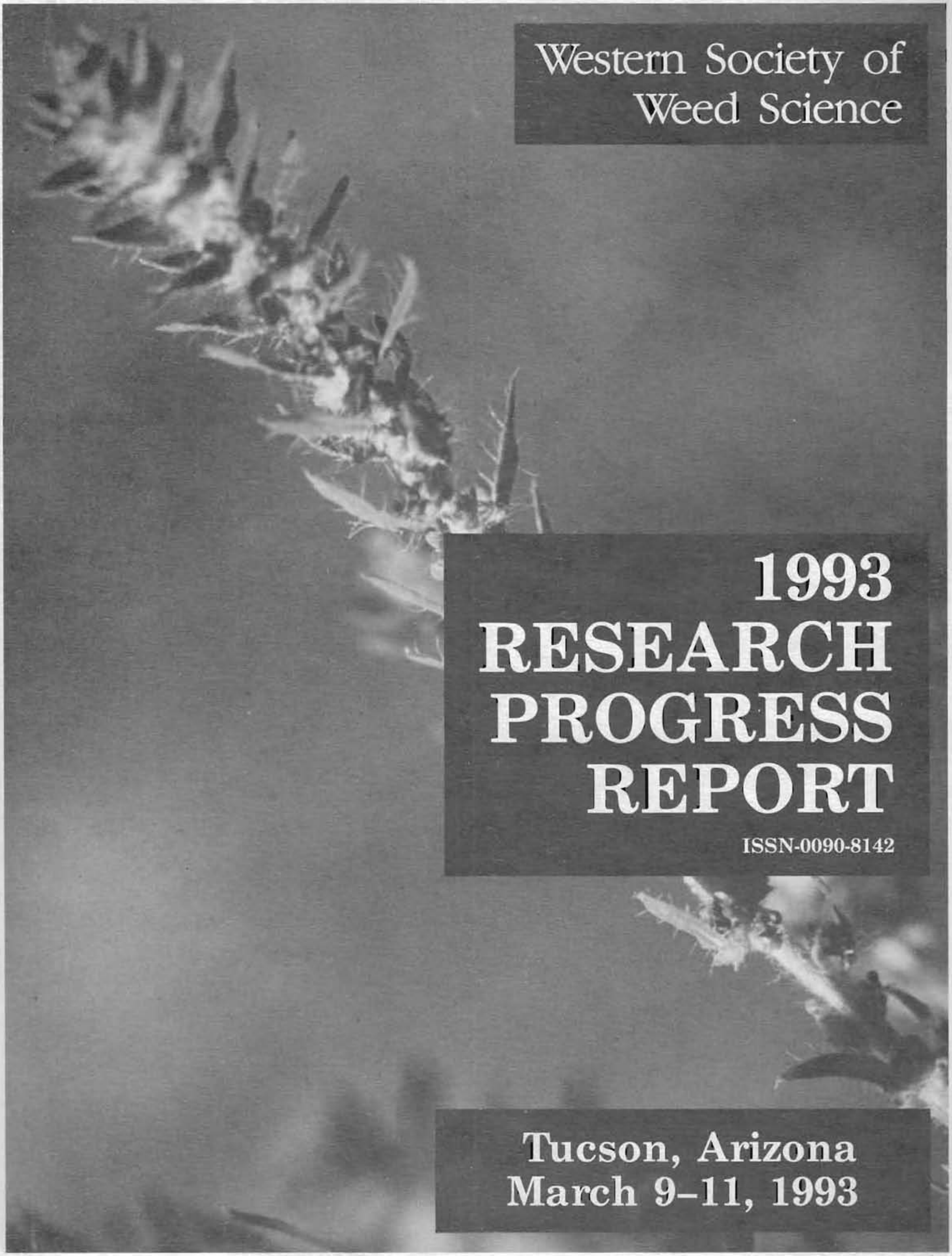

Western Society of Weed Science

1993 RESEARCH PROGRESS REPORT

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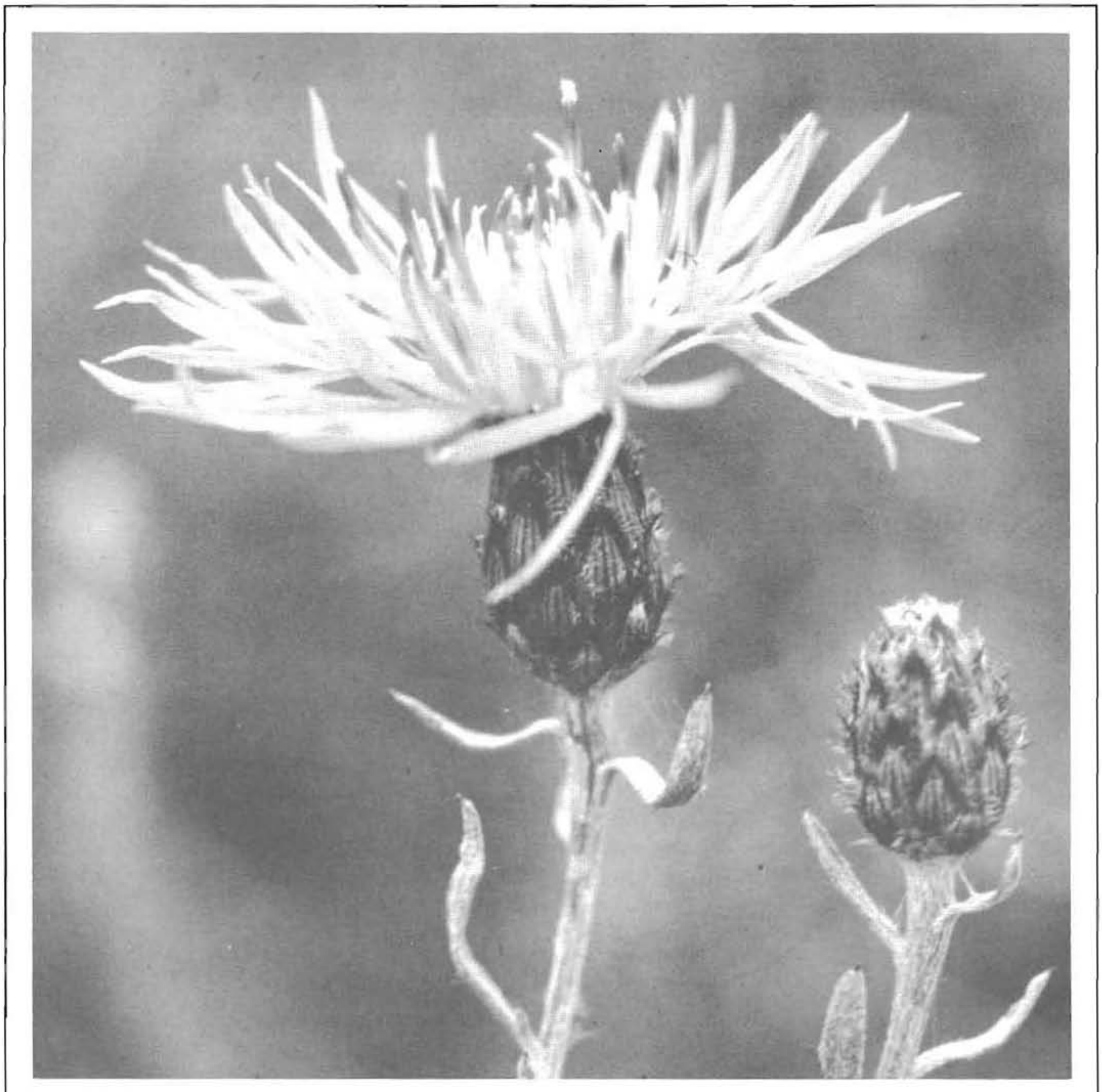

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FOREWARD

The 1993 Research Progress Report of the Western Society of Weed Science (WSWS) is a compilation of contributed results of research investigations by weed scientists in the Western United States. The overall objective of the Research Progress Report is to provide an avenue for the presentation and exchange of on-going research to the weed science community. The information in this report is preliminary; therefore, it is neither intended for publication, nor for development of endorsements or recommendations.

The reports contained herein and their respective content, format, and style are the responsibility of the author(s) who submitted them. Reports are neither retyped nor edited significantly and are photoreproduced for publication. The seven project chairpersons and chairpersons-elect were responsible for organizing and indexing reports within their projects. WSWS appreciates the time and effort of the chairperson and chairperson-elect of each project and the authors who shared their research results with other members of WSWS. Final compilation of this report is the responsibility of the Research Section Chairperson.

Charlotte Eberlein
Chairperson, Research Section
Western Society of Weed Science
1993

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PROJECT I

WEEDS OF RANGE AND FOREST

Paul F. Figueroa - Project Chairperson
Keith W. Duncan - Project Chairperson-Elect

Control of red alder seed germination using pre-plant broadcast herbicide applications: Preliminary status report. Figueroa, P.F. Red alder is a major hardwood competitor to conifers in the Pacific Northwest. It has the ability to seed in from adjacent natural stands, germinate, and develop to a level where conifers are overtopped and growth is reduced. The standard control method is to wait until alder densities exceed a density threshold and has overtopped planted conifers.

The standard spring foliar 2,4-D conifer release treatment has to be applied during a narrow window of application to minimize conifer injury. The window of application occurs when 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). The strictness of this guide has resulted in restriction in operational herbicide treatment duration that have ranged from a just a few days to several weeks in length from year to year. An alternative alder control strategy is to prevent red alder seed from germinating through the use of soil-active herbicides. This would 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 in the fall of 1988. Forty-eight 0.06 acre treatment plots were established in a Randomized Complete Block design to test imazapyr, asulam, atrazine, and sulfometuron as pre-plant, and pre-plant plus repeat broadcast application treatments to prevent alder seed from germinating. Blocks were established to correspond to seeding distances from a mature alder seed stand. These blocks represented zones 50-100, 100-150, 150-200, and 200-250 feet from the seed source. Pre-plant herbicide treatments were initially applied 3 weeks before prior to planting 2+0 Douglas-fir seedlings (3/6/89). Follow-up release treatments were done in March 1990 and February 1991.

Treatments were as follows:

Check	no herbicide treatment
Asulam (1.7 lb/a)	year 0 only (Aug 1989)
Imazapyr (0.15 lb/a)	year 0, year 0+1, year 0+1+2
Atrazine (4.0 lb/a)	year 0, year 0+1, year 0+1+2
Atrazine (4 lb/a year 0+1+2 plus asulam (1.7 lb/a) year 0	year 0,1,2; Aug 1989 for asulam
Sulfometuron (2 oz/ac)	year 0, year 0+1, year 0+1+2

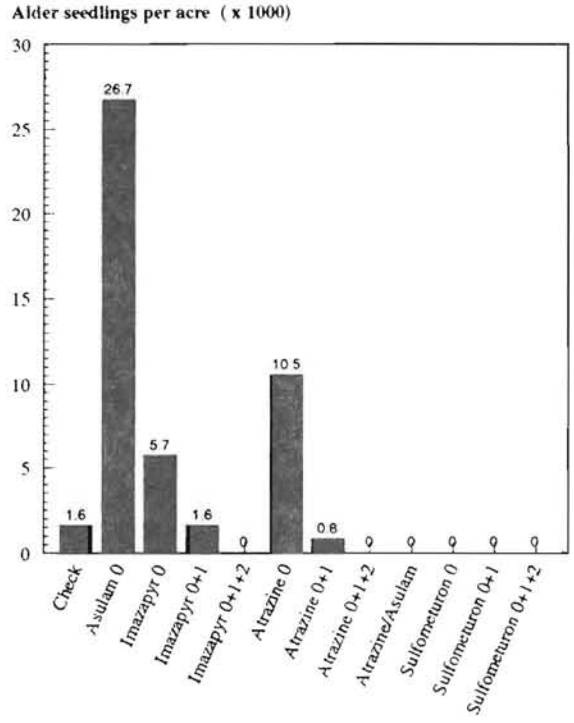
Alder seed germination patterns result in seed germination beginning closest to the seed source then progressing further distances over a five to ten year period. The following preliminary results are based on an evaluation of the red alder seeding germination data for the 50 to 100 feet zone only, since alder germination has only progressed to the 50 to 100 feet zone after four years.

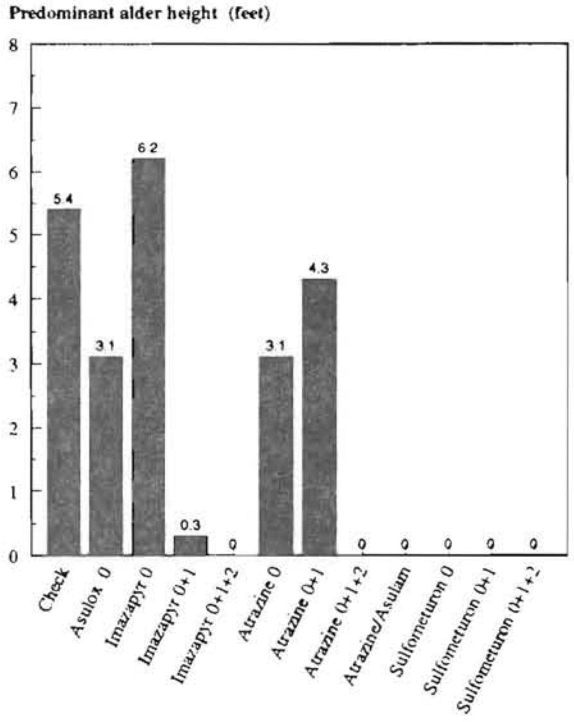
Alder germination ranged between 0 and 26,700 seedlings per acre across all treatments within the 50-100 feet zone from the natural alder stand. The non-treated check plot averaged 1600 alder per acre while the asulam and imazapyr 0, 0+1, and atrazine 0, treatments had higher levels of alder germination (Figure 1). Predominant height is the average co-dominant level of the stand. Predominant height of red alder ranged between 0.3 and 6.2 feet after four years (Figure 2) amongst treatments.

At this age in the stand, alder seeding density differences could be related to chance, but it appears applications of sulfometuron was effective preventing alder seed from germinating. Visual observations revealed 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) suggest there are other positive gains from sulfometuron in addition to controlling red alder germination.

In sites where the risk of natural seeding of red alder is high, use of soil-active herbicides, sulfometuron, and multiple year applications of atrazine may provide preventative control of red alder. This may reduce or eliminate a conifer release treatment at a later date. Future assessments of this site are planned to further evaluate herbicide treatments effects on red alder germination, overall vegetation control, and Douglas-fir growth resulting from various herbicide treatments. (Weyerhaeuser Company, 505 North Pearl Street, Centralia, WA 98531).

Ryderwood, 9100 Road herbicide screening trial. Preliminary data from plots within 50 to 100 feet zone from a mature natural alder stand. Alder seeding density and height four years after Douglas-fir plantation establishment. Asulam applied at 1.7 lb/a, imazapyr at 0.15 lb/a, atrazine at 4.0 lb/a, and sulfometuron at 2 oz/a.





Herbicide treatments applied in spring 1989 three weeks prior to planting Douglas-fir. Applications at plantation age 1 and 2 applied as a broadcast during March and February.

Mechanical control of red alder during the 60 to 120 day treatment window. Figueroa, P.F. Red alder stump sprouts vigorously after cutting, and has the ability to regain height dominance within 2 to 3 years. Hoyer and Belz (Stump sprouting related to time of cutting red alder, Washington Dept. of Natural Resources report #46, 1984) evaluated red alder mechanical control studies and developed a basic window for successful cutting to minimize alder stump sprouting. Their recommendations include 1) cutting stumps lower than 6 inches (this reduces stem surface area promoting rapid stump decay, 2) cut alder as it approaches seed bearing age (10 years), and 3) cut alder when plant moisture stress is high and during the period of low carbohydrate reserves. The current recommended mechanical cutting guide is to treat during a period 60 to 120 days after alder bud break.

An operational side-by-side demonstration site was established at Cambell Creek in the Ryderwood block of Weyerhaeuser Company's SW Washington Region. The site was broadcast burned for site preparation in fall 1982 then planted in January 1983 with 2+1 Douglas-fir. The mechanical cutting treatments were applied at plantation age 7 years. The area was divided into three 5-acre blocks. Operational mechanical cutting of red alder was to done to successive blocks at 80 (June), 105 (July), and 141 (August) days after red alder bud break, respectively.

Data collected two years after treatment showed 288 alder per acre or 19% of the cut alder sprouted in the 80 day (June) treatment as shown on the table. Most stumps had more than one stem sprouting. In addition to the 288 main stump sprouts, there was 440 smaller stems sprouting from these stumps. The height growth trend of cut alder indicates that alder in this area could regain height dominance over Douglas-fir within three years after cutting.

The 105 day (July) treatment was at successful preventing cut red alder from stump-sprouting. Only 5% of cut alder sprouted and those sprouts averaged only 0.1 feet in height two years after cutting. The 141 day (August) treatment was implemented outside the recommended cutting window and 33% the cut stumps sprouted. A total of 3640 additional alder stems were sprouting from these stumps. Alder gained height co-dominance two years after treatment and is expected to overtop the Douglas-fir three years after cutting.

This demonstration was established in an area which had different initial stand conditions. These differences may be part of the reasons why there were resprouting differences amongst treatments. When mechanical cutting has been selected as the method to control red alder, the lowest risk of getting alder sprouting would occur when cutting is timed to coincide with the center of the 60 to 120 window. The application of herbicides to cut stumps within 5 to 15 minutes after cutting will eliminate stump sprouting. Use of herbicides will increase treatment costs, but allow expansion of the mechanical cutting window to include the April through September period. (Weyerhaeuser Company, 505 North Pearl St., Centralia, WA 98531).

Stand statistics before and after mechanical cutting of red alder to release a seven-year-old Douglas-fir plantation from alder competition.

Species	Cut Month	Days After Red Alder Bud Break	Density age 7	Density age 9	DBH age 7	DBH age 9	Mean Height age 7	Mean Height age 9	% of Douglas-fir Damaged	# of Additional Sprouts
			tpa	*tpa*	*in*	*in*	*ft*	*ft*	%	*#/ac*
Red alder	Jun	80	1488	288	1.4	0.8	12.9	10.5	-	440
Std err			*804*	*189*	*0.3*	*0.5*	*2.4*	*5.3*		*586*
Red alder	Jul	105	367	17	3.2	0.0	23.5	0.1	-	0
Std err			*361*	*41*	*0.6*	*0*	*3.3*	*0.3*		*0*
Red alder	Aug	141	4340	1440	1.4	0.9	15.3	12.8	-	3640
Std err			*1710*	*1030*	*0.2*	*0.4*	*2.7*	*5.0*		*4082*
Douglas-fir	Jun	80	363	363	1.3	2.2	9.9	15.4	6.7	-
Std err			*151*	*151*	*0.9*	*1.3*	*4.8*	*6.3*	*4.6*	
Douglas-fir	Jul	105	550	517	2.4	3.4	16.1	21.3	11.1	-
Std err			*137*	*147*	*0.4*	*0.6*	*2.0*	*2.5*	*5.6*	
Douglas-fir	Aug	141	370	370	1.4	2.4	11.0	14.9	0	-
Std err			*182*	*182*	*0.9*	*1.1*	*5.7*	*7.0*	*0*	

* Percent Douglas-fir mechanically damaged by falling trees during cutting.

** Number of additional alder sprouts from stumps not measured as part of the age 9 density, DBH, and height statistics.

Seaside arrowgrass control with various rates of metsulfuron. Whitson, T.D., W.R. Tatman and R.J. Swearingen. Seaside arrowgrass is a perennial poisonous plant common in wetlands and hay meadows in the western U.S. This study was initiated following previous studies conducted with metsulfuron for seaside arrowgrass control to better define minimum application rates required for control. Herbicides were applied July 20, 1991 when seaside arrowgrass was 3 to 6 inches tall in the vegetative stage. Plots 10 by 27 ft were arranged in a randomized complete block design with four replications. Herbicides were applied broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information July 20, 1990: temperature air 77F, soil surface 74F, 1 inch 67F, 2 inches 68F, 4 inches 61F with 55% relative humidity and calm winds. Soil was a sandy loam (57% sand, 22% silt and 21% clay) with 3.9% organic matter and a pH of 7.2. Seaside arrowgrass control was excellent with rates of metsulfuron of 0.015 lb ai/A and higher the second year following application. Complete control was obtained with all metsulfuron application rates in 1991. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1672).

Seaside arrowgrass control with various rates of metsulfuron.

		% Control[2]	
Herbicide	Rate lb ai/A[1]	1991	1992
metsulfuron	.0038	100	56
metsulfuron	.0075	100	67
metsulfuron	.011	100	85
metsulfuron	.015	100	99
metsulfuron	.0188	100	96
metsulfuron	.0225	100	98
metsulfuron	.03	100	100

[1]Herbicides were applied 8/20/90.
[2]Evaluations were made 8/24/91 and 8/28/92.

Seaside Arrowgrass Control Using Various Rates of Escort
% Control (Replication Data)

Herbicide[1]	Rate lb ai/A[2]	Rep 1	Rep 2	Rep 3	Rep 4	Ave.
metsulfuron(Escort)+X-77	.0038+.25%	50	50	85	40	56
metsulfuron(Escort)+X-77	.0075+.25%	95	40	40	93	67
metsulfuron(Escort)+X-77	.011+.25%	98	90	60	90	85
metsulfuron(Escort)+X-77	.015+.25%	98	100	98	100	99
metsulfuron(Escort)+X-77	.0188+.25%	100	100	90	95	96
metsulfuron(Escort)+X-77	.0225+.25%	100	100	100	90	98
metsulfuron(Escort)+X-77	.030+.25%	100	98	100	100	100

[1]Herbicides were applied August 20, 1990. Evaluations were made August 28, 1992.
[2].0038 = 0.1 oz product/A .030 = 0.7 oz product/A

The effects of successive herbicide applications for control of downy brome (Bromus tectorum L.) in rangeland. Whitson, T.D., R.J. Swearingen, G.E. Fink and A. Lauer. Downy brome has become a very competitive annual grass in rangeland. Because of its very early growth habit it takes most of the moisture and nutrients away from the desirable perennial grasses in a rangeland community. Four studies were established to determine the effects of three yearly applications of various herbicides on the seed bank of downy brome. Treatments were applied to 35 by 660 ft. plots as single blocks with four randomized permanent transects established within each block. Herbicides were applied with a tractor mounted sprayer delivering 17 gpa at 35 psi. Application information: Niobrara County, WY April 25, 1991, temperature: air 70F, soil surface 60F, 1 inch 60F, 2 inches 60F, 4 inches 56F with 70% relative humidity and 3 to 4 mph south winds. Downy brome was in the 3 to 4 leaf stage, 1 inch tall. May 29, 1991, temperature: air 75F, soil surface 84F, 1 inch 76F, 2 inches 74F, 4 inches 73F with 65% relative humidity and 2 to 5 mph SE winds. Downy brome was in the early bloom stage. April 21, 1992, temperature: air 40F, soil surface 67F, 1 inch 64F, 2 inches 62F, 4 inches 60F with 68% relative humidity and a 4 to 5 mph west wind. Downy brome was in the 1 to 2 leaf growth stage. May 8, 1992, temperature: air 90F, soil surface 90F, 1 inch 95F, 2 inches 90F, 4 inches 85F with 50% relative humidity and calm winds. Downy brome was 50% early seed head stage. Johnson County, WY April 9, 1991, temperature: air 48F, soil surface 45F, 1 inch 45F, 2 inches 45F, 4 inches 42F with 48% relative humidity and 2 to 5 mph north winds. Downy brome was in the 2 to 4 leaf stage, 1 inch tall. May 17, 1992, temperature: air 55F, soil surface 53F, 1 inch 49F, 2 inches 49F, 4 inches 55F with 55% relative humidity and calm winds. Downy brome was in the 5 to 6 leaf stage, 1 inch tall. May 17, 1991, temperature: air 55F, soil surface 53F, 1 inch 49F, 2 inches 49F, 4 inches 55F with 55% relative humidity and calm winds. Downy brome was in the 5 to 6 leaf stage, 2 inches tall. April 23, 1992, temperature: air 59F, soil surface 67F, 1 inch 65F, 2 inches 63F, 4 inches 62F with 59% relative humidity and calm winds. May 6, 1992, temperature: air 80F, soil surface 70F, 1 inch 70F, 2 inches 70F, 4 inches 65F with 32% relative humidity and calm winds. Downy brome was in the 2 to 4 leaf stage. May 6, 1992, temperature: air 80F, soil surface 70F, 1 inch 70F, 2 inches 70F, 4 inches 65F. Downy brome was in a 50% seed head emergence stage. Unusually wet, cool conditions in Johnson Co. stimulated a second flush of downy brome seed to germinate following the May herbicide application. Herbicide applications made in 1991 without a second application in 1992 failed to control downy brome in 1992. At the Niobrara County location (Table 1) all paraquat applications applied in 1992 controlled greater than 97% of the downy brome at both application times. Glyphosate applied in 1992 was effective when applied in April at all application rates. Glyphosate applications in May were more effective when applied at the 0.63 lb ai/A rate or greater. At the Johnson Co. location (Table 2) only applications of paraquat of 0.9 and 1.1 lb ai/A applied in May at the 50% seed head emergence stage provided effective control of downy brome. Herbicides will be applied the third year in 1993 to determine if downy brome seed banks can be diminished with repeated treatments of herbicides. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1668).

Table 1. The effects of successive herbicide application for control of downy bromeon rangeland.

Herbicides	Rate lb ai/A	Application date(s)	% Control
Paraquat	0.5	4/25/91	0
	0.5	4/25/91, 4/22/92	99
	0.5	5/29/91	0
	0.5	5/29/91, 5/8/92	97
Paraquat	0.7	4/25/91	0
	0.7	4/25/92, 4/22/92	99
	0.7	5/29/91	0
	0.7	5/29/91, 5/8/92	99
Paraquat	0.9	4/25/91	0
	0.9	4/25/91, 4/22/92	99
	0.9	5/29/91	0
	0.9	5/29/91, 5/8/92	99
Paraquat	1.1	4/25/91	0
	1.1	4/25/91, 4/22/92	99
	1.1	5/29/91	0
	1.1	5/29/91, 5/8/92	99
Glyphosate	.37	4/25/91	0
	.37	4/25/91, 4/22/92	99
	.37	5/29/91	0
	.37	5/29/91, 5/8/92	80
Glyphosate	.5	4/25/91	0
	.5	4/25/91, 4/22/92	95
	.5	5/29/91	0
	.5	5/29/91, 5/8/92	90
Glyphosate	.63	4/25/91	10
	.63	4/25/91, 4/22/92	98
	.63	5/29/91	0
	.63	5/29/91, 5/8/92	95
Glyphosate	.75	4/25/91	0
	.75	4/25/91, 4/22/92	99
	.75	5/29/91	0
	.75	5/29/91, 5/8/92	99
Banvel + Atrazine	.28 + .53	4/25/91	85
	.28 + .53	4/25/91, 4/22/92	85
	.28 + .53	5/29/91	0
	.28 + .53	5/29/91, 5/8/92	85
Check	- - - -		0

Experimental location: Ronnie & Margie Brown Ranch, Niobrara County, Wyoming
Evaluated: July 7, 1992

Table 2. The effects of successive herbicide applications for control of downy brome on rangeland.

Herbicide	Rate lb ai/A	Application Date(s)	% Control
Paraquat	0.5	4/9/91	0
	0.5	4/9/91, 4/23/92	60
	0.5	5/17/91	0
	0.5	5/17/91, 5/6/92	20
Paraquat	0.7	4/9/91	0
	0.7	4/9/91, 4/23/92	80
	0.7	5/17/91	0
	0.7	5/17/91, 5/6/92	80
Paraquat	0.9	4/9/91	0
	0.9	4/9/91, 4/23/92	85
	0.9	5/17/91	0
	0.9	5/17/91, 5/6/92	95
Paraquat	1.1	4/9/91	0
	1.1	4/9/91, 4/23/92	75
	1.1	5/17/91	0
	1.1	5/17/91, 5/6/92	95
Glyphosate	0.37	4/9/91	0
	0.37	4/9/91, 4/23/92	35
	0.37	5/17/91	0
	0.37	5/17/91, 5/6/92	0
Glyphosate	0.5	4/9/91	0
	0.5	4/9/91, 4/23/92	35
	0.5	5/17/91	0
	0.5	5/17/91, 5/6/92	0
Glyphosate	0.63	4/9/91	0
	0.63	4/9/91, 4/23/92	70
	0.63	5/17/91	0
	0.63	5/17/91, 5/6/92	0
Glyphosate	0.75	4/9/91	0
	0.75	4/9/91, 4/23/92	50
	0.75	5/17/91	0
	0.75	5/17/91, 5/6/92	0
Banvel + Atrazine	0.28 + 0.53	5/17/92	0
	0.28 + 0.53	5/17/91, 5/6/92	80
Check	- - -	- - -	0

Experimental location: Glen Means Ranch, Johnson County, Wyoming
Evaluated: 7/14/92

Demonstration of herbicide control of common burdock. Zamora, D.L. To demonstrate the effectiveness of 2,4-D for controlling common burdock (*Arctium minus*) to central Montana ranchers a demonstration trial was established on a ranch near Lewistown.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied on 6/9/92 to burdock with 5 to 7 leaves. A visual estimate of control (necrosis, chlorosis, growth reduction) was made on 6/24/92.

Surfactant increased control of burdock at the low rates of 2,4-D. Control of burdock by clopyralid was increased by addition of 2,4-D. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of herbicides on common burdock at Lewistown, MT.

Herbicide[1]	Rate	Rosettes
	(lbs ai/a)	(% check)
2,4-D amine	0.95	12
2,4-D amine	1.43	27
2,4-D amine	1.9	27
2,4-D amine + surfactant	0.95 + 0.5% v/v	40
2,4-D amine + surfactant	1.43 + 0.5% v/v	50
2,4-D amine + surfactant	1.9 + 0.5% v/v	40
Clopyralid	0.094	47
Clopyralid + 2,4-D amine	0.095 + 0.5	60
Check		-
PR > F		0.01
LSD (0.05)		21

[1] All treatments included a nonionic surfactant at 0.5% v/v.

Control of sulfur cinquefoil at Missoula, MT. Zamora, D.L. Sulfur cinquefoil (*Potentilla recta*) was first reported in Montana in 1948. It can now be found in at least 19 counties in Montana and another 20 counties in Washington, Idaho, and Wyoming. A study examining the effect of herbicides on sulfur cinquefoil was started in 1991. This study was repeated in 1992.

The 1991 experiment was a randomized complete block design with four replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied at the rosette stage of growth on 6/10/92; bud stage treatments were applied on 6/22/91; mowing treatments were applied on 7/8/91; fall treatments were applied on 10/7/91. A visual estimate of percentage control (necrosis, chlorosis, height, and flowering) was made on 8/4/91. Percent coverage (an average of three 0.5-ft^2 quadrats systematically placed on a transect) was evaluated on 7/5/92.

The 1992 experiment design and application methods were the same as for the 1991 study and is located approximately 100 yds from the 1991 study site. Treatments were applied at the rosette stage of growth on 5/5/92; bud stage treatments were applied on 5/31/92; mowing treatments were applied in late June; fall treatments were applied on 9/15/92. Height of seven randomly chosen plants in each plot was measured on 7/5/92. Percent of the four replicated plots having plants that flowered also was evaluated on 7/5/92.

A split application of metsulfuron, a single application of clopyralid plus 2,4-D (0.19 + 1.0 lbs ai/a), and mowing controlled sulfur cinquefoil best the year of application for the 1991 study (Table 1.). The year after application, only picloram (0.25 lbs ai/a) treated plots had no sulfur cinquefoil plants.

A split application of metsulfuron, a single application of metsulfuron (0.011 lbs ai/a) at the rosette stage of growth, and picloram plus 2,4-D (0.25 + 0.94 lbs ai/a) resulted in short plants and no seed production for the 1992 study (Table 2). (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Table 1. Sulfur cinquefoil control at Missoula, MT - 1991.

Herbicide	Rate	Timing	Control 8/4/91	Coverage 7/5/92
	(lbs ai/a)		(%)	(%)
Picloram	0.125	rosette	30 defg[1]	0.4 d
Picloram	0.125/ 0.125	rosette/ bud	39 defgh	0 d
Picloram	0.0625/ 0.0625	rosette/ bud	25 efg	0.3 d
Picloram	0.25	bud	12 g	0 d
Picloram + 2,4-D amine	0.25 + 1.88	bud	64 bcd	0 d
2,4-D amine	1.88	bud	60 bcde	0.1 d
Clopyralid	0.125	rosette	15 g	0.1 bc
Clopyralid	0.25	rosette	32 defg	5.0 bcd
Clopyralid	0.375	rosette	24 fg	6.6 bcd
Clopyralid + 2,4-D amine	0.095 + 0.5	rosette	65 bcd	6.7 bcd
Clopyralid + 2,4-D amine	0.095 + 0.5	bud	14 g	16.5 bcd
Clopyralid + 2,4-D amine	0.19 + 1.0	rosette	86 abc	1.0 cd
Clopyralid + 2,4-D amine	0.19 + 1.0	bud	57 cdef	2.6 cd
MCPA	0.5/ 0.5	rosette/ bud	60 bcde	5.4 bcd
MCPA	1.0	bud	60 bcde	14.3 bcd
Metsulfuron[2]	0.0038/ 0.0038	rosette/ bud	93 ab	0.7 ab
Metsulfuron	0.011	rosette	56 cdef	3.8 bcd
Metsulfuron	0.011	bud	28 efg	8.0 bcd
Metsulfuron	0.011	fall	-	6.5 bcd
Picloram	0.25	fall	-	0 d
Mowing	-	bud	100 a	3.7 bcd
Untreated check	-		-	10.2 ab
Untreated check	-		-	8.1 bcd
PR > F			0.0001	0.0003

[1] Treatments followed by the same letter within a column are not significantly different according to Duncan's Multiple Range Test.

[2] A nonionic surfactant with 80% active ingredient was used at 0.25% v/v for all metsulfuron treatments.

Table 2. Sulfur cinquefoil control at Missoula, MT - 1992.

Herbicide	Rate	Timing	Height	Seed production
	(lbs ai/a)		(in.)	(%)
Picloram	0.125	rosette	8.1 cdef[1]	50
Picloram	0.125/ 0.125	rosette/ bud	5.2 efghi	50
Picloram	0.0625/ 0.0625	rosette/ bud	9.1 bcd	100
Picloram	0.25	bud	11.2 abc	100
Picloram + 2,4-D amine	0.25 + 1.88	bud	3.4 hi	0
2,4-D amine	1.88	bud	4.6 efghi	25
Clopyralid	0.125	rosette	11.9 ab	100
Clopyralid	0.25	rosette	13 a	75
Clopyralid	0.375	rosette	13.1 a	100
Clopyralid + 2,4-D amine	0.095 + 0.5	rosette	7.0 defg	50
Clopyralid + 2,4-D amine	0.095 + 0.5	bud	8.1 cde	75
Clopyralid + 2,4-D amine	0.19 + 1.0	rosette	4.5 fghi	50
Clopyralid + 2,4-D amine	0.19 + 1.0	bud	6.7 defgh	25
MCPA	0.5/ 0.5	rosette/ bud	4.5 fghi	0
MCPA	1.0	bud	5.0 efghi	0
Metsulfuron[1]	0.0038/ 0.0038	rosette/ bud	2.7 i	0
Metsulfuron	0.011	rosette	2.6 i	0
Metsulfuron	0.011	bud	5.2 efghi	25
Metsulfuron	0.011	fall	-	-
Picloram	0.25	fall	-	-
Mowing		bud	3.6 ghi	25
Untreated check			12.4 ab	100
Untreated check			13.4 a	100
PR > F			0.0001	

[1] Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

[2] A nonionic surfactant was used at 0.25% v/v.

Sulfur cinquefoil control at Lodgegrass, MT. Zamora, D.L. Sulfur cinquefoil (*Potentilla recta*) was first reported in Montana in 1948. It can now be found in at least 19 counties in Montana and another 20 counties in Washington, Idaho, and Wyoming. This trial examined the effect of several herbicides on height and seed production of sulfur cinquefoil.

The experiment was a randomized complete block design with four replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Herbicides were applied to sulfur cinquefoil in the early bud stage of growth on 6-1-92. Height was measured on June 30 and seed production among the 4 replications (a qualitative judgement of seeds produced or not produced within a plot) was evaluated on August 8.

Four weeks after treatments were applied, plants in plots treated with picloram + 2,4-D had the lowest height. [This same tank mix sprayed on 6-26-92 (when plants were in the late bud to early flower stage of growth) did not control sulfur cinquefoil in an infestation adjacent to the plots.] Nine weeks after treatments were applied to the plots, several treatments were observed to have prevented seed production. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Height and seed production of sulfur cinquefoil 4 and 9 weeks, respectively, after herbicides were applied on June 1, 1992 at Lodgegrass, MT.

Herbicide[1]	Rate	Height	Seed production
	(lbs ai/a)	(in.)	(%)
Metsulfuron + surfactant	0.0038 + 0.25% v/v	12.6 def[2]	0
Metsulfuron + surfactant	0.0075 + 0.25% v/v	11.4 f	0
Metsulfuron + surfactant	0.0038 + 0.5% v/v	12.4 ef	0
Metsulfuron + surfactant	0.0075 + 0.5% v/v	11.1 f	0
Metsulfuron + 2,4-D amine	0.0038 + 0.47	11.4 f	0
Metsulfuron + dicamba	0.0038 + 0.125	10.8 f	0
Dicamba	0.5	19.4 a	100
Dicamba	1.0	19.4 a	100
Dicamba + 2,4-D amine	0.5 + 0.47	14.1 cde	0
Dicamba + 2.4-D amine	1.0 0.47	13.8 cde	0
Clopyralid + 2,4-D amine	0.095 + 0.5	16.1 b	50
Clopyralid + 2,4-D amine	0.19 + 1.0	14.4 bcd	0
Picloram	0.25	14.8 bc	100
Picloram + 2,4-D amine	0.25 + 0.94	8.0 g	0
Check		18.8 a	100
PR > F		0.0001	

[1] All treatments included a nonionic surfactant at 0.25% v/v unless otherwise noted.

[2] Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

Sulfur cinquefoil control at Luther, MT. Zamora, D.L. Sulfur cinquefoil (*Potentilla recta*) was first reported in Montana in 1948. It now can be found in at least 19 counties in Montana and another 20 counties in Washington, Idaho, and Wyoming. This trial examined the effect of several herbicides on height and seed production of sulfur cinquefoil.

The experiment was a randomized complete block design with four replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied at the rosette stage of growth on 5-14-92; bud stage treatments were applied on 6-12-92; fall treatments were applied on 9-11-92 (not included in table). Height of up to seven plants per plot was measured on 7-1-92. Seed production was a qualitative judgement of whether a plot had plants that produced seed and is expressed as a percentage of the 4 replications; it was evaluated on August 19, 1992.

Plants treated at the rosette stage of growth were shorter than plants treated at the bud stage of growth (except for dicamba alone). Treatments applied at the rosette stage of growth prevented seed production (except for metsulfuron and dicamba). Although plants treated with metsulfuron were very short, they recovered from early growth inhibition to produce seed later in the season. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of herbicides on sulfur cinquefoil at Luther, MT.

Herbicide[1]	Rate	Timing	Height	Seed production
	(lb ai/a)		(in.)	(%)
Metsulfuron	0.0038	Rosette	3.8 gh[2]	100
Metsulfuron	0.0075	Rosette	3.4 gh	100
Metsulfuron + 2,4-D amine	0.0038 + 0.47	Rosette	3.0 h	25
Metsulfuron + dicamba	0.0038 + 0.125	Rosette	4.3 gh	100
Dicamba	0.5	Rosette	15.9 a	100
Dicamba	0.5	Bud	14.1 abc	100
Dicamba + 2,4-D amine	0.5 + 0.94	Rosette	3.8 gh	0
Dicamba + 2.4-D amine	0.5 0.94	Bud	8.4 e	25
Clopyralid + 2,4-D amine	0.095 + 0.5	Rosette	3.8 gh	0
Clopyralid + 2,4-D amine	0.095 + 0.5	Bud	11.8 cd	75
Clopyralid + 2,4-D amine	0.19 + 1.0	Rosette	4.5 gh	0
Clopyralid + 2,4-D amine	0.19 + 1.0	Bud	11.0 d	50
Picloram	0.25	Rosette	5.6 fg	0
Picloram	0.25	Bud	12.8 bcd	100
Picloram + 2,4-D amine	0.25 + 0.94	Bud	7.7 ef	0
Check			13.5 abc	100
Check			15.1 ab	100
PR > F			0.0001	

[1] All treatments included a nonionic surfactant at 0.25% v/v.
[2] Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

Control of silky crazyweed (Oxytropis sericea) two years after applying various herbicides at two growth stages. Whitson, T.D., D.C. Meyers, R.J. Swearingen and W.R. Tatman. Silky crazyweed is a poisonous plant that is common on Western U.S. rangelands. These studies were established near Buford, Wyoming to determine the long-term effectiveness of various herbicides when applied at two growth stages for control of silky crazyweed. Herbicides were applied with a six-nozzle knapsack unit delivering 30 gpa at 41 psi. Plots were 10 by 27 ft arranged in a randomized complete block design with four replications. The soil was a loam (53% sand, 30% silt and 17% clay) with 3.2% organic matter and a pH of 6.8. Application information June 9, 1990 when silky crazyweed was in the 3 to 4 inch vegetative stage, temperature: air 65F, surface 81F, 1 inch 75F, 2 inches 58F, 4 inches 52F with 55% relative humidity and calm winds. Application information: July 4, 1990 when silky crazyweed was in the early bloom stage, temperature: air 58F, soil surface 60F, 1 inch 65F, 2 inches 65F and 4 inches 59F with 79% relative humidity and 3 to 5 mph northwest winds.

Only 2,4-D LVE, failed to provide complete control of this poisonous plant, however when combined with picloram or dicamba control was excellent. In addition to control of silky crazyweed the combined treatments controlled associated species such as threetip sagebrush (Artemisia triparitita RydB.), fringed sagebrush (Artemisia frigida) and milkvetch spp. (Astragalus). Metsulfuron had little effect on the associated plant community but provided excellent control of silky crazyweed. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1669).

Control of Silky Crazyweed At Two Growth Stages

		% Control[1]	
		Date of Application	
Herbicide	Rate lb ai/A	6/9/90	7/4/90
clopyralid+2,4-D	0.13+0.61	100	98
clopyralid+2,4-D	0.18+1.0	100	100
clopyralid	0.13	96	99
clopyralid	0.19	100	100
picloram	.125	100	98
picloram+2,4-D	0.125+0.5	100	100
picloram	0.25	100	100
picloram	0.5	100	100
check	- - -	0	0
dicamba	1.0	100	100
dicamba	2.0	100	100
dicamba+2,4-D	0.5+1.0	99	100
dicamba+2,4-D	1.0+1.0	100	100
dicamba+picloram	0.5+.125	100	100
dicamba+picloram	0.5+.25	99	100
dicamba+picloram	1.0+.125	100	100
dicamba+fluroxypyr	0.5+0.5	100	100
dicamba+clopyralid	0.5+.125	100	99
dicamba+clopyralid	0.5+.25	100	100
2,4-D	2.0	97	93
metsulfuron+X-77	.0075	100	100
metsulfuron+X-77	.015	100	100
metsulfuron+X-77	.0225	100	100

[1]Evaluations were made by counting plants before and after treatment on July 20, 1992, the calculating % control in each plot.

Silky crazyweed (*Oxytropis sericea*) and broom snakeweed (*Gutierrezia sarothrae*) control with various herbicides. McDaniel, K.C. When growing together, control of these poisonous weeds with a single application of herbicide should be beneficial to livestock producers, especially in northeastern New Mexico. Research was conducted on Johnson Mesa near Folsom, New Mexico to compare fall applications of selected herbicides. Plots were 30 by 30 ft with three replications in a randomized complete block. Herbicides were broadcast with a CO_2 pressurized hand-held sprayer (10 ft boom) delivering 21 gpa at 60 psi on September 11, 1991 (air temp. 57°F, soil temp. 59°F @ 6", relative humidity 83%, wind 7 to 12 mph). Soil was a clay loam and very moist to 12 " from rain the previous day. Plants were in the late bloom and early seed set stage and were not under any apparent stress. Ten plants of each species were individually flagged in each plot at the time of spraying. The number of flagged plants dead on June 6, 1992 and September 9, 1992 were used to calculate apparent mortality.

Metsulfuron successfully controlled silky crazyweed but did not control broom snakeweed. Picloram applied alone or in combination with 2,4-D (as Grazon P+D) showed the broadest spectrum of control activity. Other herbicides were less effective. Treatment applications have been repeated in spring and fall 1992 with a final application scheduled for spring 1993 in order to compare seasonal effectiveness of these herbicides. (Department of Animal and Range Sciences, New Mexico State Univ., Las Cruces, NM 88003).

1992 evaluations of various herbicides for weed control in northeastern New Mexico

Herbicide[1]	Rate	Silky -- Crazyweed -- 6/9	9/14	Broom -- Snakeweed -- 6/9	9/14
	(oz ai/ac)	---------- (Apparent Mortality) -----------			
Metsulfuron	0.1875	82	60	0	7
Metsulfuron	0.375	100	97	0	13
	(lb ai/ac)				
Picloram + 2,4-D	0.25 + 0.375	93	95	98	98
Dicamba + atrazine	0.20 + 0.4	43	22	27	45
Dicamba + atrazine	0.20 + 0.53	67	58	35	40
Picloram	0.25	88	63	93	83
Picloram	0.375	93	61	98	94
2,4-D amine	2.0	43	18	50	53
2,4-D amine	4.0	57	13	50	95
Dicamba	0.5	72	72	55	51
Check	---	2	2	0	11

[1]L-77 surfactant added at 0.25% v/v to all treatments.

Broadcast aerial release of established Douglas-fir plantations. Figueroa, P.F., T.E. Nishimura. Grass and forb competition has been demonstrated as a key factor in the early success or failure of Douglas-fir plantations. Previous research studies have identified that a threshold level of approximately 30% ground covered by grasses and forbs can reduce Douglas-fir growth. As levels approach and exceed 100% ground cover, particularly when it occurs for repeated years, Douglas-fir can fail to become established as the dominant site competitor resulting in serious growth or survival losses. When vegetation develops at or near ground cover levels that affect Douglas-fir growth, a cost/benefit analysis should be done to determine if specific release treatments are warranted such that a release strategy can be developed prior to the next growing season.

There are several forestry-registered herbicides that can be used for early grass and forb release. However, with increasing label restrictions and the potential loss of some of the forestry-registered herbicides, alternative herbicides need to be developed. A demonstration was established to evaluate pendimethalin for potential forestry uses for release of established Douglas-fir plantations. Included in this demonstration were two herbicides currently used for Douglas-fir plantation release.

The treatment unit had been a natural Douglas-fir stand that was harvested in summer 1989. The site was broadcast burned as a site preparation treatment that fall. The site was planted with 1+1 Douglas-fir using shovels in late April 1990. Observations of the site after the first growing season identified this site as a candidate for grass and forb release. Vegetation appeared to exceed 50% ground cover for grasses and forbs.

Prior to Douglas-fir bud elongation, at the beginning of the second growing season, pendimethalin, atrazine, and 2,4-D were applied in separate broadcast aerial release treatments. A 20 gallon per acre solution rate was applied in overlapping 10 gallon per acre applications to ensure uniform herbicide coverage. Treatments were applied using a Bell 206 helicopter. Grasses had not emerged, but several forbs including *Senecio vulgaris* and *Cirsium arvense* were beginning their active growth. Each treatment was applied to a 10 acre block on March 16, 1991. Pendimethalin (4 lb/a) and atrazine (4 lb/a) were applied separately to evaluate their affect on established grass and forbs and preventing non-established grasses and forbs from developing into competitors. A low-volatile 2,4-D ester formulation (2 lb/a) treatment was applied and overlaid on half of the pendimethalin and atrazine treatments to control established forbs. One year after application, at the end of the second growing season, vegetation ground cover and Douglas-fir vigor, survival, basal caliper, and height growth were assessed.

There was considerable variation in the grass cover component among treatments and the data suggests no differences among treatments (Table 1). There was several differences in control of forbs among treatments. The combination treatments with atrazine and 2,4-D and pendimethalin and 2,4-D had the greatest reduction in forb ground cover.

Douglas-fir tree vigor (or health) on the non-treated check area was lower than those treatments. The non-treated check plots had 11% of the trees in the low vigor classes (25% or less foliage retention and chlorotic). All herbicide treatments had a greater proportion of trees in the high vigor classes (Table 2) suggesting improvement due to treatment. Basal caliper, tree height, and seedling volume was greater on treated plots compared to the non-treated check plots. The atrazine and pendimethalin treatments and both combinations with 2,4,-D had larger seedlings one year after treatment. All herbicide treatments had lower combined grass and forb levels after treatment.

There are several generalizations that can be drawn from this demonstration. There is generally a wide complex of grasses, forbs, ferns, and shrubs occurring on forest sites. Atrazine, pendimethalin, and 2,4-D treatments did not reduce competition to the level expected to maintain maximum conifer productivity. Combinations of herbicides may be needed to lower total vegetation cover to a level low enough to gain the maximum response. It appears that none of the herbicide treatments had any effect on the fern and shrub communities. While these may not have affected Douglas-fir, they have the potential to become overtopping and growth reducing competitors. Other herbicides with activity for control of ferns and shrubs may have to be considered. The ferns and shrubs may be taking advantage of reduced site utilization from grass and forbs from various treatments. The net effect could be a species replacement which maintains the total vegetation competition beyond where Douglas-fir can maximize growth.

Another contributing factor to the lower vegetation control is the timing of application. Pendimethalin and atrazine probably would have been more effective had they been applied earlier in the season before the forbs had developed into a more advanced plant growth stage. Application of the 2,4-D was probably applied too early in forb development stage. If the application of 2,4-D was delayed until a higher percentage of the forbs leafed out, the 2,4-D treatment would probably have been more effective. This would require multiple application dates for the vegetation control.

A second observations made was that none of the herbicide treatments had any toxic effects on established Douglas-fir plantations. Higher herbicide rates may need to be tested to develop data to establish the upper bounds of treatment rates for forestry registration purposes.

This demonstration illustrates that combination treatments of atrazine or pendimethalin with, or without 2,4-D were not adequate reducing vegetation competition to improve Douglas-fir height. The timing of either atrazine of pendimethalin was probably not consistent with obtaining a maximum treatment affect. Changing atrazine and pendimethalin applications to prior to when grasses and forbs have germinated would increase the probability of better control. Timing the 2,4-D treatments to coincide when forbs have reached their highest germination level and growth, prior to Douglas-fir breaking bud would probably have increased the 2,4-D efficacy. Consideration must be made to control the fern and shrub population to prevent those from becoming competitors. (Weyerhaeuser Company, 505 North Pearl St., Centralia, WA 98531, American Cyanamid, 17454 SW Canal Circle, Lake Oswego, OR 97034).

Table 1. Two-year-old Douglas-fir: treatment means for percent vegetation ground cover one year after application.

Treatment	Rate	Grass		Forbs		Ferns		Shrubs		Total		Grass & Forbs	
	(lb/a)	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*
Check	-	8	*5*	62	*11*	20	*8*	13	*3*	103	*10*	70	*12*
2,4-D	2	10	*4*	45	*12*	47	*10*	14	*5*	116	*8*	54	*11*
Atrazine	4	9	*4*	21	*4*	45	*11*	69	*7*	144	*7*	30	*6*
Pendimethalin	4	9	*4*	46	*9*	61	*10*	34	*11*	150	*11*	55	*10*
Atrazine + 2,4-D	4 + 2	4	*2*	5	*2*	52	*13*	41	*10*	102	*16*	9	*3*
Pendimethalin + 2,4-D	4 + 2	24	*10*	6	*3*	60	*9*	32	*10*	122	*14*	30	*10*

Table 2. Two-year-old planted Douglas-fir: treatment means for tree vigor, mortality, basal caliper, height, and tree volume one year after application.

Treatment	Rate	High Vigor		Low Vigor		Mortality		Basal Caliper		Height		Tree Volume	
	(lb/a)	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(mm)	*(se)*	(cm)	*(se)*	(cm^3)	*(se)*
Check	-	88	*6*	11	*6*	1	*2*	11	*1*	58	*7*	23	*7*
2,4-D	2	95	*4*	5	*4*	0	*0*	11	*1*	60	*11*	25	*9*
Atrazine	4	100	*0*	0	*0*	0	*0*	16	*1*	88	*9*	61	*13*
Pendimethalin	4	98	*2*	1	*2*	1	*2*	13	*1*	83	*11*	38	*8*
Atrazine + 2,4-D	4 + 2	98	*3*	1	*2*	1	*3*	14	*2*	78	*15*	46	*18*
Pendimethalin + 2,4-D	4 + 2	97	*4*	2	*2*	1	*3*	14	*2*	86	*12*	50	*17*

Broadcast aerial release of established red alder plantations. Figueroa, P.F., T.E. Nishimura. The most critical element in establishing successful red alder plantations is getting proper vegetation control through site preparation. Previous operational plantations and research studies have shown that vegetation levels above 80 to 100% ground coverage (combined grass, forb, shrub, w/o ferns) at the end of the first growing season will have resulted in reduced red alder growth during the first growing season. Vegetation competition levels above 120% ground cover, at the end of the first growing season, will have resulted in both reduced seedling growth and reduced alder survival during the first growing season.

Effective implementation of this vegetation threshold guide requires the forester to forecast the expected vegetation coverage prior to the first growing season. A critical missing link is a guide to forecast future vegetation competition from post-harvest ground conditions. Without this forecasting tool, foresters generally opt to be more thorough in their pre-plant site preparation rather than risk potential plantation failure. An additional problem foresters have factor into their decision to apply herbicides for site preparation is that there are currently no acceptable broadcast aerial release options for established red alder plantations.

Red alder release options need to be developed to allow foresters the option of reducing site preparation costs where there is a low risk of vegetation development. These release options will give them alternative control methods if vegetation develops to an unacceptable level (with or without previous herbicide treatments). To begin to address this issue, a herbicide screening trial was established to examine two herbicides for broadcast aerial release of established red alder plantations.

The site selected for this demonstration was a one-year-old red alder plantation. It had been broadcast burned for site preparation in the fall of 1989. In March 24, 1990. Prior to planting, the site was treated with a atrazine (4 lb/a) for grass and forb control. The site was subsequently planted April 12, 1990 with 1+0 bareroot red alder seedlings. The atrazine treatment was not effective controlling first-year forbs. The atrazine treated area had 90% total vegetation cover and 84% total coverage excluding the fern population. These vegetation levels were not different than the untreated check areas that had 86% total vegetation and 84% coverage without the fern population. The vegetation cover was at a level where reduced alder growth in the second growing season was expected.

The second-year herbicide release demonstration was applied at the beginning of the second growing season. A low-volatile 2,4-D ester formulation (2 lb/a) and pendimethalin (4 lb/a) were applied separately and in combination to determine their ability to control grasses, forbs, ferns, and shrubs. Treatments were applied as an aerial broadcast treatment on March 16, 1991 using a 20 gallon per acre solution. Each treatment was applied to five acres using a Bell 206 helicopter. Approximately 1% of the red alder had swollen buds which were nearly to the point of leafing out. The grasses had not yet emerged, but several forbs including *Senecio vulgaris* and *Cirsium arvense* were beginning their active growth.

One year after application, at the end of the second growing season, vegetation ground cover and alder survival and height growth was assessed. The 2,4-D, pendimethalin, and combination treatments were all similar for vegetation competition (Table 1). There is currently only observational information and no data to identify the threshold level of vegetation coverage that effects second-year alder plantation growth or survival. However, the treatment plots and untreated check plots and all were at a level that we expect there would be growth improvements if competing vegetation levels were reduced.

Table 2 shows red alder vigor, survival, and tree height one year after treatment. These data showed no toxicity effects from either 2,4-D or pendimethalin. There was no red alder growth enhancements due to treatments. We relate this to the lack of growth improvement is consistent with the treatments lack of being able to reduce vegetation competition to below a level expected to improve growth during the second growing season.

There are several generalizations that can be drawn from this demonstration. First, the 2,4-D and pendimethalin treatments did not effectively control competing vegetation. The application date was a contributing factor to the lower than expected control. Pendimethalin probably would have been more effective had it been applied earlier in the season before grass and forbs were actively growing. Additionally, application of the 2,4-D was probably too early in forb development stage. Unfortunately, application of 2,4-D could not have been delayed without having a higher percentage of red alder leafing out. The toxicity of 2,4-D on red alder with full foliage is well documented and we would have increased the risk to planted alder.

A second generalization is that neither herbicide treatment had any toxic effects on established alder plantations. Early in the growing season the 2,4-D treatments appeared to have resulted in alder trees having lower vigor, which included stunted alder leaves, and lower crown complement (compared to the pendimethalin and non-treated check plots). These lower vigor conditions apparently washed out over the growing season and were less apparent towards then end of the growing season. We speculate that the low-volatile 2,4-D ester was absorbed through the bark and by the newly expanding buds.

This demonstration illustrates that the rates and timing were inadequate to reduce competing vegetation below some threshold level to improve second-year red alder plantation growth. Pendimethalin appeared to be non-toxic to red alder applied at 4 lb/a, while 2 lb/a of 2,4-D had symptoms of toxicity that did not affect second-year survival or growth. (Weyerhaeuser Company, 505 North Pearl St., Centralia, WA 98531, American Cyanamid, 17454 SW Canal Circle, Lake Oswego, OR 97034).

Table 1. Two-year-old planted red alder: treatment means for percent vegetation cover one-year after application.

Treatment	Rate	Grass		Forbs		Ferns		Shrubs		Total		w/o Ferns	
	(lb/a)	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*
Check	-	3	*2*	78	*7*	21	*9*	17	*8*	119	*13*	102	*11*
2,4-D	2	25	*9*	68	*8*	11	*7*	14	*5*	118	*11*	104	*8*
Pendimethalin	4	5	*2*	81	*5*	13	*4*	18	*7*	117	*11*	99	*8*
Pendimethalin + 2,4-D	4 + 2	18	*6*	78	*6*	8	*9*	10	*4*	114	*11*	104	*10*

Table 2. Two-year-old planted red alder: tree vigor, mortality, tree height, and percent height growth one year after application.

Treatment	Rate	High Vigor		Low Vigor		Mortality		Height		Height Growth		Percent Growth	
	(lb/a)	(%)	*(se)*	(%)	*(se)*	(%)	*(se)*	(cm)	*(se)*	(cm)	*(se)*	(%)	*(se)*
Check	-	70	*13*	4	*3*	26	*13*	178	*21*	84	*13*	90	*9*
2,4-D	2	80	*7*	5	*4*	15	*7*	181	*10*	84	*7*	88	*7*
Pendimethalin	4	68	*12*	6	*4*	25	*10*	158	*29*	76	*20*	88	*19*
Pendimethalin + 2,4-D	4 + 2	86	*8*	2	*1*	12	*7*	194	*21*	101	*13*	105	*10*

Halogeton control with metsulfuron, dicamba, picloram, and 2,4-D in Colorado rangeland. Sebastian, J.R. 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 3 replications. All treatments were sprayed with X-77 surfactant (0.25% v/v). Treatments were applied June 17 and June 23,1992 at site 1 and 2 respectively, 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. Site 1 had a 1 to 3 foot tall greasewood overstory while site 2 was a solid, single species HALGL stand.

Visual evaluations compared with non-sprayed control plots were taken at both sites on October 12, 1992. Metsulfuron provided good to excellent (73 to 94%) HALGL control at both sites approximately 5 months after treatment (MAT) (Table 2). Dicamba (32 oz ai/A) or dicamba tank mixes provided poor to good (48 to 78%) HALGL control while picloram and the three 2,4-D formulations provided poor (19 to 53%) control 5 MAT.

Halogeton at both sites only grew 3 inches from time of application to fall dormancy which may have decreased HALGL control. Also, at site 1 loss of HALGL control was apparent around bases of greasewood plants due to poor herbicide coverage at time of application. Herbicide treatments will be evaluated again in 1992 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application data for halogeton control with 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 30

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

Treatment	Rate	Timing	Halogeton control October 12, 1992 Maybell, CO Site 1	Site 2
	(oz ai/A)		---------(% of check)	----------
metsulfuron	0.1	1-3"	83	73
	0.2	1-3"	88	81
	0.3	1-3"	93	90
	0.5	1-3"	80	84
	0.6	1-3"	83	94
metsulfuron	0.1			
+ dicamba	3	1-3"	64	76
	0.2			
	3	1-3"	78	81
picloram	2	1-3"	49	19
	4	1-3"	26	28
	8	1-3"	36	40
dicamba	8	1-3"	49	45
	16	1-3"	61	50
	32	1-3"	78	68
dicamba	8			
+ picloram	2	1-3"	68	56
	16			
	2	1-3"	70	56
	8			
	4	1-3"	68	48
2,4-D amine	16	1-3"	38	41
weedone 638	16	1-3"	53	36
Hi-Dep	16	1-3"	51	35
dicamba	8			
+ 2,4-D	16	1-3"	72	61
LSD			25	17

X-77 surfactant was added to all treatments 0.25% v/v.

Demonstration of herbicide control of houndstongue. Zamora, D.L. To demonstrate the effectiveness of 2,4-D control houndstongue (*Cynoglossum officinale*) to central Montana ranchers a demonstration trial was established on a ranch near Judith Gap.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied on 6/9/92 to houndstongue in the rosette and flowering stage of growth. A visual estimate of control (necrosis, chlorosis, and growth reduction) was made on 6/24/92 and density was measured on 10/1/92.

Most treatments allowed several houndstongue plants to reproduce and many rosettes survived through the fall and probably will reproduce next year. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of herbicides on houndstongue at Judith Gap, MT.

		Control (6/24/92)		Density (10/1/92)	
Herbicide[1]	Rate	Rosettes	Bolted	Rosettes	Bolted
	(lbs ai/a)	--- (% check) ---		-- (no. per plot) --	
2,4-D amine	0.95	40	43	20	4
2,4-D amine	1.43	57	43	8	1
2,4-D amine	1.9	47	47	17	8
2,4-D amine + surfactant	0.95 + 0.5% v/v	43	43	7	0
2,4-D amine + surfactant	1.43 + 0.5% v/v	30	30	9	4
2,4-D amine + surfactant	1.9 + 0.5% v/v	57	57	7	0
Clopyralid	0.094	10	17	63	8
Clopyralid + 2,4-D amine	0.095 + 0.5	30	33	22	3
Check		-	-	49	3
PR > F		0.002	0.04	0.001	0.10
LSD (0.05)		20	24	22	7

[1] All treatments included a nonionic surfactant at 0.5% v/v.

Houndstongue control on Colorado rangeland with spring or fall-applied herbicides. Sebastian, J.R. and K.G. Beck. Two rangeland experiments were established near Craig and Meeker, CO 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 or June 5, 1992) and fall (both October 12, 1992) applications were made for timing comparison. The design was a randomized complete block with 3 replications. All treatments were sprayed with X-77 surfactant (0.25% v/v). Treatments were applied with a CO_2-pressurized 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 compared to non-sprayed control plots (control from spring-applied herbicides) were taken at both sites on October 12, 1992. Picloram and picloram plus dicamba treatments provided good to excellent rosette and bolted CYWOF control approximately 4 months after spring treatment (MAT) were applied (Table 2). Metsulfuron and metsulfuron plus dicamba provided good to excellent bolted and rosette CYWOF control at Craig and bolted CYWOF control at Meeker while providing fair to good and poor rosette CYWOF control at Meeker 4 MAT, respectively. Spring-applied metsulfuron (0.3 oz ai/A) plus 2,4-D (16 oz ai/A) provided excellent rosette and bolted CYWOF control 4 MAT.

Fall herbicides were applied October 12 in Craig and October 13, 1992 in Meeker, CO and will be evaluated with spring treatments in 1993 for CYWOF control longevity (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				
Location	Craig, CO		Meeker, Co	
Application date	June 4	Oct 12	June 5	Oct 12
Application time	9:00 AM	8:00 AM	10:30 AM	4:00 PM
Air temperature, C	23	20	24	20
Cloud cover, %	50	40	40	10
Relative humidity, %	35	47	25	48
Wind speed, mph	0 to 2	0 to 5	0 to 5	3 to 8
Soil temperature, (2.0 in.), C	14	12	13	18

Weed data Application date	Species	Growth stage	Height (in)	Density (plants/ft^2)
Craig, CO				
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
Meeker, CO				
June 5, 1992	CYWOF	rosette	1	1
	CYWOF	bolting	7 to 17	10 to 15
October 12, 1992	CYWOF	rosette	1 to 4	1 to 5
	CYWOF	bolting	14 to 24	10 to 15

Table 2. Houndstongue control on Colorado rangeland with fall vs spring applied herbicides.

Treatment	Rate	Timing	Houndstongue control[a]			
			Craig, CO October 12, 1992		Meeker, CO October 13, 1992	
			Bolting	Rosettes	Bolting	Rosettes
	(oz ai/A)		----------(% of check)----------			
metsulfuron	0.1	spring	68	94	95	89
	0.2	spring	77	83	85	61
	0.3	spring	80	100	96	65
	0.5	spring	90	95	93	82
	0.6	spring	87	93	96	88
metsulfuron + dicamba	0.1 3	spring	82	77	88	43
	0.2 3	spring	80	82	95	45
metsulfuron + 2,4-D	0.3 16	spring	88	100	100	100
picloram	4	spring	87	90	91	100
dicamba	8	spring	73	53	60	57
	16	spring	83	87	85	80
picloram + dicamba	2 8	spring	88	93	92	100
	4 8	spring	95	97	92	95
	2 16	spring	83	89	82	77
LSD (0.05)			13	19	13	24

[a]Data not shown for fall-applied treatments; fall herbicides were applied October 12, 1992 in Craig, CO and October 13, 1992 in Meeker, CO and will not be evaluated until spring 1993.

A comparison of four perennial grasses established in spring on their ability to establish in stands of Russian knapweed. Whitson, T.D., J.P. Buk, D.W. Koch and R.J. Swearingen. Russian knapweed is a highly competitive perennial weed which often establishes as monocultures because of its allelopathic properties. This experiment was established near Casper, Wyoming to determine if perennial grasses could effectively be established then compete with Russian knapweed without the use of herbicides.

Plots 28 by 80 ft with four replications were arranged as a complete block design. The study site was plowed 6 to 8 inches deep and leveled in March 1990. Seeding was done on March 26, 1990 with a Tye seeder using 1.5 inch depth bands and a drill spacing of 8 inches. The following species and seeding rates were used:

Crested wheatgrass (Elphraim) - 9.5 lb PLS/acre
Intermediate wheatgrass (Oahe) - 10.8 lb PLS/acre
Russian wildrye (Bozoisky) - 5.6 lbs PLS/acre
Big bluegrass (Sherman) - 3.4 lbs PLS/acre

Areas seeded with intermediate wheatgrass had a grass establishment of 45% and a 55% canopy cover of Russian knapweed while those seeded to Russian wildrye had a grass establishment of 40% with a 60% canopy of Russian knapweed. Crested wheatgrass had a 15% establishment and big bluegrass failed to establish. The grasses intermediate wheatgrass and Russian wildrye will possibly become even more competitive as mowing is used as a control technique in future years. (Dept. of Plant, Soil and Insect Sciences, University of Wyoming, Laramie WY 82071 SR 1676).

A comparison of four perennial grasses on their ability to establish in stands of Russian knapweed.

		% Cover	
Grass Species	Plot No.	Russian knapweed	grass establishment
Crested wheatgrass	101	50	10
Crested wheatgrass	202	80	10
Crested wheatgrass	304	90	10
Crested wheatgrass	303	70	30
Average		80	20
Big bluegrass	102	100	0
Big bluegrass	104	100	0
Big bluegrass	103	100	0
Big bluegrass	101	100	0
Average		100	0
Intermediate wheatgrass	103	60	40
Intermediate wheatgrass	101	70	30
Intermediate wheatgrass	102	40	60
Intermediate wheatgrass	104	50	50
Average		55	45
Russian wildrye	104	80	20
Russian wildrye		60	40
Russian wildrye		50	50
Russian wildrye		50	50
Average		60	40

A comparison of four perennial grasses on their ability to establish in stands of Russian knapweed.

	% Cover[2]	
Grass species[1]	Russian knapweed	grass est.
crested wheatgrass (Ephraim)	80	20
big bluegrass (Sherman)	100	0
intermediate wheatgrass (Oahe)	55	45
Russian wildrye (Bozoisky)	60	40

[1]Grasses were seeded March 26, 1990.
[2]Evaluations made September 3, 1992.

A comparison of two perennial grass establishment methods when seeded in the fall in a Russian knapweed infestation. Whitson, T.D., J.P. Buk, D.W. Koch and R.J. Swearingen. Russian knapweed is a highly competitive perennial weed which contains allelopathic substances. This experiment was conducted near Casper, Wyoming to determine if desirable perennial grasses could be established and effectively compete with Russian knapweed. Plots 21 by 75 feet, with four replications, were arranged as a complete block design. The study site was plowed 6 to 8 inches deep and leveled in June, 1990. Glyphosate was applied at .8 lb ai/A to 1/2 the establishment area on July 19, 1990 and reapplied September 29, 1990. Tillage with a rototiller was done on the remaining 1/2 of the area on July 17, 1990 and September 26, 1990. Seeding was done on October 20, 1990 with a Tye seeder using 1.5 inch depth bands and a drill spacing of eight inches. The following species and seeding rates were used:

crested wheatgrass (Ephraim) - 9.5 lb PLS/acre
big bluegrass (Sherman) - 3.4 lb PLS/acre
pubescent wheatgrass (Luna) - 10.8 lbs PLS/acre
Russian wildrye (Bozoisky) - 5.6 lbs PLS/acre

Russian knapweed cover was reduced 42% in all plots treated before seeding with glyphosate and 22% when tillage was used rather than glyphosate. Grass cover averaged 25% in plots treated before seeding with glyphosate and 23% in areas where tillage was used to control Russian knapweed before seeding. Neither glyphosate or tillage provided long-term Russian knapweed control therefore grasses only partially established. Crested wheatgrass had an average canopy of 41% in areas established with a rototiller and 35% in areas established with glyphosate. Luna pubescent wheatgrass had a canopy of 38% when established with glyphosate compared to 25% with tillage. Russian wildrye had an average canopy cover of 26% in both establishment methods. No big bluegrass establishment was found in either experimental area. Perennial grasses established better the second year of the study continue to be monitored. Dept. of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1675).

Perennial grass establishment in an infestation of Russian knapweed

		% Cover[2]	
Grass Species[1]	Establishment method	Russian knapweed	grass establishment
big bluegrass (Sherman)	glyphosate	85	0
big bluegrass (Sherman)	rototiller	100	0
pubescent wheatgrass (Luna)	glyphosate	54	38
pubescent wheatgrass (Luna)	rototiller	75	25
Russian wildrye (Bozoisky)	glyphosate	58	26
Russian wildrye (Bozoisky)	rototiller	69	26
Crested wheatgrass (Ephriam)	glyphosate	65	35
Crested wheatgrass (Ephriam)	rototiller	59	41

[1]Grasses were seeded October 20, 1990
[2]Evaluations made September 2, 1992.

Russian knapweed control with herbicides on Colorado rangeland. Sebastian, J.R. 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 sprayed with X-77 surfactant (0.25% v/v). All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/A, 15 psi. Other application information is presented in Table 1. Plot size was 10 feet by 30 feet.

Visual evaluations compared to non-treated control plots were taken at Eagle in June and August 1990, October 1991, and September 1992. Picloram fall-applied at 1.0 lb provided excellent CENRE control approximately 6, 11, 25, and 36 months after treatment (MAT), respectively (Table 2). Picloram at 0.5 lb ai/A fall-applied provided good CENRE control 11 MAT and fair control 25 and 36 MAT, respectively. Picloram at 0.5 and 1.0 lb spring-applied provided 71 and 92% control 16 MAT. However, only picloram at 1.0 lb spring-applied provided acceptable long-term control (86-91%). Chlorsulfuron and metsulfuron did not provide acceptable long-term control. There were no differences within a herbicide treatment between fall and spring applications.

Herbicide treatments will be evaluated again in 1993 for control longevity. (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		
Location	Eagle, CO	
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/direction, 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			
			June 1990	August 1990	October 1991	September 1992
	(lb ai/a)		------------(% of check)-----------			
picloram	0.25	fall	75	60	46	42
picloram	0.5	fall	92	81	72	70
picloram	1.0	fall	100	94	92	86
dicamba	0.5	fall	51	13	8	8
dicamba	1.0	fall	77	41	8	3
picloram	0.25					
+ dicamba	0.5	fall	92	49	38	36
picloram	0.13					
+ dicamba	1.0	fall	96	71	49	43
chlorsulfuron	0.38	fall	63	31	6	6
chlorsulfuron	0.75	fall	86	59	0	0
metsulfuron	0.3	fall	78	48	0	0
picloram	0.25	bolting	-	59	44	40
picloram	0.5	bolting	-	70	71	65
picloram	1.0	bolting	-	80	92	91
dicamba	0.5	bolting	-	50	4	3
dicamba	1.0	bolting	-	67	15	22
picloram	0.25					
+ dicamba	0.5	bolting	-	72	58	54
picloram	0.13					
+ dicamba	1.0	bolting	-	65	25	20
chlorsulfuron	0.38	bolting	-	39	0	0
chlorsulfuron	0.75	bolting	-	68	24	13
metsulfuron	0.3	bolting	-	56	10	10
LSD (0.05)			11	20	26	23

Russian knapweed (Centaurea repens L.) control at various growth stages. Whitson, T.D., R.J. Swearingen, J. Baker and R.D. Cunningham. Designated as a noxious weed in many states, Russian knapweed occupies over 100,000 acres in Wyoming but is reported in over 21 states in the west. Various herbicides were applied near Riverton, Wyoming at three growth stages, to determine their control efficacies. Herbicides were applied with a six-nozzle knapsack unit delivering 30 gpa at 45 psi. Plots were 10 by 27 ft. arranged in a randomized complete block design with four replications. Soils were a loamy sand (89% sand, 4% silt and 7% clay) with 1.1% organic matter and 8.0 pH. Russian knapweed growth stage and application information: May 17, 1989 during rosette to 5 inch vegetative growth, temperature: air 72F, soil surface 80F, 1 inch 82F, 2 inches 84F and 4 inches 84F with 45% relative humidity and calm winds; July 7, 1989 when Russian knapweed was in early bloom, temperature: air 82F, soil surface 80F, 1 inch 82F, 2 inches 76F and 4 inches 76F with 40% relative humidity and calm winds and October 9,1989, after Russian knapweed was defoliated by frost, temperature: air 65F, soil surface 82F, 1 inch 80F, 2 inches 72F and 4 inches 65F with 38% relative humidity and 1 to 2 mph west winds.

Picloram applied at 0.375 lb ai/A and above either alone or with 2,4-D(LVE) at 1.0 lb ai/A provided greater than 96% control at all growth stages. Clopyralid applied at 0.19 and 0.25 lb ai/A with and without 2,4-D had significant increases in control with applications made at the bloom and early dormancy stages compared to the rosette stage. Dicamba at 2.0 lb ai/A controlled 62% of the Russian knapweed at early dormancy but had less than 10% control in the rosette and bloom stage. Applying herbicides in the fall will allow applications to be made at the time of harvest when sensitive crops such as beans and sugarbeetshave been harvested, therefore no crop damage will take place. Fall applications also come when more labor could possibly be available to make applications. (Plant, Soil and Insect Sciences, University of Wyoming, Laramie WY 82071. SR 1674)

Russian knapweed control at various growth stages.

		Boysen Reservoir		
Treatment[1]	Rate lb ai/A	5/18/89	7/7/89	10/9/89
		- - - - - - - - - % - - - - - - - - - -		
Picloram	0.375	96	99	99
Picloram	0.5	99	99	99
Picloram	0.635	99	99	99
Picloram+2,4-D	0.375+1.0	98	99	96
Picloram+2,4-D	0.5+1.0	99	100	99
Picloram+2,4-D	0.635+1.0	99	99	99
clopyralid+2,4-D	0.19+1.0	11	92	75
clopyralid+2,4-D	.25+1.5	55	77	89
dicamba+2,4-D	1.0+2.0	10	21	29
dicamba+2,4-D	2.0+2.0	1	24	55
2,4-D	2.0	0	05	01
dicamba	2.0	9	03	62
dicamba	4.0	42	39	69
dicamba+picloram	0.5+0.125	75	93	83
dicamba+triclopyr	0.2+0.25	0	21	05
dicamba+fluroxypyr	0.5+0.5	1	19	19
dicamba+clopyralid	0.5+0.125	28	12	65
clopyralid	0.188	28	80	84
clopyralid	0.25	70	96	94
clopyralid	0.375	88	80	97
clopyralid+2,4-D+picloram	0.18+1.0+.25	97	75	95
clopyralid+L-77	0.188+0.25% v/v	30	58	77
picloram+L-77	0.375+0.25% v/v	96	99	97
(LSD 0.05)		29.1	31.6	23.4

[1]Herbicides were applied 5/18/92 (rosette stage), 7/7/89 (bloom stage), 10/9/89 (early dormancy)

Russian knapweed (Centaurea repens L.) control with various herbicides applied during early fall dormancy. Whitson, T. D., J. D. Jenkins, C. Cauffman and R. J. Swearingen. Russian knapweed, a poisonous perennial forb is common throughout the western United States along river bottoms, irrigated hay fields and on disturbed land. This study was established near Manderson, Wyoming on October 9, 1991. Russian knapweed was 85% defoliated from a killing frost which occurred October 1, 1991. Plots 10 by 27 feet 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. Application information on October 9, 1991: temperature air 75° F, soil surface 66° F, 1 inch 66° F, 2 inches 62° F and 4 inches 68° F with 26% relative humidity and calm winds. Soil was a silt loam (13% sand, 62% silt and 25% clay) with 4.0% organic matter and a pH of 8.0. Picloram applications of 0.25 lb. ai/A and the combination of picloram plus dicamba at 0.25 + 1.0 lb. ai/A provided 92 and 96% control, respectively. All picloram applied at 0.38 lb. ai/A or greater controlled over 99% of the Russian knapweed. Clopyralid at 0.25 ai/A and the combination of clopyralid plus 2,4-D at 0.27 + 1.25 ai/A controlled 85 and 90% of the Russian knapweed, respectively. In addition to greater control, fall applications offer opportunities to apply herbicides when neighboring sensitive crops have been harvested and provide a larger window of application which would possibly allow for better use of labor. (Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071, SR 1682)

Russian knapweed control with various herbicides applied during fall dormancy.

Herbicide[1]	Rate ai/A	% Control[2]
picloram	0.25	92
picloram	0.38	100
picloram	0.5	100
picloram	0.75	99
picloram	1.0	100
picloram+2,4-D(LVE)	0.5+1.0	100
picloram+2,4-D(LVE)	0.75+1.0	100
dicamba	1.0	49
dicamba+picloram	1.0+0.25	96
dicamba+2,4-D(LVE)	1.0+1.0	54
clopyralid+2,4-D	.19+1.0	66
clopyralid+2,4-D	.27+1.5	90
clopyralid	0.25	85
metsulfuron+X-77	0.45 oz+0.25% v/v	54
metsulfuron+X-77	0.23 oz+0.25% v/a	34
metsulfuron+2,4-D(LVE)+X-77	0.45 oz+1.0+0.25% v/v	66
metsulfuron+2,4-D(LVE)+X-77	0.23 oz+1.0+0.25% v/v	24
CHECK		0
(LSD 0.05)		23.4

[1]Herbicides were applied 10/9/91.
[2]Evaluations were made 8/5/92.

Russian knapweed control with various herbicides applied during fall dormancy.
Treatment replication data

Herbicide[1]	Rate ai/A	Rep 1	Rep 2	Rep 3	Rep 4	Ave.
picloram	0.25	95	90	95	92	93
picloram	0.38	99	99	92	100	100
picloram	0.5	100	100	100	100	100
picloram	0.75	100	100	100	99	100
picloram	1.0	100	100	100	100	100
picloram+2,4-D(LVE)	0.5+1.0	99	100	100	100	100
picloram+2,4-D(LVE)	0.75+1.0	100	100	100	100	100
dicamba	1.0	50	15	60	70	49
dicamba+picloram	1.0+0.25	95	95	92	100	96
dicamba+2,4-D(LVE)	1.0+1.0	25	20	90	80	54
clopyralid+2,4-D(A)	.19+1.0	60	60	65	80	66
clopyralid+2,4-D(A)	.29+1.5	75	93	94	98	90
clopyralid	0.25	90	80	90	80	85
metsulfuron+X-77	0.45 oz+0.25% v/v	85	10	80	40	54
metsulfuron+X-77	0.23 oz+0.25% v/v	20	75	20	20	34
metsulfuron+2,4-D(LVE)+X-77	0.45 oz+1.0+0.25% v/v	50	70	70	75	66
metsulfuron+2,4-D(LVE)+X-77	0.23 oz+1.0+0.25% v/v	5	30	50	10	24
CHECK		0	0	0	0	0

[1]Herbicides were applied 10/9/91
[2]Evaluations were made 8/5/92

Control of duncecap larkspur (Delphinium occidentale (Wats.) Wats) at two growth stages with various herbicides. Whitson, T.D., G.E. Fink, R.J. Swearingen and J.R. Gill. Duncecap larkspur, a deep-rooted perennial, growing on high elevation rangeland, contains toxic alkaloids that are often poisonous to cattle. These studies were established near Barnum, Wyoming to determine the effectiveness of various herbicides applied at two growth stages. The first study was initiated May 23, 1989 when D. larkspur was in the 4 to 6 leaf growth stage, and the second study July 19, 1989 when D. larkspur was 2 to 3 ft. tall and in the bud to early bloom stage. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information May 23, 1989: temperature air 74F, soil surface 61F, 1 inch 62F, 2 inches 60F, 4 inches 60F with 18% relative humidity and 0-5 mph NE winds, and July 19, 1989: temperature air 85F, soil surface 87F, 1 inch 77F, 2 inches 79F and 4 inches 85F with 30% relative humidity and calm winds. Soil was a silty clay (28% sand, 46% silt and 26% clay) with 7.9% organic matter and a pH of 6.3. Treatments applied at the 4 to 6 leaf stage which controlled greater than 95% of the D. larkspur plants resulting in greater than 95% D. larkspur biomass reduction included: metsulfuron at 0.063 lb ai/A, and the combinations of metsulfuron+picloram at 0.063+.75, 0.063+1.0 or 0.125+1.0 lb ai/A and metsulfuron+dicamba at 0.125+0.5 lb ai/A. Treatments applied during the early bloom stage which controlled greater than 88% of the D. larkspur plants resulting in greater than 91% biomass reduction were picloram at 1.5 or 2.0 lb ai/A and metsulfuron+picloram at 0.125+1.0 lb ai/A. Applications of metsulfuron were most effective in controlling D. larkspur in the 4 to 6 leaf stage while picloram was most effective when applied at the bloom stage. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1670).

Duncecap Control At Two Growth Stages

		% Control Applied[2]		% Biomass Reduction	
Herbicide[1]	Rate lb ai/A	4-6 leaf	early bloom	4-6 leaf	early bloom
picloram	.75	55	42	45	29
picloram	1.0	67	50	61	48
picloram	1.5	78	88	76	91
picloram	2.0	68	100	60	100
2,4-D(LVE)	1.0	59	39	38	18
2,4-D(LVE)+picloram	1.0+.25	60	73	20	83
triclopyr+2,4-D(LVE)	0.5+1.0	59	0	30	10
triclopyr+2,4-D(LVE)+picloram	0.5+1.0+.25	63	23	49	14
picloram+L-77	.75+.25%	50	38	53	58
triclopyr+2,4-D	0.5+1.0+.25%	58	0	46	23
metsulfuron	0.063+.25%	95	43	97	65
metsulfuron+picloram+X-77	0.063+.75+.25%	96	80	98	94
metsulfuron+picloram+X-77	0.063+1.0+.25%	95	81	97	95
metsulfuron+picloram+X-77	0.125+1.0+.25%	100	96	100	98
metsulfuron+dicamba+X-77	0.063+0.5+.25%	92	52	95	71
metsulfuron+dicamba+X-77	0.125+0.5+.25%	96	68	97	80
Check		- -	- -	0	0

[1]Treatments were applied at 4 to 6 leaf stage on May 23, 1989 and early bloom on July 19, 1989.

[2]Evaluations were made July 15, 1992.

[3]Average number of plants per square rod on July 15, 1992 was 26.

Tall Larkspur Control at Two Growth Stages
Larkspur Plant Counts (Replication Data)

Herbicide[1]	Rate lb ai/A	Rep 1		Rep 2		Rep 3		Rep 4		Average		% Control
		5/30/89	7/15/92	5/30/89	7/15/92	5/30/89	7/15/92	5/30/89	7/15/92	5/30/89	7/15/92	
Tordon (picloram)	.75	23	15	26	18	22	10	33	17	26	15	42
Tordon	1.0	39	11	19	5	15	14	23	16	24	12	50
Tordon	1.5	36	7	21	0	27	3	19	3	26	3	88
Tordon	2.0	29	0	15	0	19	0	21	1	21	0	100
2,4-D(LVE)	1.0	24	27	28	21	49	25	30	8	33	20	39
2,4-D(LVE)+Tordon	1.0+0.25	27	7	24	5	25	9	26	8	26	7	73
Crossbow(triclopyr+2,4-D(LVE)	0.5+1.5	22	28	18	20	17	15	19	21	19	21	0
Crossbow+Tordon	1.5+0.25	23	14	40	20	18	21	21	26	26	20	23
Tordon+L-77	.75+.25%	14	14	16	8	35	17	17	11	21	13	38
Crossbow+L-77	1.5+.25%	10	15	23	22	25	22	22	21	20	20	0
Escort(metsulfuron)+X-77	.063+.25%	18	15	19	8	23	13	25	13	21	12	43
Escort+Tordon+X-77	.063+.75+.25%	16	4	22	6	14	1	28	4	20	4	80
Escort+Tordon+X-77	.063+1.0+.25%	14	7	21	0	25	4	24	4	21	4	81
Escort+Tordon+X-77	0.125+1.0+.25%	17	1	50	0	25	2	15	0	27	1	96
Escort+Banvel(dicamba)+X-77	0.063+0.5+.25%	20	11	17	11	11	6	37	13	21	10	52
Escort+Banvel+X-77	0.125+0.5+.25%	16	3	26	9	30	13	26	6	25	8	68
CHECK		6	10	25	9	24	13	21	6	19	10	- -

1Treatments were made during bud to early bloom stage on July 19, 1989. Evaluations were made July 15, 1992.

Control of duncecap larkspur (Delphinium occidentale (Wats.) Wats.) with picloram and 2,4-D(LVE) combination. Whitson, T.D., R.J. Swearingen, G.E.Fink and J.R. Gill. In previous studies done to control duncecap larkspur extremely high rates of picloram were required for control. This study was initiated to determine if lower picloram rates might be effective when combined with 2,4-D(LVE). Herbicide applications were made July 12, 1991 when duncecap larkspur was from 18 to 24 inches tall and in the early seed setting stage. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Application information: temperature, air 78F, soil (surface) 89F, 1 inch 80F, 2 inches 76F, 4 inches 76F with 50% relative humidity and calm winds. Soil was a silty clay (28% sand, 46% silt and 26% clay) with 7.9% organic matter and a pH of 6.3. Duncecap larkspur biomass reduction was 89% or more with applications of picloram at 1.0 ai/A in combination with 2 lb ai 2,4-D. When duncecap larkspur plant counts were compared to their pretreatment counts application rates of picloram plus 2,4-D at 1.25+2.0 or 1.5+2.0 lb ai/Aprovided only 73% reduction in plant numbers.

Biomass reduction would likely be adequate to prevent cattle poisoning when levels reached 89% or more but plant counts would likely be used as an indicator for the length of time required for reinvasion of duncecap larkspur. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1678).

Duncecap larkspur (Delphenium occidentale (Wats.) Wats.) control with picloram combined with 2,4-D(LVE).

		% Reduction[2]	
Herbicide[1]	Rate lbs ai/A	Plant Numbers	Biomass
picloram+2,4-D	0.75+2.0	59	83
picloram+2,4-D	1.0+2.0	58	89
picloram+2,4-D	1.25+2.0	73	93
picloram+2,4-D	1.5+2.0	73	92

[1]Herbicides were applied 7/12/91 when duncecap larkspur was 18 to 24 inches tall in early bloom.
[2]Evaluations were made 8/15/92.

Duncecap larkspur plant count reductions with picloram and 2,4-D combinations

Herbicide[1]	Rate lb ai/A	Rep 1[2]	Rep 2	Rep 3	Rep 4	Ave.
picloram(Tordon)+2,4-D	0.75+2.0	69	55	59	52	59
picloram(Tordon)+2,4-D	1.0+2.0	59	64	47	62	58
picloram(Tordon)+2,4-D	1.25+2.0	83	67	81	59	73
picloram(Tordon)+2,4-D	1.5+2.0	77	74	62	80	73

Duncecap larkspur biomass reduction with picloram and 2,4-D combinations.

Herbicide[1]	Rate lb ai/A	Rep 1[2]	Rep 2	Rep 3	Rep 4	Ave.
picloram(Tordon)+2,4-D	0.75+2.0	78	85	82	85	83
picloram(Tordon)+2,4-D	1.0+2.0	83	94	90	90	89
picloram(Tordon)+2,4-D	1.25+2.0	98	90	95	90	93
picloram(Tordon)+2,4-D	1.5+2.0	98	95	80	95	92

[1]Herbicides were applied 7/12/91 when duncecap larkspur was 18 to 24 inches tall.
[2]Evaluations were made 8/15/92.

Duncecap larkspur (Delphinium occidentale (Wats.) Wats.) control with metsulfuron plus 2,4-D. Whitson, T.D., G.E. Fink, R.J. Swearingen and J.R. Gill. This study was conducted following several other experiments on control of tall larkspur. The purpose was to determine if applications of metsulfuron plus 2,4-D would provide consistent control of duncecap larkspur. The study was initiated on June 14, 1991 when duncecap larkspur was in the 4 to 5 leaf stage. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information on June 14, 1991: temperature air 77F, soil surface 74F, 1 inch 72F, 2 inches 71F, 4 inches 71F with 23% relative humidity and calm winds. Soil was a silty clay (28% sand, 46% silt and 26% clay) with 7.9% organic matter and a pH of 6.3. Duncecap larkspur biomass reductions greater than 95% were found in plots treated with metsulfuron at 0.45 oz/ai/A+2,4-D at 0.5 lb ai/A and above. Plant counts were compared to the pretreatment counts of duncecap larkspur. Metsulfuron at 0.63 oz ai/A+2,4-D at 0.5 lb ai/A provided control of 88% of duncecap larkspur plants. Biomass reduction would be used in a prediction of cattle poisoning but plant counts would likely be used as in indicator for the length of time required for reinvasion of duncecap larkspur. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1677).

Duncecap larkspur control with various applications of the combined treatment of metsulfuron+2,4-D.

		% Reduction[2]	
Herbicide[1]	Rate ai/A	Plant Numbers	Biomass
metsulfuron+2,4-D(LVE)	0.3 oz + .5 lb	75	94
metsulfuron+2,4-D(LVE)	0.38 oz + .5 lb	51	89
metsulfuron+2,4-D(LVE)	0.45 oz + .5 lb	79	95
metsulfuron+2,4-D(LVE)	0.53 oz +.5 lb	78	95
metsulfuron+2,4-D(LVE)	0.63 oz + .5 lb	88	97

[1]Herbicides applied June 14, 1991 to duncecap larkspur in the 4 to 6 leaf stage.
[2]Evaluations made July 15, 1992.

Duncecap larkspur plant count reductions with metsulfuron/2,4-D combined treatments.

Herbicide	Rate ai/A	Rep 1	Rep 2	Rep 3	Rep 4	Ave.
metsulfuron(Ally)+2,4-D	.3 oz + .5 lb	80%	85%	75	61	75
metsulfuron(Ally)+2,4-D	.38 oz + .5 lb	31%	67%	55	52	51
metsulfuron(Ally)+2,4-D	.45 oz + .5 lb	84%	83%	68	82	79
metsulfuron(Ally)+2,4-D	.53 oz + .5 lb	82%	91%	61	79	78
metsulfuron(Ally)+2,4-D	.63 oz + .5 lb	93%	84%	85%	88%	88

Duncecap larkspur biomass reduction with metsulfuron/2,4-D combined treatments

Herbicide	Rate ai/A	Rep 1	Rep 2	Rep 3	Rep 4	Ave.
metsulfuron(Ally)+2,4-D	.3 oz + .5 lb	90	95	93	96	94
metsulfuron(Ally)+2,4-D	.38 oz + .5 lb	80	94	90	93	89
metsulfuron(Ally)+2,4-D	.45 oz + .5 lb	95	95	94	96	95
metsulfuron(Ally)+2,4-D	.53 oz + .5 lb	96	98	90	96	95
metsulfuron(Ally)+2,4-D	.63 oz + .5 lb	98	95	97	97	97

Economics of Tall Larkspur Control on Rangelands. Nielsen, D.B., M.H. Ralphs, J.O. Evans, and C.A. Call. Larkspurs (*Delphinium* spp.) are responsible for more cattle deaths on high mountain rangelands than any other cause. Three herbicides, glyphosate, picloram, and metsulfuron, were tested for efficacy in controlling duncecap larkspur (*D. occidentale (Wats.) Wats.).* Several different application rates were tested and an economic analysis was done for the most effective rate for each herbicide. Alternative application methods were also tested and analyzed for economic feasibility.

Cost and return data were based on the results of an economic study done at Manti Canyon, Utah, in the mid 1970's. The 1970's cost for labor, $3.61 per acre, and equipment, $4.06 per acre, were indexed to 1992 rates which resulted in doubling these costs to $15.33 per acre. Ranchers suffered a 4.5 percent annual death loss to larkspur on the Manti allotment. Control of dense patches of larkspur reduced this loss by 94 percent. Dense patches of larkspur covered about 4.0 percent of the rangeland area where the death losses occurred. Roller application equipment costs were based on actual costs of constructing the equipment for the 1992 study. Back pack sprayer costs were based on time required to treat individual plants and 1992 costs of equipment.

The benefits of larkspur control are the value of cows saved annually as a result of control. An average cow was valued at $500 per head in 1992. Based on these estimates the benefit from each acre of larkspur controlled is $48 per acre. The Manti study estimated the life of the treatment to be at least 10 years. Each herbicide and the alternative application methods were analyzed for economic feasibility. In addition, the analysis was done for each case where it was assumed that the annual loss was only 2.25 percent not 4.5 percent of the herd. In one case the analysis was done where it was assumed that the treatment would only last five years.

The economic feasibility criterion that was used is the internal rate of return. This percentage rate can be compared to the interest rate if a rancher has to borrow money to control larkspur. A project is considered economically feasible if the internal rate of return is higher than the cost of money (interest rate). The analysis is summarized in the Table below. All of the treatments for the three herbicides considered are economically feasible with many of the internal rates of return substantially higher than current interest rates on borrowed money. Internal rates of return over 100 percent reflect situations where the costs are more than recovered the first year after treatment. (Utah State Agricultural Experiment Station, USDA/ARS Poisonous Plants Laboratory, Logan, Utah 84322-4820)

Economics of larkspur control on rangelands

Chemical	Application method	Cost of treatment/A	Value of cattle saved/A treated	Life of treatment	Internal rate of return %
Metsulfuron	Boom Sprayer (1 year treatment)	applic $15.33 chem $21.24 $36.57	$48 (4.5% loss)	10 yrs	131.23
			$24 (2.25% loss)	10 yrs	65.19
	Boom Sprayer (2 year treatment)	first yr $36.57 second yr $29.78	$48 (4.5% loss)	10 yrs	54.85
			$24 (2.25% loss)	10 yrs	28.73
	Boom Sprayer (1 year treatment)	applic $15.33 chem $21.34 36.57	$48 (4.5% loss)	2 yrs	19.74
Picloram	Boom Sprayer (1 year treatment)	applic $15.33 chem $96.60 $111.93	$48 (4.5% loss)	10 yrs	41.56
			$24 (2.25% loss)	10 yrs	16.97
	Boom Sprayer (1 year treatment)	" "	$48 (4.5% loss)	5 yrs	32.31
Glyphosate	Spot treatment retractable hoses (2) Oakley,ID	Labor $54.16 Equip $60.83 Chem $20.44 $135.43	$48 (4.5% loss)	10 yrs	33.47
			$24 (2.25% loss)	10 yrs	12.03
	Spot treatment retractable hoses (2) Manti, UT	Labor $27.08 Equip $30.42 Chem $20.44 $77.94	$48 (4.5% loss)	10 yrs	61.06
			$24 (2.25% loss)	10 yrs	2.23
Metsulfuron	Roller	Equip $ 6.74 Labor $14.94 Chem $14.87 $36.55	$48 (4.5% loss)	10 yrs	131.30
			$24 (2.25% loss)	10 yrs	65.23
Picloram	Roller	Applic $21.68 Chem $67.62 $89.30	$48 (4.5% loss)	10 yrs	52.99
			$24 (2.25% loss)	10 yrs	23.66
Glyphosate	Roller	Applic $21.68 Chem $15.00 $36.68	$48 (4.5% loss)	10 yrs	130.83
			$24 (2.25% loss)	10 yrs	64.99
Glyphosate	Backpack 6 hr day	Applic $41.79 Chem $20.44 $62.63	$48 (4.5% loss)	10 yrs	77.05
			$24 (2.25% loss)	10 yrs	38.50
	Backpack 5 hr day	Applic $50.15 $20.44 $70.59	$48 (4.5% loss)	10 yrs	67.86
			$24 (2.25% loss)	10 yrs	33.78
	Backpack 4 hr day	Applic $62.68 $20.44 $83.12	$48 (4.5% loss)	10 yrs	57.50
			$24 (2.25% loss)	10 yrs	28.37

Tall larkspur control on high elevation rangelands: assessment of application techniques and response of non-target vegetation. Bunderson, F.B., J.O. Evans, M.H. Ralphs and C.A. Call. Duncecap larkspur (*Delphinium occidentale*) and barbey larkspur (*D. barbeyi*) are the most important poisonous plants, in terms of total livestock losses, on high elevation rangelands in the Intermountain Western US. Herbicide control efforts of these tall larkspurs are difficult because of a heavy waxy leaf cuticle and resprouting capabilities of the roots.

Three herbicides (picloram, glyphosate, and metsulfuron) were applied at two rates by conventional boom sprayer and carpeted roller applicators (Table 1). The carpeted roller applicator is capable of applying herbicides to leaf undersides of larkspur plants where it is thought to be more readily absorbed. Herbicide efficacy was evaluated by measuring larkspur density and cover, and cover of associated desirable vegetation. The experimental location for the barbey larkspur was 17 km east of Manti in central Utah at elevation 3050 m, and the location for the duncecap larkspur was 32 km west of Oakley in southern Idaho at elevation 2270 m.

Larkspur density was reduced significantly by most treatments (Table 2). All treatments reduced larkspur cover percentage (Table 3). Barbey larkspur appeared to be more tolerant to metsulfuron than picloram while the reverse was true of duncecap larkspur. Spray treatments generally controlled larkspur better than carpeted roller applications. Grass cover increased in all treatments except for glyphosate at the duncecap larkspur site (Table 3). At that site, picloram and metsulfuron plots had a 1:6 forb to grass ratio, while glyphosate plots had a 5:1 forb to grass ratio. Most of the forbs remaining in the glyphosate treatments were resistant undesirable weed species. The same trend existed at the barbey site but grass cover averaged only 4% on the control plots which is not enough to allow grasses to fill voids left by herbicide treatment. Some sites may be so completely dominated by barbey larkspur that insufficient seed bank of desirable species remain to fill vacancies when larkspur is eliminated. Bare ground increased with all treatments.

The carpeted roller applicator appears to lack the ability to apply enough herbicide on large robust larkspur plants to affect mortality. Further research is needed before the use of carpeted roller applicators can be recommended for larkspur control. Advancements in herbicide application technology and herbicide chemistry make herbicide use less objectional, therefore research of herbicide control of larkspur must continue. Selective control, either by application method or herbicide applied, is essential because the effects on associated vegetation and the possibility of invasion by undesirable species and soil erosion enlarges when the site is opened. (USDA/ARS Poisonous Plant Research Laboratory, Utah Agriculture Experiment Station, Logan, UT 84322-4820)

Table 1 Herbicide application rates and application methods used for larkspur control at Oakley, Idaho and Manti, Utah, 1990

Herbicide	Boom sprayer Application rate	Carpeted roller Solution concentration
Glyphosate	1.1 kg ai/ha	1.00% ai
	2.2 kg ai/ha	6.68% ai
Picloram	1.1 kg ae/ha	1.00% ae
	2.2 kg ae/ha	13.36% ae
Metsulfuron	70 g ai/ha	0.10% ai
	140 g ai/ha	0.20% ai

The high rate solutions applied with the sprayer were the same as the low concentration solutions applied with the carpet roller.

Table 2 Percent reduction of larkspur density, 1 year after herbicide application, Oakley, Idaho and Manti, Utah, 1991

Herbicide	Duncecap	Barbey
	----------%----------	
Picloram	51_c	77_b
Metsulfuron	70_b	33_c
Glyphosate	87_a	87_a
Over-all rate		
Low	62_b	58_b
High	76_a	63_a
Over-all method		
Sprayer	80_a	62_a
Roller	58_b	69_a

[a-c] Means of the same category not followed by the same letter are significantly different ($P<0.05$)

TABLE 3 Mean percent cover 1 year post treatment, 1991.

	Larkspur		Annual Forb		Perennial Forb		Grass		Ground	
Treatment	Dun	Bar	Dun	Bar	Dun	Bar	Dun	Bar	Dun	Bar
Control	17	54	16	*	12	24	29	4	27	16
Picloram	5_a	3_b	1_b		2_b	5_c	43_a	26_a	49_a	66_a
Metsulfuron	2_b	8_a	1_b		5_b	12_b	46_a	26_a	47_a	54_b
Glyphosate	1_b	1_b	28_a		16_a	18_a	10_b	10_b	45_a	69_a
Sprayer applied	2_a	5_a	19_a		16_a	10_b	32_a	21_a	50_a	68_a
Roller applied	2_a	3_a	22_a		15_a	20_a	34_a	21_a	45_a	58_b
Low rate	3_a	6_a	10_a		11_a	13_a	34_a	22_a	42_b	58_b
High rate	2_a	2_a	11_a		5_b	10_a	32_a	20_a	62_a	68_a

*Insignificant part of the vegetation. Dun = duncecap site; Bar = barbey site. [a-c] Means of the same category not followed with the same letter are significantly different ($P<0.05$).

Control of wild licorice (Glyeyrrhiza lepidota) at two growth stages with various herbicides. Whitson, T.D., R.J. Swearingen and W.R. Tatman. Wild licorice is a deep rooted perennial commonly found in wet areas. It is highly competitive, and is currently spreading. Burs found on wild licorice are difficult to scour from wool and therefore reduce the value of a fleece. Two experiments were established near Rock River, Wyoming to test the effects of various herbicides when applied at two wild licorice growth stages. The first experiment was applied July 17, 1990 when wild licorice was in bloom, the second was initiated when seed pods had ripened but leaves were green. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 41 psi. Application information, July 17, 1990: air 80F, surface 90F, 1 inch 77F, 2 inches 76F, 4 inches 73F with 56% relative humidity and 0-2 mph NW winds. August 21, 1990: air 69F, surface 80F, 1 inch 80F, 2 inches 70F, 4 inches 69F with 75% relative humidity and 2-3 mph N winds. The soil was a sandy loam (70% sand, 17% silt and 13% clay) with 1.3% organic matter and a pH of 8.5 on the July experiment and a loam (43% sand, 34% silt and 23% clay) with 13.6% organic matter and a pH of 7.7 on the August experiment.

Evaluations were made two years after herbicides were applied to determine the long-term effect of the herbicide application. Herbicides which controlled greater than 93% of wild licorice in the seed stage were dicamba at 2.0 lb ai/A and the combinations of dicamba plus 2,4-D at 1.0+1.0 lb ai/A or dicamba+picloram at 1.0+0.125 lb ai/A. Herbicides applied at the bloom stage were less effective than treatments applied at the seed stage with picloram at 0.5 lb ai/A controlling greater than 90% of the wild licorice at that stage. The average % control of all treatments applied at the seed stage was 54% while the average % control of all treatments at the bloom stage was 38%. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1671).

Control of wild licorice at two growth stages with various herbicides

		% Control			
		Seed Stage		Bloom Stage	
Herbicide[1]	Rate lb ai/A	1991	1992	1991	1992
clopyralid+2,4-D	.14+.6	31	26	55	29
clopyralid+2,4-D	.19+1.0	48	76	93	51
clopyralid	0.125	23	46	98	16
clopyralid	0.188	21	41	100	19
picloram	0.125	38	21	66	21
picloram+2,4-D	0.125+0.5	51	38	60	45
picloram	0.25	83	35	85	56
picloram	0.50	99	65	90	90
dicamba	1.0	66	83	98	44
dicamba	2.0	75	93	94	59
dicamba+2,4-D	0.5+1.0	39	78	94	20
dicamba+2,4-D	1.0+1.0	33	94	96	29
dicamba+picloram	0.5+0.125	66	56	98	55
dicamba+picloram	0.5+0.25	81	75	96	63
dicamba+picloram	1.0+0.125	79	93	98	63
dicamba+fluroxypyr	0.5+0.5	41	59	89	35
dicamba+clopyralid	0.5+0.125	75	79	96	61
dicamba+clopyralid	0.5+0.25	65	71	98	59
2,4-D	2.0	15	35	51	8
metsulfuron+X-77	0.0075+.25%	0	0	0	0
metsulfuron+X-77	0.015+.25%	0	6	23	1
metsulfuron+X-77	0.0225+.25%	10	15	69	6

[1]Herbicides were applied July 17, 1990 during bloom stage and August 21, 1990 during ripened seed pod formation. Evaluations were made August 5, 1991 and August 10, 1992.

Control of Wyeth lupine (Lupinus wyethii S. Wats.) with various herbicides. Whitson, T.D, T. Bateman and R.J. Swearingen. Wyeth lupine is a perennial forb especially common in high elevation western rangeland. Wyethii lupine is considered the most common cause of sheep poisoning in the western U.S. and although cattle are seldom poisoned from wyethii lupine it is often responsible for skeletal birth defects in newborn calves. This study was established near Afton, Wyoming to determine the efficacy of various herbicides on wyeth lupine. Wyeth lupine was in the bud to early bloom stage when herbicides were applied. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information on July 16, 1991: temperature air 78F, soil surface 83F, 1 inch 86F, 2 inches 82F, 4 inches 80F with 78% relative humidity and calm winds. Soil was a silt loam (11% sand, 66% silt and 23% clay) with 6.4% organic matter and a pH of 6.0. Picloram and dicamba used alone or in combination with each other failed to control wyethii lupine. Wyeth lupine control was higher when picloram or dicamba was combined with 2,4-D(LVE). Picloram plus 2,4-D(LVE) at 0.125+0.5 lb ai/A, dicamba plus 2,4-D(LVE) at 0.5+1.0 and 1.0+1.0 controlled 45%, 73% and 73% of wyethii lupine, respectively. 2,4-D used alone at 2.0 lb ai/A controlled 35% of the w. lupine. No treatment provided complete control of this poisonous perennial. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1673).

Control of Weyeth lupine with various herbicides

Herbicide[1]	Rate lb ai/A	% Control
clopyralid+2,4-D	0.63+.12	0
clopyralid+2,4-D	1.0+.19	3
clopyralid+2,4-D	.125	0
clopyralid+2,4-D	.118	0
picloram	.125	3
picloram+2,4-D(LVE)	0.125+0.5	45
picloram+2,4-D(LVE)	0.25	0
picloram+2,4-D(LVE)	0.5	13
dicamba	1.0	10
dicamba	2.0	16
dicamba+2,4-D(LVE)	0.5+1.0	73
dicamba+2,4-D(LVE)	1.0+1.0	73
dicamba+picloram	0.5+0.125	0
dicamba+picloram	1.0+0.125	13
dicamba+fluroxypyr	0.5+0.5	0
dicamba+clopyralid	0.5+0.125	3
dicamba+clopyralid	0.5+0.25	0
2,4-D(LVE)	2.0	35
metsulfuron+X-77	.0075+0.25% v/v	0
metsulfuron+X-77	.015+0.25 v/v	0

[1]Herbicides were applied July 16, 1991.
[2]Evaluations were made July 28, 1992.

Control of Wyeth lupine with various herbicides
Treatment replication data

		%Control[2]				
Herbicide[1]	Rate lb ai/A	Rep 1	Rep 2	Rep 3	Rep 4	Ave.
Curtail	0.748	0	0	0	0	0
Curtail	1.188	0	10	0	0	3
Stinger	0.125	0	0	0	0	0
Stinger	0.188	0	0	0	0	0
Tordon	0.125	0	0	10	0	3
Tordon+2,4-D	0.125+0.5	80	50	50	0	45
Tordon	0.25	0	0	0	0	0
Tordon	0.50	0	50	0	0	13
Banvel	1.0	0	0	0	40	10
Banvel	2.0	15	50	0	0	16
Banvel+2,4-D	0.5+1.0	50	90	70	80	73
Banvel+2,4-D	1.0+1.0	90	70	50	80	73
Banvel+Tordon	0.5+0.125	0	0	0	0	0
Banvel+Tordon	1.0+0.125	25	0	0	25	13
Banvel+Starane	0.5+0.5	0	0	0	0	0
Banvel+Stinger	0.5+0.125	0	0	0	10	3
Banvel+Stinger	0.5+0.25	0	0	0	0	0
2,4-D	2.0	40	50	50	0	35
Ally+X-77	0.0075+0.25%	0	0	0	0	0
Ally+X-77	0.015+0.25%	0	0	0	0	0
Ally+X-77	0.0225+0.25%	0	0	0	0	0

[1]Herbicides were applied July 16, 1991.
[2]Evaluations were made July 28, 1992.

Fall application of herbicides for mesquite control. McDaniel, K.C. and K.W. Duncan. Honey mesquite (*Prosopis glandulosa* Torr) is usually commercially sprayed between late May to early July (45 to 90 days after bud break) under New Mexico conditions. Earlier research in Texas suggest clopyralid is equally effective when applied throughout the growing season. This screening trial was conducted to examine a late season application of clopyralid and triclopyr applied alone or with other herbicides. Studies were established in northeastern New Mexico near San Jon (sandy loam soil) and in southern New Mexico near Las Cruces (sandy soil). Herbicides were aerially applied at 4 gpa total volume and were mixed in a 1:5 oil:water emulsion, emulsifier and drift control agent were added.

At San Jon plots were 270 by 1600 ft (10 ac) with 100 ft buffers. Application information on September 12, 1991 when mesquite was not stressed but in the late vegetative stage was temperature: air 24°C; soil at 6 inch 21°C; RH 60%; WS 6 mph; soil moisture moderate to high. Treatments with triclopyr provided higher canopy reduction and apparent mortality compared to clopyralid alone or mixed with picloram. This is a major advantage because triclopyr cost less than clopyralid.

At Las Cruces plots were 250 by 1250 ft (7 ac) with 100 ft buffers. Treatments were applied September 26, 1991 to mesquite foliage excessively damaged by insect girdlers. During spraying temperature was 17°C air; 19°C soil; RH 75% WS 3 mph; soil moisture moderate. Tree girdler activity was estimated to occur on 60% of the plants with about 5 to 20% of the stems on each plant damaged. This probably prevented or reduced herbicide absorption and influenced mortality results on this site. (Department of Animal and Range Sciences, and Cooperative Extension Service, New Mexico State University, Las Cruces, NM 88003)

Herbicide[1]	Rate (lb ae/a)	Study Area: Las Cruces		San Jon	
		%			
		AM[2]	CR	AM	CR
Clopyralid	0.5	0	35	5	50
Clopyralid + 0.25% organosilicone surf.	0.5	0	55	15	65
Triclopyr	0.5	0	40	70	95
Clopyralid + Triclopyr	0.125+ 0.125	0	10	45	80
Clopyralid + Triclopyr	0.25 + 0.5	0	70	85	99
Clopyralid + Picloram	0.25 + 0.25	0	30	20	65
Check		0	25	5	0

[1] Herbicides were applied 9/12/91 near San Jon and 9/26/91 near Las Cruces.

[2] Apparent mortality (AM) determined by counting 200 plants/trt as alive or dead, and canopy reduction (CR) visually estimated on 6/12/92 near San Jon and 5/15/92 near Las Cruces.

Effect of herbicides on common mullein. Zamora, D.L. The effect of several herbicides on height and flowering of common mullein (*Verbascum thapsus*) was determined on a roadside near Helena, Montana.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied 5/31/92 to mullein in the late rosette to early bolt stage of growth. Height (the average of 10 randomly chosen plants in each of the three replications) was measured on 7/30/92. Flowering is the percentage of 10 randomly chosen plants, in each of the three replications, that were flowering on 7/30/92. Grass injury is a visual estimate of percentage injury compared to the untreated control and was evaluated on 7/30/92.

Sulfometuron and imazapyr (at 0.5 lbs ai/a) controlled common mullein with minimal grass injury. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of herbicides on common mullein at Helena, MT.

Herbicide	Rate	Height	Flowers	Grass injury
	(lbs ai/a)	(in.)	(%)	(%)
2,4-D amine	1.88	19	34	0
Picloram	0.5	16	30	0
Picloram + 2,4-D amine	0.5 + 0.94	12	27	7
Glyphosate	2.0	9	0	68
Metsulfuron	0.011	14	52	0
Metsulfuron 2,4-D amine	0.011 + 0.94	12	23	2
Nicosulfuron	0.07	18	50	3
Sulfometuron	0.19	6	0	22
Imazapyr	0.5	4	0	37
Imazapyr	1.0	5	0	60
Imazapyr	1.5	4	0	70
Check		38	100	-
PR > F		0.002	0.003	0.0001
LSD (0.05)		13	43	24

[1] All treatments included surfactant at 0.25% v/v.

Evaluation of several herbicides for fringed sagebrush control. Lym, Rodney G. Fringed sagebrush (*Artemisia frigida*) is the most widely distributed and abundant species of the *Artemisia* genus. It is found from Mexico throughout the West to Alaska in high plains, valleys, mountains, and grasslands. Fringed sagebrush is resistant to drought and overgrazing and increased rapidly in North Dakota mixed- and short-grass rangelands following severe drought conditions in 1988. The purpose of this research was to evaluate imazethapyr, clopyralid and metsulfuron for fringed sagebrush control.

The experiment was established near Jamestown, ND in grazed pastureland on May 30, 1991. Fringed sagebrush was in the vegetative growth stage and actively growing. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 35 ft in a randomized complete block design with three replications. Fringed sagebrush control evaluations were based on a visual estimate of percent stand reduction as compared to the untreated check.

		Control		
Treatment	Rate	Aug 91	May 92	Aug 92
	oz/A		%	
2,4-D LVE	8	56	33	28
2,4-D LVE	12	67	45	53
2,4-D LVE	16	78	79	93
2,4-D amine	12	41	37	30
2,4-D mixed amine[a]	12	44	51	56
Imazethapyr + Sun-It II	2 + 1 qt	3	5	3
Picloram	4	28	33	33
Picloram + 2,4-D LVE	2 + 8	81	72	76
Picloram + 2,4-D LVE	4 + 8	84	90	94
Picloram + 2,4-D amine	4 + 8	58	60	73
Dicamba + X-77	8 + 0.25%	35	41	32
Dicamba + X-77	16 + 0.25%	70	79	47
Clopyralid + 2,4-D	1.5 + 8	83	77	85
Clopyralid + 2,4-D	3 + 16	92	95	98
Metsulfuron + X-77	0.10 + 0.25%	4	9	3
Metsulfuron + X-77	0.30 + 8 + 0.25%	17	24	23
Metsulfuron + 2,4-D LVE + X-77	0.10 + 8 + 0.25%	65	45	53
LSD (0.05)		23	34	45

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

Imazethapyr and metsulfuron did not control fringed sagebrush (Table). Clopyralid plus 2,4-D provided excellent long-term control especially when applied at 3 + 16 oz/A which averaged 98% control in August 1992. However, 2,4-D LVE at 16 oz/A provided 93% control and would cost only $3 to $4/A compared to over $25/A for clopyralid plus 2,4-D. Fringed sagebrush control was better with 2,4-D LVE and mixed amine formulations than with 2,4-D amine at the same application rate. Picloram plus 2,4-D LVE at 4 + 8 oz/A provided similar control to 2,4-D LVE at 16 oz/A alone but would have to maintain control much longer than 2,4-D LVE alone to be cost-effective. Dicamba provided similar control to 2,4-D amine. (Published with approval of the Agric. Exp. Stn., North Dakota State University, Fargo 58105).

<u>Field scabious control with herbicides</u>. Zamora, D.L. Field scabious (*Knautia arvensis*), an exotic plant from Eurasia, is spreading in Montana from high elevation meadows to pastures and alfalfa in Madison County. It also is being planted on sod roofs in Gallatin County. An experiment was established in a pasture at Alder, Montana to find an effective herbicide for controlling field scabious.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 10 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied on 10/2/92. The field scabious had dispersed seed but still had actively growing basal leaves; seedling field scabious also was present at densities up to 30/ft^2. A visual estimate of control (necrosis, chlorosis, and growth reduction) was made on 11-17-92. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Control of field scabious with herbicides at Alder, Montana.

Herbicide[1]	Rate	Control
	(lbs ai/a)	(%)
Metsulfuron	0.0038	57 abc[2]
Metsulfuron	0.0011	63 ab
2,4-D amine	0.94	50 bcd
2,4-D amine	1.88	33 de
Dicamba	0.5	50 bcd
Dicamba	1.0	63 ab
Clopyralid	0.25	10 f
Clopyralid	0.5	70 a
Clopyralid + 2,4-D amine	0.095 + 0.5	20 ef
Clopyralid + 2,4-D amine	0.19 + 1.0	50 bcd
Picloram	0.25	53 abc
Picloram	0.5	70 a
Triclopyr ester	1.0	43 cd
Triclopyr ester	2.0	63 ab
Check		
PR>F		0.0001

[1] All treatments included a nonionic surfactant at 0.25% v/v.

[2] Numbers followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

<u>Broom snakeweed control with picloram and an organosilicone additive</u>. McDaniel, K.C. Broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt & Rusby) is a common noxious range weed and often sprayed commercially over vast areas. In New Mexico, about 100,000 to 200,000 acres are sprayed annually primarily with picloram. The accepted commercial rate is 0.25 lb. ai/ac applied from late September until December. This experiment established near Corona, NM was designed to investigate sub-recommended rates with the inclusion of an organosilicone surfactant (XRM-5234). Treatments were applied under various environmental conditions on seven dates. An original objective was to spray under relatively high (morning) and low (afternoon) humidity conditions on a particular date as was the case on October 24-25 and December 5-6, 1991. Because environmental conditions did not sufficiently change during a 48 hour period only a single set of treatments were applied on November 14, 1991, and April 8 and May 8, 1992.

Addition of 0.125% v/v organosilicone surfactant did not enhance the effectiveness of picloram for broom snakeweed control. There was a dosage response, however picloram was less effective when applied in December and May compared to other dates. Results from morning and afternoon spraying were inconclusive but snakeweed control tended to be higher when sprayed under relatively high humidity conditions on October 23 (60% RH) compared to lower humidity on October 24, 1991 (25% RH). (Department of Animal and Range Science, New Mexico State University, Las Cruces, NM 88003).

Snakeweed mortality following applications of picloram and picloram plus organosilicone surfactant (XRM-5234) under various environmental conditions on the NMSU Corona Research Ranch. Treatments evaluated 18 August 1992.

Date		10/25/91	10/24/91	11/14/91	12/6/91	12/5/91	4/8/92	5/8/92
Spray Time		8:15-9:15	3:45-4:30	8:30-9:20	8:45-9:30	2:10-2:45	9:15-10:15	11:15-12:15
Air Temp°C		8.6	18.5	8.8	6.8-11.6	13.8-11.8	18	19.5
Soil Temp (10.50cm)		12.7, 16.3	19, 16	8.8, 8.7	1.2, 4.2	2.9, 4.1	9.3, 9.5	14.7, 15.2
% RH		70-50%	25%	89%	42-25%	18%	17%	36%
Wind Speed (km/hr)		2.9	4.2	3	5.5	<3	<3	4.7
	Dosage (kg/ha)	Snakeweed Mortality (%)						
Picloram	0.07	5	8	14	4	15	11	3
+ Surfactant	0.125%	5	13	11	5	9	18	4
Picloram	0.14	17	32	38	25	27	66	4
+ Surfactant	0.125%	26	44	31	21	13	54	13
Picloram	0.21	78	68	80	18	33	85	23
Picloram	0.28	93	78	85	55	55	95	35
Surfactant	0.125%	4	6	7	1	5	2	2
Control	-	7	5	11	2	6	1	2
LSD =(0.05)		14	25	34	24	18	26	6

Comparison of 2,4-D formulations with picloram or glyphosate spring- or fall-applied for leafy spurge control. Lym, Rodney G., and Calvin G. Messersmith. Picloram plus 2,4-D is the most cost-effective treatment for leafy spurge control. 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. Control has been similar regardless of the 2,4-D formulation applied with picloram. However, subtle differences between treatments may not be revealed when treatments are applied only once. Recently, several powder formulations of 2,4-D have been formulated to decrease the cost of container shipment and disposal. The purpose of these experiments was to evaluate various 2,4-D formulations plus glyphosate, metsulfuron, or picloram applied annually for leafy spurge control.

The first experiment was established on June 7, 1990 near Valley City. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Retreatments were applied in 1991. All plots were 10 by 30 ft in a randomized complete block design with four replicates. Evaluations were based on visible percent stand reduction as compared to the control.

Leafy spurge control was similar with picloram plus 2,4-D regardless of 2,4-D formulation (Table 1). Control was generally lower 15 MAFT (months after the first treatment) than 3 MAFT. Above average precipitation was received during the second year (1991) and leafy spurge regrowth was vigorous. Picloram at 0.25 lb/A provided better leafy spurge control than either 2,4-D formulation alone even when 2,4-D was applied at 4 lb/A.

Table 1. Comparison of 2,4-D amine and mixed amine formulations applied alone and with picloram in June 1990 and 1991 for leafy spurge control (Lym and Messersmith).

Treatment	Rate	Months after first treatment			
		3	12	15	24
	— lb/A —	% control			
2,4-D mixed amine[a]	1	27	0	0	0
2,4-D mixed amine[a]	2	33	0	0	0
2,4-D mixed amine[a]	4	29	0	1	6
2,4-D alkanolamine	4	43	0	4	8
2,4-D mixed amine[a] + picloram	2 + 0.25	59	18	26	29
2,4-D alkanolamine + picloram	2 + 0.25	58	13	46	33
2,4-D mixed amine[a] + picloram	2 + 0.5	83	50	54	79
2,4-D alkanolamine + picloram	2 + 0.5	78	47	64	77
Picloram	0.25	62	4	23	22
Picloram	0.5	79	35	60	65
Picloram	1	96	89	93	100
2,4-D alkanolamine + picloram	1 + 0.5	77	29	64	78
LSD (0.05)		18	22	25	22

[a]Mixed amine salts of 2,4-D (2:1 v/v dimethylamine:diethanolamine)-HiDep.

The second and third experiments were established September 9, 1991 near Valley City using the same methods previously described. Leafy spurge was in the fall regrowth stage with red stems and leaves.

As in the previous experiment with spring-applied treatments, leafy spurge control was similar with picloram plus 2,4-D regardless of 2,4-D formulation (Table 2). No treatment provided satisfactory control 12 MAT including picloram plus 2,4-D at 0.5 plus 1 lb/A, the standard fall-applied treatment for leafy spurge. Previous research has shown this treatment will provide 90% or better leafy spurge control following 3 to 4 annual retreatments.

Leafy spurge control with glyphosate was similar regardless of 2,4-D formulation (Table 3). Metsulfuron did not control leafy spurge whether applied alone or with 2,4-D regardless of formulation. The commercial formulation of glyphosate plus 2,4-D even when applied at a lower rate tended to provide better control than the tank-mixed treatments.

The fourth experiment was established June 8, 1992 near Valley City when the leafy spurge was in the yellow bract to flowering growth stage with lush growth and 18 to 24 inches tall. The 2,4-D formulations were added to water immediately prior to application and no surfactants were used.

The water soluble powder CL-782 provided only 68% topgrowth control 1 MAT compared to 97% or better for all other 2,4-D formulations including a second dimethylamine powder (Table 4). Control was similar for all 2,4-D treatments 3 MAT, including CL-782 and averaged 20%.

In general, leafy spurge control was similar with all 2,4-D formulations applied alone or in combination with picloram or glyphosate. CL-782 dimethylamine 80% WSP was the only 2,4-D formulation evaluated that provided less control than other 2,4-D formulations and this occurred only 1 MAT. (Published with approval of the Agric. Exp. Stn., North Dakota State University, Fargo 58105).

Table 2. Comparison of 2,4-D mixed amine and alkanolamine applied in September 1991 for leafy spurge control (Lym and Messersmith).

Treatment	Rate	Control/MAT	
		9	12
	— lb/A —	— % —	
2,4-D mixed amine[a]	1	16	0
2,4-D mixed amine[a]	2	15	0
2,4-D mixed amine[a]	4	20	0
2,4-D mixed amine[a] + picloram	2 + 0.25	67	5
2,4-D mixed amine[a] + picloram	2 + 0.5	94	11
2,4-D alkanolamine + picloram	2 + 0.5	97	9
2,4-D alkanolamine + picloram	1 + 0.25	66	0
2,4-D alkanolamine + picloram	1 + 0.5	96	35
LSD (0.05)		30	6

[a]Mixed amnine salts of 2,4-D (2:1 dimethylamine:diethanolamine)-HiDep.

Table 3. 2,4-D mixed amine applied alone and with glyphosate or metsulfuron for leafy spurge control in September 1991 (Lym and Messersmith).

Treatment	Rate	Control/MAT 9
	— oz/A —	— % —
2,4-D mixed amine[a]	15.2	18
2,4-D mixed amine[a]	30.4	5
Metsulfuron	0.25	9
Glyphosate	2	0
2,4-D mixed amine[a] + metsulfuron	15.2 + 0.25	0
2,4-D mixed amine[a] + metsulfuron	30.4 + 0.25	0
2,4-D mixed amine[a] + glyphosate	15.2 + 2	4
2,4-D mixed amine[a] + glyphosate	30.4 + 2	0
2,4-D alkanolamine + glyphosate	20.8 + 12.2	13
2,4-D mixed amine[a] + glyphosate	20.8 + 12.2	4
Glyphosate + 2,4-D[b]	0.4 + 0.7	32
LSD (0.05)		20

[a]Mixed amine salts of 2,4-D (2:1 dimethylamine:diethanolamine)-HiDep.
[b]Commercial formulation (Landmaster BW).

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

Treatment	Rate	Control/MAT 1	3
	- lb/A -	— % —	
2,4-D dimethylamine (Weedar 64)	2	98	20
2,4-D dimethylamine + diethanolamine (HiDep)	2	98	13
2,4-D butoxyethylester (Weedone LV4)	2	100	18
2,4-D acid + butoxyethylester (Weedone 638)	2	99	18
2,4-D isooctyl(2-ethylhexyl)ester (Esteron 99)	2	99	18
2,4-D triisopropanolamine + diethylamine (Formula 40)	2	97	17
2,4-D dimethylamine 80% WSP (CL-782)	2	68	28
2,4-D dimethylamine 85% WSP (Savage)	2	99	26
Picloram	0.5	99	89
LSD (0.05)		11	27

Comparison of various picloram formulations applied alone and with adjuvants for leafy spurge control. Lym, Rodney G. Picloram formulated as the potassium (K) salt (Tordon 22K) is the most effective herbicide for leafy spurge control. However, application rates are relatively high because picloram is poorly absorbed by leafy spurge. The purpose of this research was to 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 1991 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. 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 or a water-soluble acid powder (XRM-5255) alone or with 2,4-D spring- or fall-applied (Table 1). Picloram K-salt provided a nearly 2-fold increase in leafy spurge control compared to the acid powder when applied at 0.25 and 0.5 lb/A and an average of 32% increase in control at 1 lb/A averaged over application and evaluation dates. In general, adding 2,4-D to picloram regardless of formulation increased leafy spurge control compared to picloram alone, but the K-salt formulation still provided much better control than the acid powder.

The second experiment evaluated picloram K-salt alone or with various adjuvants or 2,4-D and picloram ester for leafy spurge control. The adjuvants evaluated included the commercial surfactants Scoil (a methylated crop oil), LI-700 (an acidified lecithin), Raider II (pyro-phosphate surfactant blend), and the experimental additive BAS-090. Picloram isooctyl ester was formulated with triclopyr butoxethyl ester (1:2) as the commercial product Access. The experiment was established at Valley City and on the Sheyenne National Grasslands in June 1991.

Leafy spurge control increased when picloram at 0.25 lb/A was applied with an adjuvant at Valley City but not Sheyenne (Table 2). BAS-090 and Scoil increased or tended to increase control more than the other adjuvants evaluated and was similar to control from picloram plus 2,4-D at 0.25 plus 1 lb/A. No adjuvant increased control when applied with picloram plus 2,4-D compared to the herbicides alone. In general, picloram plus triclopyr ester did not control leafy spurge regardless of application rate. Plant leaves desiccated rapidly when the ester formulation was applied and regrowth began within 30 days of treatment.

A similar experiment was established in September 1991 at Valley City and Hunter, ND except the commercial surfactant Silwett L-77 (an organosilicone) replaced LI-700 and the picloram rate was 0.5 lb/A. No adjuvant increased leafy spurge control compared to picloram or picloram plus 2,4-D applied alone in the fall (Table 3). Picloram plus triclopyr ester did not provide satisfactory leafy spurge control.

The final experiment compared the picloram K-salt, acid powder and ester formulations applied alone or with adjuvants, 2,4-D plus glyphosate, dicamba, and the experimental herbicide V-53482. The experiments were established near

Hunter, ND when leafy spurge was in the early flowering and the flower to seed-set growth stages.

As in the first experiment, picloram K-salt provided much better leafy spurge control than the acid powder except when XRM-5255 was applied with 2,4-D LVE (Table 4). Leafy spurge control averaged 98 and 70% control 3 and 12 months after treatment (MAT), respectively, with XRM-5255 plus 2,4-D LVE at 4 + 16 oz/A compared to 92 and 38%, respectively, with picloram K-salt plus 2,4-D LVE. Leafy spurge control with 2,4-D amine was similar to 2,4-D LVE when applied with picloram K-salt but declined 50% or more when applied with XRM-5255.

Dicamba at 32 oz/A provided similar leafy spurge control to picloram at 4 oz/A and control was not improved by adding 2,4-D or Scoil (Table 4). Glyphosate plus 2,4-D provided only 40% leafy spurge control 3 MAT. Neither V-53482 nor picloram plus triclopyr ester provided satisfactory leafy spurge control as the topgrowth was killed quickly but the plant regrew within 30 days.

In summary, picloram K-salt formulation provided much better leafy spurge control than the acid powder formulation whether applied alone or with adjuvants or 2,4-D amine. XRM-5255 applied with 2,4-D LVE provided similar leafy spurge control to the K-salt formulation and should be further evaluated. Leafy spurge control, in general, was not improved when picloram was applied with a spray adjuvant: but when an increase did occur, it was similar to picloram applied with 2,4-D, and the latter is a less costly treatment. Picloram applied as an ester killed the top growth rapidly but the plants regrew within 30 days. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Table 1. Comparison of picloram formulated as the potassium salt[a] and the dry acid XRM-5255[b] at two application dates near Valley City, ND (Lym).

Application date and treatment	Rate	Control		
		Aug 91	June 92	Aug 92
	— lb/A —		%	
June 1991				
Picloram	0.25	30	12	6
Picloram	0.5	60	48	22
Picloram	1	87	79	50
XRM-5255	0.25	16	6	4
XRM-5255	0.5	35	8	3
XRM-5255	1	53	33	11
Picloram+2,4-D	0.25+1	52	24	13
Picloram+2,4-D	0.5+1	55	36	17
XRM-5255+2,4-D	0.25+1	38	16	10
XRM-5255+2,4-D	0.5+1	45	15	15
LSD (0.05)		19	25	16
September 1991				
Picloram	0.25	.	21	4
Picloram	0.5	.	76	22
Picloram	1	.	95	62
XRM-5255	0.25	.	13	0
XRM-5255	0.5	.	14	4
XRM-5255	1	.	78	19
Picloram+2,4-D	0.25+1	.	50	12
Picloram+2,4-D	0.5+1	.	89	40
XRM-5255+2,4-D	0.25+1	.	6	1
XRM-5255+2,4-D	0.5+1	.	49	11
LSD (0.05)			27	11

[a]Picloram formulated as the potassium salt in Tordon 22K.
[b]Picloram acid formulated as a water soluble powder.

Table 2. Picloram applied as a potassium salt or isooctyl ester formulation with adjuvants in June 1991 for leafy spurge control (Lym).

Treatment	Rate	Location and evaluation date					
		Valley City		Sheyenne		Mean	
		Aug 91	June 92	Aug 91	June 92	Aug	June
	— lb/A —			% control			
Picloram	0.25	19	2	68	17	44	9
Picloram+Scoil	0.25+1 qt	52	25	44	7	48	16
Picloram+BAS-090	0.25+1 qt	76	44	57	8	71	26
Picloram+LI-700	0.25+0.5%	47	23	39	5	43	14
Picloram+RaiderII	0.25+1 pt	30	10	72	12	51	11
Picloram+2,4-D	0.25+1	68	35	59	19	63	27
Picloram+2,4-D+Scoil	0.25+1 +1 qt	55	23	83	6	69	15
Picloram+2,4-D+BAS-090	0.25+1 +1 qt	51	34	69	25	60	30
Picloram+2,4-D+Raider II	0.25+1 +1 pt	48	14	52	4	50	9
Picloram ester+triclopyr ester[a]	0.25+0.5	14	1	52	5	34	3
Picloram ester+triclopyr ester[a] +2,4-D	0.25+0.5+1	25	8	53	3	30	5
Picloram ester+triclopyr ester[a] +Scoil	0.25+0.5 +1 qt	40	18	35	3	37	10
LSD (0.05)		25	23	31	17	20	14

[a]Picloram isooctyl ester plus triclopyr butoxyethyl ester (1:2)-Access.

Table 3. Picloram applied as a potassium salt or isooctyl ester formulation with adjuvants in September 1991 for leafy spurge control (Lym).

		Location and/ 1992 evaluation date					
		Valley City		Hunter		Mean	
Treatment	Rate	May	Aug	May	Aug	May	Aug
	— lb/A —	% control					
Picloram	0.5	92	11	89	46	90	28
Picloram+Scoil	0.5+1 qt	96	13	83	36	89	24
Picloram+BAS-090	0.5+1 qt	95	19	88	44	91	31
Picloram+Silwett L-77	0.5+0.5%	96	18	80	28	88	23
Picloram+Raider II	0.5+1 pt	98	16	74	15	86	15
Picloram+2,4-D	0.5+1	96	15	966	47	96	31
Picloram+2,4-D+Scoil	0.5+1+1 qt	97	32	94	39	95	35
Picloram+2,4-D+BAS-090	0.5+1+1 qt	99	34	86	28	93	31
Picloram+2,4-D+Raider II	0.5+1+1 pt	97	25	88	46	93	36
Picloram ester+triclopyr ester[a]	0.5+1	47	6	8	0	27	3
Picloram ester+triclopyr ester[a]+2,4-D	0.5+1+1	36	2	16	3	26	2
Picloram+triclopyr ester[a]+ Scoil	0.5+1+1 qt	42	4	3	0	22	2
LSD (0.05)		24	16	13	22	13	24

[a]Picloram isooctyl ester plus triclopyr butoxyethyl ester (1:2)-Access.

Table 4. Herbicides applied at two growth stages for leafy spurge control near Hunter, ND (Lym).

		Application growth stage and evaluation date			
		Early flower		Flower to seed-set	
Treatment	Rate	Aug 91	June 92	Aug 91	June 92
	— oz/A —	%			
V-53482+Scoil	0.75+1 qt	18	0	47	0
V-53482+Scoil	1+1 qt	19	0	38	0
V-53482+Scoil	1.25+1 qt	11	0	15	0
V-53482+Scoil	1.5+1 qt	34	0	..	..
Picloram	4	34	10	63	26
Picloram+Scoil	4+1 qt	..		77	39
Picloram+L-77	4+0.5%	46	15	84	18
XRM-5255[b]	4	12	10	39	18
XRM-5255[b]+Scoil	4+1 qt	22	10	42	4
XRM-5255[b]+L-77	4+0.5%	16	6	30	9
Picloram+2,4-D LVE	4+16	..	..	92	38
Picloram+2,4-D amine	4+16	55	19	94	38
Picloram+2,4-D amine	8+16	98	65	..	..
XRM-5255[b]+2,4-D LVE	4+16	..	..	98	70
XRM-5255[b]+2,4-D amine	4+16	..	..	49	14
Dicamba	32	51	14		..
Dicamba+2,4-D amine	32+16	36	23		..
Dicamba+2,4-D[a]+Scoil	32+16+1qt	16	30		..
Glyphosate+2,4-D[a]	6.5+11	40	28		..
Glyphosate+2,4-D[a]+picloram	6.5+11+8	93	65	..	..
Picloram ester+triclopyr ester[c]	4+8	32	16	45	16
Picloram ester+triclopyr ester[c]+2,4-D amine	4+8+16	..	..	48	13
Picloram ester+triclopyr ester[c]+Scoil	4+8+1 qt		..	30	13
LSD (0.05)		31	20	31	25

[a]Commerical formulation (Landmaster BW).
[b]Picloram acid formulated as a water soluble powder.
[c]Picloram isooctyl ester plus triclopyr butoxyethyl ester (1:2)-Access.

Control of leafy spurge with retreatments of picloram and 2,4-D LVE. Ferrell, M.A. and T.D. Whitson. This research was conducted near Devil's Tower, Wyoming to compare the efficacy of retreatments of picloram and 2,4-D LVE on the control of leafy spurge. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The original herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi May 28, 1987 (air temp. 60 F, soil temp. 0 inch 60 F, 1 inch 55 F, relative humidity 75%, wind west at 10 mph, sky cloudy). Retreatment information is as follows: July 6, 1988 (air temp. 93 F, soil temp. 0 inch 110 F, 1 inch 95 F, 2 inch 83 F, 4 inch 80 F, relative humidity 38%, wind south at 5 mph, sky partly cloudy); June 6, 1989 (air temp. 80 F, soil temp. 0 inch 100 F, 1 inch 97 F, 2 inch 80 F, 4 inch 73 F, relative humidity 45%, wind south at 3 mph, sky clear); June 6, 1990 (air temp. 70 F, soil temp. 0 inch 83 F, 1 inch 78 F, 2 inch 75 F, 4 inch 65 F, relative humidity 50%, wind south at 10, sky partly cloudy); and June 13, 1991 (air temp. 72 F, soil temp. 0 inch 82 F, 1 inch 80 F, 2 inch 79 F, 4 inch 77 F, relative humidity 60%, wind northwest at 5, clear). The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was in the full bloom stage and 8 to 12 inches in height, for the original treatments and in seed set and 12 to 16 inches in height, for the retreatments. Infestations were heavy thoughout the experimental area. Visual weed control evaluations were made June 8, 1988, May 25, 1989, June 6, 1990, June 12, 1991 and June 9, 1992.

Leafy spurge control in 1988 was 80% or better with picloram at rates greater than 1.0 lb ai/a. No 1988 retreatments increased leafy spurge control to 80% or better. Picloram at 0.25 lb ai/a and 2,4-D LVE at 1.0 and 2.0 lb ai/a were the only 1989 retreatments that didn't increase leafy spurge control to 80% or better. Picloram at 0.25 lb and 2,4-D at 1.0 lb were the only 1990 retreatments that did not increase leafy spurge control to 80% or better. Picloram at 2.0 lb ai/a maintained 80% or better shoot control through 1990 before retreatment was needed. Picloram at 1.0, 1.25, 1.5, 1.75 and picloram + 2,4-D maintained 80% control or better in 1991. Picloram at 1.0, 1.25 and 2,4-D at 1.0 or 2.0 maintained 80% control or better in 1992. Plots with less than 80% control were retreated again June 10, 1992. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1667.)

Leafy spurge control

	Rate (lb ai/a)									
		Retreatment				Percent control[2]				
Treatment[1]	Original	1988	1989	1990	1991	1988	1989	1990	1991	1992
picloram	0.25	0.25	0.25	0.25	0.25	5	13	54	54	60
picloram	0.5	0.5	0.5	none	0.5	48	28	89	73	74
picloram	0.75	0.5	0.5	none	0.5	59	50	88	75	70
picloram	1.0	0.5	0.5	none	none	75	68	96	86	80
picloram	1.25	none	0.5	none	none	83	76	94	86	81
picloram	1.5	none	0.5	none	none	80	65	93	85	73
picloram	1.75	none	0.5	none	0.5	83	73	96	88	78
picloram	2.0	none	none	none	0.5	89	81	82	76	79
picloram + 2,4-D LVE	0.25 + 1.0	0.25 + 1.0	0.25 + 1.0	none	0.25+ 1.0	25	51	92	85	79
2,4-D LVE	1.0	1.0	1.0	1.0	1.0	0	15	70	74	88
2,4-D LVE	2.0	2.0	2.0	2.0	none	18	34	78	85	89
Check	none	none	none	none	none	0	0	0	0	0
(LSD 0.05)						17	21	11	14	15
(CV)						25	32	10	14	15

[1]Original treatments applied May 28, 1987. Retreatments applied July 6,1988; June 6, 1989; June 6, 1990; and June 13, 1991.

[2]Visual evaluations June 8, 1988; May 25, 1989; June 6, 1990; June 12,1991; and June 9, 1992.

The control of leafy spurge (*Euphorbia esula* L.) with various rates of picloram. M.A. Ferrell. This research was conducted near Devil's Tower, Wyoming to compare the efficacy of various rates of picloram for leafy spurge control. Retreatments were light rates of picloram or picloram/2,4-D tankmixes and were applied as needed to attain or maintain 80% control. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The initial herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 40 psi May 24, 1989 (air temp. 56 F, soil temp. 0 inch 74 F, 1 inch 77 F, 2 inch 76 F, 4 inch 75 F, relative humidity 45%, wind west at 3-5 mph, sky partly cloudy). Retreatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi June 6, 1990 (air temp. 72 F, soil temp. 0 inch 87 F, 1 inch 85 F, 2 inch 83 F, 4 inch 75 F, relative humidity 51%, wind south at 10 mph, sky partly cloudy) and June 13, 1991 (air temp. 72 F, soil temp. 0 inch 82 F, 1 inch 80 F, 2 inch 79 F, 4 inch 77 F, relative humidity 60%, wind northwest at 5 mph, clear). 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 12 to 14 inches in height, for the initial treatments and in full bloom and 20 inches in height for the retreatments. Infestations were heavy throughout the experimental area. Visual weed control evaluations were made June 6, 1990; June 13, 1991; and June 10, 1992.

Plots with initial treatments of 1.25 lb ai/a picloram or greater gave 80% or better leafy spurge control and did not require retreatment in 1990. All other plots required retreatment. Initial treatments maintaining 80% control or better in 1991 were two 1.5 lb picloram treatments, one 1.75 lb picloram treatment and all 2.0 lb picloram treatments. The only 1990 retreatment attaining 80% control or better in 1991 was 0.5 lb picloram over an initial 1.0 lb picloram. Plots with less than 80% control in 1991 were retreated. None of the retreatments applied in 1991 attained 80% control. Two of the three initial 2.0 lb picloram treatments maintained 80% leafy spurge control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1663.)

Leafy spurge control

Treatment[1]	Rate (lb ai/a)	Retreatment[2]	Rate (lb ai/a)	Retreatment applied		Percent control[3]		
				6-6-90	6-13-91	1990	1991	1992
picloram	0.25	picloram	0.25	yes	yes	30	43	33
picloram	0.5	picloram	0.25	yes	yes	48	53	28
picloram	0.5	picloram	0.5	yes	yes	50	79	71
picloram	0.5	picloram + 2,4-D amine	0.25 + 1.0	yes	yes	44	71	74
picloram	0.75	picloram	0.25	yes	yes	60	78	65
picloram	0.75	picloram	0.5	yes	yes	65	71	64
picloram	0.75	picloram + 2,4-D amine	0.25 + 1.0	yes	yes	63	65	69
picloram	1.0	picloram	0.25	yes	yes	76	75	61
picloram	1.0	picloram	0.5	yes	no	74	81	60
picloram	1.0	picloram + 2,4-D amine	0.25 + 1.0	yes	yes	71	74	66
picloram	1.25	picloram	0.25	no	yes	84	74	59
picloram	1.25	picloram	0.5	no	yes	87	75	69
picloram	1.25	picloram + 2,4-D amine	0.25 + 1.0	no	yes	81	63	65
picloram	1.5	picloram	0.25	no	no	89	80	66
picloram	1.5	picloram	0.5	no	no	91	80	69
picloram	1.5	picloram + 2,4-D amine	0.25 + 1.0	no	yes	87	75	69
picloram	1.75	picloram	0.25	no	yes	93	78	66
picloram	1.75	picloram	0.5	no	no	93	84	73
picloram	1.75	picloram + 2,4-D amine	0.25 + 1.0	no	no	92	79	69
picloram	2.0	picloram	0.25	no	no	95	84	74
picloram	2.0	picloram	0.5	no	no	97	85	80
picloram	2.0	picloram + 2,4-D amine	0.25 + 1.0	no	no	98	87	84
picloram + 2,4-D amine	0.25 + 1.0	picloram + 2,4-D amine	0.25 + 1.0	yes	yes	35	74	68
(LSD 0.05)						10	16	22
(CV)						10	16	25

[1]Treatments applied May 24, 1989.
[2]Retreatments applied to maintain or attain 80% control.
[3]Visual evaluations June 6, 1990; June 13, 1991; and June June 10, 1992.

Dicamba, picloram, 2,4-D tankmixes for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with tankmixes of dicamba, picloram, and 2,4-D amine. Plots were 10 by 13.5 ft. with four replications arranged in a randomized complete block. Spring treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 40 gpa at 40 psi June 11, 1991 (air temp. 86 F, soil temp. 0 inch 95 F, 1 inch 85 F, 2 inch 80 F, 4 inch 80 F, relative humidity 30%, wind south at 5 mph, sky clear). Late summer treatments were applied September 11, 1991 (air temp. 70 F, soil temp. 0 inch 85 F, 1 inch 80 F, 2 inch 80 F, 4 inch 75 F, relative humidity 55%, wind west at 3 mph, sky 30% 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 14 to 18 inches in height, for the spring treatments and past seed production and 14 to 20 inches in height, for the late summer treatments. Infestations were heavy thoughout the experimental area. Visual evaluations were made September 25, 1992.

Late summer applications of picloram+dicamba+2,4-D provided significantly better leafy spurge control than spring applications of picloram+dicamba+2,4-D. Herbicide combinations provide better control than individual herbicides at both dates. The addition of surfactant to combination treatments had no effect on leafy spurge control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1662.)

Leafy spurge control

Treatment	Rate	Application date/evaluation date	
		June 11, 1991/ Sept. 25, 1992	Sept 11, 1991/ Sept. 25, 1992
	(lb ai/a)	------------------(percent control[1])---------------------	
picloram+dicamba+2,4-D amine[2]	0.25+1.0+1.0	18	63
picloram+dicamba+2,4-D amine	0.25+1.0+1.0	13	53
picloram+dicamba+2,4-D amine[2]	0.25+2.0+1.0	23	71
picloram+dicamba+2,4-D amine	0.25+2.0+1.0	55	78
picloram+dicamba+2,4-D amine[2]	0.5+1.0+1.0	28	89
picloram+dicamba+2,4-D amine	0.5+1.0+1.0	64	86
picloram+dicamba+2,4-D amine[2]	0.5+2.0+1.0	39	78
picloram+dicamba+2,4-D amine	0.5+2.0+1.0	61	83
picloram	0.25	0	18
picloram	0.5	23	68
dicamba[2]	1.0	0	15
dicamba[2]	2.0	0	8
2,4-D amine	1.0	5	5
(LSD 0.05)		26	22
(CV)		78	30

[1]Percent control by visual estimation. An LSD (0.05) of 24 is valid for comparison of treatment means between application dates (CV=45%).
[2]Surfactant (X-77) added at 0.5% v/v.

Dicamba tankmixes for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to compare the efficacy of tankmixes of dicamba or 2,4-D LVE or picloram on the control of leafy spurge. Treatments and retreatments have been applied to maintain or attain 80% leafy spurge control. 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 30 gpa at 40 psi May 24, 1989 (air temp. 56 F, soil temp. 0 inch 74 F, 1 inch 77 F, relative humidity 45%, wind west at 3 mph, sky partly cloudy). Retreatments were applied June 7, 1990 (air temp. 62 F, soil temp. 0 inch 55 F, 1 inch 53 F, 2 inch 52, 4 inch 50, relative humidity 55%, wind south at 3 mph, sky partly cloudy) and June 18, 1991 (air temp. 74 F, soil temp. 0 inch 95 F, 1 inch 87 F, 2 inch 80, 4 inch 75, relative humidity 57%, wind south at 5 mph, sky partly 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 12 to 20 inches high, for both initial treatments and retreatments. Infestations were heavy thoughout the experimental area. Visual evaluations were made June 6, 1990; June 18, 1991; and June 11, 1992.

No initial treatment provided 80% control in 1990. 1990 retreatments provided 80% control or better in all plots, except where the initial treatment was 2.0 lb dicamba or 2.0 lb dicamba plus 1.0 lb 2,4-D LVE. No 1991 retreatments provided 80% control in 1992. However, 1990 retreatments, where the initial treatment was 1.0 lb dicamba plus 0.5 lb picloram or 1.0 lb dicamba plus picloram plus 2,4-D are maintained 80% or better control in 1992. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1666.)

Leafy spurge control

				Retreatment applied		Percent control[3]		
Treatment[1]	Rate	Retreatment[2]	Rate	June 7 1990	June 18 1991	June 6 1990	June 18 1991	June 11 1992
	lb ai/a		lb ai/a					
dicamba	2.0	dicamba	2.0	yes	yes	58	73	79
dicamba + 2,4-D LVE	1.0 + 1.0	dicamba + 2,4-D LVE	1.0 + 1.0	yes	yes	50	79	79
dicamba + picloram	1.0 + 0.25	dicamba + picloram	1.0 + 0.25	yes	no	58	80	78
dicamba + picloram	1.0 + 0.5	dicamba + picloram	1.0 + 0.5	yes	no	65	86	83
dicamba + picloram + 2,4-D LVE	1.0 + 0.5 + 1.0	dicamba + picloram + 2,4-D LVE	1.0 + 0.5 + 1.0	yes	no	73	88	83
(LSD 0.05)						9	5	5
(CV)						12	5	5

[1]Treatments applied May 24, 1989.
[2]Retreatments applied to maintain or attain 80% control.
[3]Percent control by visual estimation.

Effect of herbicides and application timing on leafy spurge. Zamora, D.L. Several herbicides were tested for their ability to control leafy spurge near Big Timber, MT. The experiment was a randomized complete block design with four replications. Plot size was 7 ft. x 25 ft.

Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. The treatments were applied on 9-18-91 and 6-1-92. The majority of the leafy spurge had disseminated seed and was still green and actively growing for the fall application (plant height and density were 18 to 24 in. and 17 plants/yd^2, respectively). Leafy spurge was in the true flower stage of growth for the June application. Visual estimations of leafy spurge and grass injury (necrosis, chlorosis, and growth reduction) compared to the untreated check were made on 7-24-92.

A fall application of nicosulfuron, imazaquin (0.25 lbs ai/a), and quinclorac (1.0 and 1.5 lbs ai/a), or a spring application of V-54382 provided good control of leafy spurge. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of herbicides on leafy spurge at Big Timber, MT.

Herbicide[1]	Rate	Timing	Injury: Leafy spurge	Injury: Grass
	(lbs ai/a)		---- (% of check)	----
Imazethapyr	0.0625	Fall	47 efg[2]	0 c
Imazethapyr	0.125	Fall	66 bcdef	0 c
Imazethapyr	0.125	Spring	46 efg	1 bc
Imazamethabenz	0.47	Spring	74 abcde	1 bc
Imazaquin	0.125	Fall	60 def	0 c
Imazaquin	0.25	Fall	92 abc	2 bc
Imazaquin	0.25	Spring	60 def	2 bc
Primisulfuron	0.0625	Fall	40 fg	0 c
Primisulfuron	0.125	Fall	28 gh	5 bc
Nicosulfuron	0.0625	Fall	95 ab	4 bc
Nicosulfuron	0.125	Fall	97 a	5 bc
Nicosulfuron	0.0625	Spring	55 defg	2 bc
V-54382	0.63	Fall	12 hi	2 bc
V-54382	0.125	Fall	51 efg	0 c
V-54382	0.25	Fall	54 defg	0 c
V-54382	0.125	Spring	91 abc	4 bc
V-54382	0.25	Spring	82 abcd	1 bc
Quinclorac	0.5	Fall	60 def	4 bc
Quinclorac	1.0	Fall	95 ab	6 b
Quinclorac	1.5	Fall	100 a	12 a
Picloram + 2,4-D amine	0.5 + 1.0	Fall	82 abcd	2 bc
Picloram + 2,4-D amine	0.38 + 0.65	Fall	65 cdef	1 bc
Check			0 i	0 c

[1] All treatments included a nonionic surfactant at 0.25% v/v, except quinclorac which included Sunit at 1 qt/A.
[2] Treatments within a column followed by the same letter are not different according to Duncan's Multiple Range Test level (P=0.05).

Glyphosate as a setup treatment for dicamba or dicamba combinations in leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with a setup treatment of glyphosate or glyphosate plus 2,4-D isopropylamine followed one year later by dicamba alone or in combination with 2,4-D LVE or picloram. Plots were 10 by 13.5 ft. with four replications arranged in a randomized complete block. Setup treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi June 5, 1990 (air temp. 63 F, soil temp. 0 inch 86 F, 1 inch 85 F, 2 inch 80 F, 4 inch 75 F, relative humidity 40%, wind west at 5 mph, sky clear). Follow up treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 40 gpa at 40 psi June 13, 1991 (air temp. 64 F, soil temp. 0 inch 100 F, 1 inch 95 F, 2 inch 80 F, 4 inch 75 F, relative humidity 70%, wind northwest at 5 mph, sky clear). 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 12 to 14 inches in height, for both applications. Infestations were heavy thoughout the experimental area. Visual evaluations were made June 9, 1992.

Supression of leafy spurge was evident 3 months after setup or followup treatments. None of the leafy spurge in the treated plots had produced seed. In the spring of 1992 no treatments provided effective leafy spurge control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1664.)

Leafy spurge control

Initial Treatment	Rate	Retreatment[2]	Rate	application date/evaluation date		
				June 5, 1990/ Sept 13, 1990	June 5, 1990/ June 13, 1991	June 13, 1991/ June 9, 1992
	(lb ai/a)		(lb ai/a)	(% control[1])	(% suppression[1])	(% control[1])
glyphosate	0.38	dicamba	0.5	25	40	8
glyphosate + 2,4-D	0.38 + 0.34	dicamba	0.5	70	40	20
glyphosate + 2,4-D	0.38 + 0.65	dicamba	0.5	70	40	18
glyphosate	0.38	dicamba	1.0	50	40	10
glyphosate + 2,4-D	0.38 + 0.34	dicamba	1.0	70	40	15
glyphosate + 2,4-D	0.38 + 0.65	dicamba	1.0	65	40	13
glyphosate	0.38	dicamba + 2,4-D	0.5 + 1.0	40	40	14
glyphosate + 2,4-D	0.38 + 0.34	dicamba + 2,4-D	0.5 + 1.0	70	40	19
glyphosate + 2,4-D	0.38 + 0.65	dicamba + 2,4-D	0.5 + 1.0	69	40	18
glyphosate	0.38	dicamba + picloram	0.5 + 1.3	38	40	13
glyphosate + 2,4-D	0.38 + 0.34	dicamba + picloram	0.5 + 1.3	70	40	13
glyphosate + 2,4-D	0.38 + 0.65	dicamba + picloram	0.5 + 1.3	68	40	13
(LSD 0.05)				15		10
(CV)				19		53

[1]% control and % suppression by visual estimation.

[2]Surfactant (X-77) added at 0.5% v/v.

Imazethapyr tankmixes for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with imazethapyr alone or in combination with dicamba, glyphosate, 2,4-D LVE, or picloram. Plots were 10 by 13.5 ft. with four replications arranged in a randomized complete block. Spring treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 40 gpa at 40 psi June 10, 1991 (air temp. 74 F, soil temp. 0 inch 80 F, 1 inch 75 F, 2 inch 70 F, 4 inch 70 F, relative humidity 58%, wind south at 3 mph, sky clear). Late summer treatments were applied September 11, 1991 (air temp. 70 F, soil temp. 0 inch 85 F, 1 inch 80 F, 2 inch 80 F, 4 inch 75 F, relative humidity 55%, wind west at 3 mph, sky 50% 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 14 to 18 inches in height, for the spring treatments and past seed production and 14 to 20 inches in height, for the late summer treatments. Infestations were heavy thoughout the experimental area. Visual evaluations were made June 11, 1992.

No spring or fall applied treatment provided adequate control of leafy spurge in 1992. The treatment which provided the most control was imazethapyr + picloram at 0.125 + 0.25 lb/A. This combination provided better control than either imazethapyr or picloram applied alone. Fall applied treatments provided better leafy spurge control than spring applied treatments. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1665.)

Leafy spurge control

Treatment	Rate	1991 application date/evaluation date	
		June 10/ June 11, 1991	Sept 11/ June 11, 1991
	(lb ai/a)	(percent control[1])	
imazethapyr[2]	0.063	0	20
imazethapyr[2]	0.125	0	28
imazethapyr + 2,4-D LVE[2]	0.063 + 1.0	8	30
imazethapyr + dicamba[2]	0.063 + 1.0	3	23
imazethapyr + picloram[2]	0.063 + 0.25	8	45
imazethapyr + glyphosate[2]	0.063 + 0.38	3	38
imazethapyr + 2,4-D LVE[2]	0.125 + 1.0	20	68
imazethapyr + dicamba[2]	0.125 + 1.0	13	54
imazethapyr + picloram[2]	0.125 + 0.25	18	78
imazethapyr + glyphosate[2]	0.125 + 0.38	0	54
2,4-D LVE[2]	1.0	5	15
dicamba[2]	1.0	5	23
picloram[2]	0.25	3	35
glyphosate[2]	0.38	0	20
(LSD 0.05)		10	18
(CV)		132	35

[1]Percent control by visual estimation.

[2]Surfactant (X-77) added at 0.25% v/v. 32-0-0 liquid fertilizer added at 1.0 quart N/acre.

Late summer applications of quinclorac or imazethapyr for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with late summer applications of quinclorac and imazethapyr, alone or in combination. Plots were 10 by 13.5 ft. with four replications arranged in a randomized complete block. Late summer treatments were applied September 11, 1991 (air temp. 76 F, soil temp. 0 inch 85 F, 1 inch 90 F, 2 inch 90 F, 4 inch 85 F, relative humidity 40%, wind west at 5 mph, sky 30% 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 past seed production and 14 to 20 inches in height. Infestations were heavy thoughout the experimental area. Visual evaluations were made June 11, 1992.

Late summer applications of quinclorac and imazethapyr, alone or in combination, did not provide adequate control of leafy spurge nine months after treatment. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1661.)

Leafy spurge control

Treatment[1]	Rate	Control[3]
	(lb ai/a)	(%)
quinclorac[2]	0.25	0
imazethapyr[2]	0.06	0
imazethapyr[2]	0.13	5
quinclorac+imazethapyr[2]	0.25+0.06	40
quinclorac+imazethapyr[2]	0.25+0.13	50
picloram	1.0	91
(LSD 0.05)		15
(CV)		26

[1]Treatments applied September 11, 1991.
[2]Crop oil concentrate (Sunit) added at 1 quart/acre.
[3]Visual evaluations June 11, 1992.

Leafy spurge control with aerial application of three 2,4-D formulations. Whitson, T. D., D. A. Austin, R. J. Swearingen and M. A. Ferrell. Aerial applications are commonly used to treat leafy spurge growing on rangeland. This experiment was applied aerially as a four year study to determine long-term effects of three formulations of 2,4-D applied with and without picloram. The study was conducted near Sundance, Wyoming on a dryland site with an average annual precipitation of 12 to 14 inches. Treatment areas 227 by 1089 ft. were applied as single blocks with four permanently located 100 ft line transects, within each treatment. Herbicides were applied on May 26, 1989, May 16, 1990 and June 10, 1991. Point-frame evaluations were made yearly at the time herbicides were applied with final evaluation on June 9, 1992. Application information: May 26, 1989, temperature: air 41° F, soil surface 40° F, 1 inch 50° F, 2 inches 50° F, 4 inches 53° F with 90% relative humidity and west winds 2 to 3 mph. May 17, 1990, temperature: air 65° F, soil surface 65° F, 1 inch 58° F, 2 inches 60° F, 4 inches 62° F with 80% relative humidity and west winds 4 to 5 mph. Application information: June 13, 1991, temperature: air 75° F, soil surface 72° F, 1 inch 68° F, 2 inches 65° F, 4 inches 61° F with 65% relative humidity and calm winds. Herbicides were applied by airplane equipped with a 24-nozzle airfoil 3-inch drop nozzle boom with 010 nozzles and 46 corners delivering 3 gal/A at 120 mph. Soil at the site was a silt loam (22%, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Applications of picloram were made along with 2,4-D formulations in 1989 and 1991. 2,4-D formulations were applied to all study areas in 1989, 1990 and 1991. Evaluations of live canopy were taken within treatments on four permanently located line transects before and after the application of the herbicides. Live canopy of leafy spurge, perennial grasses and bare ground were determined by making 100 point-frame counts along each 100 foot line transect. The percent change was then calculated from the original inventory.

The average live canopy cover of leafy spurge declined from 48.2% from the original inventory in 1989 to 13.5% in all treatment areas in 1992. Leafy spurge live canopy was significantly higher in the area treated with 2,4-D amine. No advantage was found when picloram was added to any 2,4-D formulation except that of 2,4-D amine, which had a control increase of 27% when picloram was added. Perennial grasses had an average live canopy cover increase of 640% within all treatments while the average amount of bare ground declined 24.8% from the time of the original inventory evaluation in 1989 to the final evaluation in 1992. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1680).

Leafy spurge control with three formulations of 2,4-D and picloram

	Leafy Spurge			Perennial Grass			Bare Soil		
	Pretrt. 1989	1992	% dec.	1989	1992	% increase	1989	1992	% dec.
2,4-D Amine	34	17	49	20	56	330	46	27	39
2,4-D Amine + Picloram (Tordon)	47	11	76	14	66	1440	42	23	42
(Hi-Dep)2,4-D	46	12	73	19	61	520	35	27	19
(Hi-Dep)2,4-D + Tordon	57	17	77	15	64	510	29	20	28
(Weedone 638)2,4-D	49	11	77	19	60	330	32	30	16
Weedone 638 + Picloram	56	13	79	12	53	690	33	35	5
Overall Ave.	48.2	13.5	71.8	16.5	60.0	640	36.2	27	24.8
LSD @ 0.05	- -	- -	17.4	- -	- -	- -	- -	- -	- -

Leafy spurge control with imazethapyr, imazaquin, quinclorac, and nicosulfuron. Lym, Rodney G., and Calvin G. Messersmith. Previous research at North Dakota State University has shown that nicosulfuron at 1 to 2 oz/A, imazethapyr and imazaquin at 2 to 4 oz/A, and quinclorac at 16 to 24 oz/A provide good leafy spurge control when fall-applied. Also, control has occasionally been increased when these herbicides have been applied with an adjuvant. The purpose of this research was to evaluate imazethapyr, imazaquin, quinclorac, and nicosulfuron with several spray adjuvants fall-applied for leafy spurge control.

The experiment was established at Hunter and Chaffee, ND on September 2 and 6, 1991, respectively. Leafy spurge at Hunter was 16 to 20 inches tall with 4- to 6-inch sparse fall regrowth, red leaves and moisture stressed, while at Chaffee it was 28 to 36 inches tall, with lush, dense fall regrowth with green leaves and adequate soil moisture. The soil at Hunter was sandy with pH 7.4 and 2.3% organic matter and at Chaffee was a sandy loam with pH 7.8 and 6.7% organic matter. 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 four times in a randomized complete block design. A follow-up treatment of picloram plus 2,4-D at 8 + 16 oz/A was spring-applied on June 22, 1992 to the rear one-third of all plots. Visual evaluations were based on percent stand reduction as compared to the control.

Quinclorac tended to provide the best leafy spurge control at both locations and averaged 97 and 69% control 9 and 12 months after treatment (MAT), respectively, regardless of adjuvant (Table). Control at Chaffee was higher than at Hunter with imazethapyr, imazaquin, and nicosulfuron and averaged 27 and 92, 61 and 93, 42 and 74%, respectively, 9 MAT averaged over rate and adjuvant. The quinclorac treatments and imazaquin plus Scoil (a methulated-seed oil adjuvant) were the only treatments to provide similar control at Chaffee and Hunter.

Nicosulfuron provided an average of 58 and 22% control 9 and 12 MAT, respectively, and control was similar regardless of application rate or adjuvant (Table). Imazaquin and imazethapyr tended to provide better leafy spurge control when applied with Scoil than X-77 surfactant, especially at Hunter. However, control with quinclorac was similar at both locations when applied with BAS-090 or Scoil regardless of herbicide rates.

Retreatment with picloram plus 2,4-D provided 90% control 2 MAT, averaged over both locations, and was similar regardless of the original treatment. In summary, quinclorac and imazethapyr show the most promise for consistent leafy spurge control of the herbicides evaluated. Control was similar to picloram plus 2,4-D at 8 + 16 oz/A, the standard fall-applied treatment. Nicosulfuron may be useful for leafy spurge control in cropland, but previous research has shown this herbicide injures grass and would not be acceptable for pasture and rangeland use. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table. Leafy spurge control with various herbicides applied September 1991 alone and then retreated with picloram plus 2,4-D in June 1992 (Lym and Messersmith).

		Hunter			Chaffe			Mean		
		May	August		May	August		May	August	
Treatment	Rate	Con-trol	Con-trol	Retreatment[a]	Con-trol	Con-trol	Retreatment[a]	Con-trol	Con-trol	Retreatment[a]
	oz/A				%					
Imazethapyr + X-77	2 + 0.5%	5	0	98	76	8	86	41	4	92
Imazethapyr + X-77	4 + 0.5%	36	6	99	85	14	71	61	10	85
Imazethapyr + Scoil	2 + 1 qt	20	1	97	90	29	82	55	15	89
Imazethapyr + Scoil	4 + 1 qt	47	9	93	88	43	86	68	26	89
Imazaquin + X-77	2 + 0.5%	34	3	94	85	10	90	60	6	92
Imazaquin + X-77	4 + 0.5%	38	6	92	98	36	91	69	21	91
Imazaquin + Scoil	2 + 1 qt	84	8	83	92	38	95	88	23	89
Imazaquin + Scoil	4 + 1 qt	87	13	89	96	49	82	92	31	85
Quinclorac + BAS-090	16 + 1 qt	91	38	97	100	82	97	95	60	97
Quinclorac + BAS-090	24 + 1 qt	95	65	99	100	93	98	97	79	99
Quinclorac + Scoil	16 + 1 qt	93	44	99	99	72	97	96	58	98
Quinclorac + Scoil	24 + 1 qt	97	67	99	100	94	96	98	80	98
Nicosulfuron + X-77	1 + 0.5%	34	5	98	72	28	83	53	17	91
Nicosulfuron + X-77	2 + 0.5%	27	26	98	75	15	81	51	20	89
Nicosulfuron + Scoil	1 + 1 qt	60	14	85	80	30	86	70	22	86
Nicosulfuron + Scoil	2 + 1 qt	46	42	87	70	12	74	58	27	81
Picloram + 2,4-D	8 + 16	88	70	97	82	36	87	85	53	92
LSD (0.05)		23	25	NS	14	22	17	14	34	NS

[a]Picloram plus 2,4-D at 8 + 16 oz/A applied to the rear one-third of each plot on June 22, 1992.

Leafy spurge control with quinclorac applied with various adjuvants. Lym, Rodney G. 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, 20 to 30 inches tall with 2 to 3 inch new fall growth. 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 quinclorac provided the best leafy spurge control when fall-applied.

Treatment[a]	Rate	Evaluation date		
		June 91	June 92	Sept 92
	lb/A	% control		
Quinclorac + BAS-090	1 + 1 qt	90	93	77
Quinclorac + Scoil	1 + 1 qt	74	95	77
Quinclorac	1	49	82	53
Quinclorac + picloram	1 + 0.5	85	97	84
Quinclorac + picloram + BAS-090	1 + 0.5 + 1 qt	91	99	87
Picloram + 2,4-D	0.5 + 1	81	92	70
Picloram + 2,4-D + Scoil	0.5 + 1 + 1 qt	43	69	46
Picloram + 2,4-D + BAS-090	0.5 + 1 + 1 qt	57	83	52
Picloram + Scoil	0.5 + 1 qt	71	82	50
Picloram	0.5	60	84	62
LSD (0.05)		28	14	22

[a]Treatments applied annually for 2 yr.

Quinclorac provided approximately 20% better leafy spurge control in June 1992 following a second application compared to June 1991 regardless of adjuvant (Table). Quinclorac at 1 lb/A plus BAS-090 provided better leafy spurge control than quinclorac applied alone or with the methulated-seed-oil adjuvant Scoil 9 months after treatment but control was similar following the second treatment. Control with quinclorac plus BAS-090 or Scoil was similar to picloram plus 2,4-D at 0.5 plus 1 lb/A, the most commonly used fall-applied treatment. Quinclorac applied with picloram or picloram plus BAS-090 provided similar control to picloram plus 2,4-D and quinclorac plus BAS-090 or Scoil. Scoil applied with picloram did not improve leafy spurge control compared to picloram alone and reduced control when applied with picloram plus 2,4-D.

Quinclorac plus BAS-090 or Scoil fall-applied provided good leafy spurge control and may 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).

Leafy spurge control with selected formulations of 2,4-D. Zamora, D.L. A cooperative experiment was established near Columbus, Montana to compare control of leafy spurge with different formulations of 2,4-D. Other states cooperting in this experiment include Wyoming, North Dakota and Minnesota.

The experiment was a randomized complete block design with four replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 10 gpa at 42 psi through Teejet XR110015 nozzles. Treatments were applied on 6/1/92 to leafy spurge in the true flower stage of growth. A visual estimate of control (necrosis, chlorosis, growth reduction) was made on 9/1/92. Density and average height in three 1.35-ft^2 quadrats (systematically placed along a transect) also were measured on 9/1/92.

There was no difference among 2,4-D formulations in control or height 90 days after treatment. The differences among 2,4-D formulations in density 90 days after treatment are ambiguous since the density of the untreated check was less than some treated plots. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of selected formulations of 2,4-D on leafy spurge 90 days after treatment.

Product	Formulation	Rate	Control	Height	Density
		(lbs ae/a)	(%)	(in)	(no./ft^2)
Weedar 64	dimethylamine	2.0	40	9	8
Hi Dep	dimethyl + diethanolamine	2.0	40	8	9
Weedone LV4	butoxyethylester	2.0	40	9	6
Weedone 638	butoxyethylester + free acid	2.0	42	9	6
Esteron 99C	isooctyl (2-ethylhexyl) ester	2.0	44	8	7
Tordon 22K	picloram	0.5	88	2	0.2
Untreated			-	13	5
PR > F			0.0001	0.001	0.002
LSD (0.05)			12	4	3

Leafy spurge control with reduced rates of picloram, picloram plus 2,4-D, dicamba, and dicamba plus 2,4-D applied for 1 to 4 consecutive years. Sebastian, J.R. and K.G. Beck. An experiment was established near Pagosa Springs, CO to evaluate leafy spurge (EPHES) control with reduced rates of picloram, picloram + 2,4-D, dicamba, and dicamba + 2,4-D. The experiment was designed as a split-plot with four replications. Herbicides and rates comprised the main plots (arranged as a randomized complete block) and treatments applied for 1,2,3, or 4 consecutive years constituted the split. Flowering applications were sprayed June 1, 1989 (year 1), May 31, 1990 (year 2), June 6, 1991 (year 3), and June 30, 1992 (year 4). 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. Main plot size was 10 by 60 feet and sub-plots were 10 by 15 feet.

Visual evaluations were compared to non-treated control plots and taken in May and September 1990, June and October 1991, and June and September 1992. All first year treatments provided poor (4 to 59%) EPHES control in May 1990, approximately 12 months after treatment (MAT) and little to no control was observed 16,24, and 29 MAT (Table 2). In June 1991, approximately 1 year after 2nd year treatments, picloram at 0.5 lb and picloram plus 2,4-D (0.5 + 1.0 lb) provided marginal (66 to 68%) EPHES control. Third year treatments of picloram at 0.5 lb and picloram plus 2,4-D (0.5 + 1.0 lb) provided fair EPHES control 4 months after the third year application.

Good EPHES control became apparent after 4 consecutive years of picloram at 0.5 lb and picloram plus 2,4-D (0.25 + 1.0 lb and 0.5 + 1.0 lb). Dicamba 2.0 lb and dicamba + 2,4-D (1.0 + 2.0 lb) provided fair and good control 2 months after the fourth year application.

Lack of grass competition and severe drought conditions existed in 1989 and 1990 and may have decreased EPHES control from residual herbicide activity. Favorable growing conditions were apparent in 1991 and 1992 which reflected an increase in Kentucky bluegrass and western wheatgrass densities with EPHES control of 70% or greater. Herbicide treatments will be evaluated again in 1992 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application data for leafy spurge control with reduced rates of picloram, picloram + 2,4-D, dicamba, and dicamba + 2,4-D applied for 1 to 3 consecutive years.

Environmental data				
Application date	June 1, 1989	June 31, 1990	June 6, 1991	June 30, 1992
Application time	10:00 AM	2:00 PM	7:00 PM	10:00 AM
Air temperature, C	26	18	10	16
Cloud cover, %	5	0	80	15
Relative humidity, %	14	24	85	35
Wind speed, mph	3 to 5	2 to 5	0	3 to 7
Soil temperature, C	17	11	15	24

Application date	species	growth stage	height (in.)	density (shoots/ft^2)
June 1, 1989	EPHES	open bract	8 to 16	10 to 20
June 31, 1990	EPHES	flowering	13 to 16	10 to 20
June 6, 1991	EPHES	flowering	12 to 16	10 to 20
June 30, 1992	EPHES	flowering	16 to 24	10 to 20

Table 2. Leafy spurge control with reduced rates of picloram, picloram + 2,4-D, dicamba, dicamba + 2,4-D applied for 1 to 4 consecutive years.

Herbicide	Rate	Year of treatment	Leafy spurge					
			May 1990	Sept 1990	June 1991	Oct 1991	June 1992	Sept 1992
	(lb ai/a)		(% of check)					
picloram	0.25	1	38	0	4	0	0	0
		2	-	74	38	39	11	5
		3	-	-	-	55	18	23
		4	-	-	-	-	-	60
	0.5	1	59	0	11	0	5	4
		2	-	80	66	55	23	19
		3	-	-	-	75	56	41
		4	-	-	-	-	-	81
picloram + 2,4-D	0.25 1.0	1	36	0	0	0	4	3
		2	-	66	43	54	24	19
		3	-	-	-	59	40	33
		4	-	-	-	-	-	85
	0.5 1.0	1	55	0	0	0	0	0
		2	-	78	68	66	25	20
		3	-	-	-	76	55	46
		4	-	-	-	-	-	91
dicamba	2.0	1	14	0	4	0	0	0
		2	-	53	20	20	13	11
		3	-	-	-	39	23	21
		4	-	-	-	-	-	70
dicamba + 2,4-D	1.0 2.0	1	19	0	4	0	0	0
		2	-	34	23	4	11	15
		3	-	-	-	54	57	26
		4	-	-	-	-	-	85
LSD (0.05)			10	10	11	18	17	15

Leafy spurge control with sulfometuron and/or picloram plus 2,4-D in a 3 yr rotation. Lym, Rodney G., and Calvin G. Messersmith. Previous research at North Dakota State University has shown that sulfometuron applied with picloram or 2,4-D provides good leafy spurge control especially when fall applied. However, sulfometuron can cause severe grass injury when fall applied. Picloram plus 2,4-D at 0.25 plus 1 lb/A will provide approximately 90% leafy spurge control when applied annually for 3 to 5 yr. The purpose of this research was to evaluate leafy spurge control and grass injury with sulfometuron plus picloram or 2,4-D applied annually for 3 yr or rotated with picloram plus 2,4-D as spring- or fall-applied treatments in pastures.

The experiment was established at three locations, Chaffee and Valley City in eastern and Dickinson in western North Dakota. The soil at Dickinson was a loamy fine sand with pH 6.5 and 6% organic matter, at Valley City a loam with pH 7.1 and 9.2% organic matter, and at Chaffee a sandy loam with pH 7.4 and 6.7% organic matter. Treatments were spring-applied the first week of June and fall-applied the first or second week of September in 1988. Retreatments were applied at a similar time in 1989 and 1990. Leafy spurge received the same treatments in 1990 as in 1988 to complete the 3 yr treatment program. Herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Plots were 9 by 30 ft at Chaffee and Dickinson and 10 by 30 ft at Valley City. Each treatment was replicated four times in a randomized complete block design at all sites. Evaluations taken visually were based on percent stand reduction as compared to the control. The initial grass stand at Dickinson was too sparse to allow reliable evaluation of grass injury, so the experiment was abandoned following the June 1990 evaluation.

Leafy spurge control, averaged across all spring-applied treatments increased from 18 to 49 to 78% 12, 24, and 36 months after the first treatment (MAT), respectively (Table). Sulfometuron spring-applied with picloram or 2,4-D annually for 3 yr provided an average of 79% leafy spurge control which was similar to picloram plus 2,4-D at 80%. However, grass injury from sulfometuron spring-applied for 3 yr averaged 34%. There was no advantage to applying sulfometuron following picloram plus 2,4-D or vice versa.

Leafy spurge control with sulfometuron plus picloram at 1.25 plus 4 oz/A fall applied for 3 consecutive yr averaged 96%, but grass injury averaged 94% (Table). Sulfometuron plus 2,4-D at 1.25 plus 16 oz/A averaged 62% leafy spurge control and 95% grass injury following three consecutive fall-applied treatments. Picloram plus 2,4-D fall-applied for 3 consecutive yr averaged only 27% leafy spurge control, but control increased to 34 and 44% when sulfometuron plus 2,4-D or sulfometuron plus picloram, respectively, were applied the second yr rather than picloram plus 2,4-D. However, grass injury also increased to an average of 30%.

Sulfometuronm plus picloram at 1.25 plus 4 oz/A fall-applied provided the best long-term control and averaged 77% 48 MAT compared to 11% for the standard treatment of picloram plus 2,4-D at 4 plus 16 oz/A, but grass injury was still 65% (Table). In general, leafy spurge control with sulfometuron plus 2,4-D or picloram was similar to picloram plus 2,4-D when applied in the spring but the sulfometuron combinations were best when fall-applied. However, grass injury was severe when sulfometuron was fall-applied. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table. Leafy spurge control and grass injury from sulfometuron, picloram, and 2,4-D in pastures applied in various combinations spring or fall for 3 consecutive yr. (Lym and Messersmith).

1988 and 1990 Date applied and treatment	Rate	1989 Treatment	Rate	12 MAT[a] Control	12 MAT[a] Grass inj.	24 MAT[a] Control	24 MAT[a] Grass inj.	36 MAT[a] Control	36 MAT[a] Grass inj.	48 MAT[a] Control	48 MAT[a] Grass inj.
	- oz/A -		- oz/A -	%							
Spring											
Sume+picl	1.25+4	Sume+picl	1.25+4	18	12	37	23	79	41	37	4
Sume+picl	1.25+4	Picl+2,4-D	4+16	18	11	46	10	86	24	50	13
Sume+2,4-D	1.25+16	Sume+2,4-D	1.25+16	21	16	28	14	78	26	50	14
Sume+2,4-D	1.25+16	Picl+2,4-D	4+16	28	9	57	7	79	11	53	1
Picl+2,4-D	4+16	Picl+2,4-D	4+16	13	0	56	2	80	1	56	0
Picl+2,4-D	4+16	Sume+picl	1.25+4	17	0	67	55	71	2	49	0
Picl+2,4-D	4+16	Sume+2,4-D	1.25+16	11	0	49	21	76	8	54	0
LSD (0.05)				NS	7	12	16	11	19	18	18
Fall											
Sume+picl	1.25+4	Sume+picl	1.25+4	46	70	80	86	96	94	77	65
Sume+picl	1.25+4	Picl+2,4-D	4+16	52	76	42	56	89	61	58	16
Sume+2,4-D	1.25+16	Sume+2,4-D	1.25+16	31	80	49	89	62	95	32	33
Sume+2,4-D	1.25+16	Picl+2,4-D	4+16	25	89	10	51	35	70	14	57
Picl+2,4-D	4+16	Picl+2,4-D	4+16	10	3	7	3	27	0	11	0
Picl+2,4-D	4+16	Sume+picl	1.25+4	6	0	62	48	44	26	21	13
Picl+2,4-D	4+16	Sume+2,4-D	1.25+16	2	0	38	64	34	33	19	23
LSD (0.05)				12	7	16	19	20	18	20	51

[a]Mean 12, 24, 36, or 48 months after the first treatment averaged over 3 locations.

Picloram with or without surfactant (Sylgard®) for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate control of leafy spurge with picloram, with or without surfactant, for control of leafy spurge. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Treatments were applied June 09, 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 20% 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 full bloom and 14 to 20 inches in height. Infestations were heavy thoughout the experimental area. Visual evaluations were made September 23, 1992.

Evaluations four months after application show the surfactant Sylgard® to have no effect on leafy spurge control with picloram at any rate. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR1659.)

Leafy spurge control

Treatment[1]	Rate	Control[2]
	(lb ai/a)	(%)
picloram+Sylgard[1]	0.25	10
picloram+Sylgard[1]	0.5	40
picloram+Sylgard[1]	1.0	90
picloram	0.25	10
picloram	0.5	40
picloram	1.0	91
(LSD 0.05)		11
(CV)		19

[1]Surfactant (Sylgard®) added at 0.25% v/v.
[2]Visual evaluations September 23, 1992.

Quinclorac tankmixes for control of leafy spurge. Ferrell, M.A. This research was conducted near Devil's Tower, Wyoming to evaluate leafy spurge control with early or late summer applications of quinclorac, alone or in combination with other herbicides. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. Spring treatments were applied June 10, 1991 (air temp. 70 F, soil temp. 0 inch 115 F, 1 inch 80 F, 2 inch 75 F, 4 inch 70 F, relative humidity 65%, wind south at 5 mph, sky 40% cloudy). Fall treatments were applied September 25, 1990 (air temp. 65 F, soil temp. 0 inch 70 F, 1 inch 65 F, 2 inch 60 F, 4 inch 60 F, relative humidity 34%, wind south at 3 mph, sky clear). 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 full bloom and 14 to 20 inches in height for the spring treatments or past seed production and 14 to 20 inches in height for the fall treatments. Infestations were heavy thoughout the experimental area. Visual evaluations were made June 18, 1991 and June 10, 1992 or September 25, 1992.

Fall applications of quinclorac + picloram (1.0 + 0.5 lb/A), provided 80% control of leafy spurge nine months after treatment. However, control had dropped to 51% by June 1992. No other treatments provided effective leafy spurge control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1660.)

Leafy spurge control

		Application date/evaluation date		
Treatment	Rate	Sept. 25, 1990/ June 18, 1991	Sept. 25, 1990/ June 10, 1992	June 10, 1991/ Sept. 25, 1992
	(lb ai/a)	(control[1])		
quinclorac[2]	0.5	25	10	30
quinclorac+2,4-D LVE[2]	0.5+1.0	35	18	51
quinclorac+dicamba	0.5+1.0	36	15	48
quinclorac+picloram[2]	0.5+0.5	46	20	60
quinclorac[2]	1.0	64	33	55
quinclorac+2,4-D LVE[2]	1.0+1.0	71	33	65
quinclorac+dicamba	1.0+1.0	75	36	60
quinclorac+picloram[2]	1.0+0.5	80	51	65
(LSD 0.05)		11	20	19
(CV)		16	57	27

[1]Percent control by visual evaluation.
[2]Crop oil concentrate (Sunit) added at 1 quart/acre.

Various spray additives applied with picloram and 2,4-D in an annual treatment program for leafy spurge control. Lym, Rodney G., and Frank A. Manthey. Picloram is the most effective herbicide for leafy spurge control and when applied with 2,4-D provides better control than picloram applied alone. Previous research at North Dakota State University has shown that less than 40% of the picloram applied to leafy spurge is absorbed and approximately 5% reaches the roots. The increased control from the addition of 2,4-D is due to decreased picloram metabolism, not increased absorption or translocation. A likely approach for increased picloram efficiency for leafy spurge control is to increase absorption and thereby increase the amount of picloram translocated to the roots. The purpose of these experiments was to evaluate various additives applied with picloram and picloram plus 2,4-D for increased leafy spurge control compared to the herbicides applied alone. Many spray additives were screened for potential to increase leafy spurge control with picloram and 2,4-D in greenhouse studies. Compounds with the most potential were evaluated in a series of field trials.

The first experiment evaluated picloram alone or applied with various spray additives as spring or fall applied treatments. The experiment was established on June 7 and September 19, 1990 near Valley City, ND, and June 24 and September 12, 1990 on the Sheyenne National Grasslands. A second experiment evaluated picloram plus 2,4-D applied alone or with various spray additives and was established at the same locations and dates as the picloram experiment. Retreatments were applied on approximately the same dates in 1991 and 1992. The 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. Leafy spurge control evaluations were based on a visual estimate of percent stand reduction as compared to the untreated check.

The additives evaluated included the commercial surfactants, X-77, LI-700, Silwett L-77, Triton CS-7, Triton X-100, Triton N-57, and Surftac. Industrial surfactants evaluated were Gafac RA-600 (free acids of a complex organic phosphate ester), Emulphor ON-877 (polyoxyethylated fatty alcohol), Mapeg 400 MO (PEG 400 Monooleate), Pluronic L63 (block copolymers of propylene oxide and ethylene oxide), and Tetronic 1504 (block copolymers of ethylene oxide and propylene oxide).

Leafy spurge control for the June-applied treatments averaged over both locations 24 months after the first treatment (MAFT) increased when picloram at 0.25 lb/A was applied with X-77 + Silwett L-77, Mapeg 400 MO, Gafac RA-600, and Emulphor ON-877 to picloram alone (Table 1). Leafy spurge control with picloram at 0.25 lb/A alone was 27% averaged over both locations compared to 57% when applied with these spray additives. Control for the September-applied treatments was similar regardless whether picloram at 0.5 lb/A was applied alone or with a spray additive.

In the second experiment, no additive increased leafy spurge control when applied with picloram plus 2,4-D in the June applied treatments (Table 2). However, several including Triton CSF, LI-700, and Triton N57 tended to decrease control when applied with picloram plus 2,4-D compared to the herbicides applied alone. As with picloram alone, control for picloram plus 2,4-D applied in September was similar regardless of the additive.

In general, leafy spurge control was increased slightly when a spray additive was added to picloram applied in June but not in September. No additive increased control when applied with picloram plus 2,4-D and several decreased control. The additives that did increase short-term control with picloram or picloram plus 2,4-D represent several groups of chemicals. Thus, it is not yet possible to narrow the focus for the "ideal" spray additive with these herbicides for leafy spurge control. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Table 1. Evaluation of picloram plus various additives applied in spring or fall for leafy spurge control (Lym and Manthey).

Application time and additive	Rate[a]	Location/evaluation date (MAFT)[b] Valley City 3/9	12	24	Sheyenne 3/9	12	24	Mean[c] 12	24
	- % -	%							
June									
None	..	36	5	36	64	11	18	8	27
Pluronic L63	0.5	47	3	60	74	26	27	15	43
Tetronic 1504	0.5	57	7	66	77	22	32	15	49
Triton X-100	0.5	50	4	61	78	15	27	10	44
Triton CS-7	0.5	66	9	52	69	16	21	13	34
Surftac	0.5	50	11	41	56	16	25	14	33
X-77 + L-77[d]	0.25 + 0.25	62	10	55	74	44	54	27	55
Mapeg 400 MO	0.5	63	12	68	78	27	51	20	60
LI-700	0.5	56	3	45	80	31	32	17	38
X-77	0.5	54	6	57	80	21	33	14	45
Gafac RA-600	0.5	57	6	65	86	40	58	23	61
Emulphor ON-877	0.5	60	7	65	78	16	40	12	52
LSD (0.05)		21	NS	14	20	NS	27	NS	27
September									
None	..	74	9	24	93	45	40	27	32
Pluronic L63	0.5	79	12	28	97	45	33	28	30
Tetronic 1504	0.5	84	14	32	95	35	37	24	35
Triton X-100	0.5	81	13	42	97	39	42	26	42
Triton CS-7	0.5	83	10	37	97	62	37	36	37
Surftac	0.5	86	12	31	96	26	26	19	28
X-77 + L-77[d]	0.25 + 0.25	83	11	22	93	23	33	17	27
Mapeg 400 MO	0.5	83	9	22	90	43	42	26	32
LI-700	0.5	83	6	15	97	35	31	21	23
X-77	0.5	90	13	21	92	39	31	26	26
Gafac RA-600	0.5	78	5	11	93	58	35	31	23
Emulphor ON-877	0.5	82	21	40	95	63	52	42	46
LSD (0.05)		9	NS	NS	NS	NS	NS	NS	NS

[a]Picloram was applied at 0.25 lb/A in June or 0.5 lb/A in September.
[b]Months after first treatment.
[c]Mean 12 or 24 MAFT for spring or fall applied treatments, respectively.
[d]L-77 was Silwett L-77.

Table 2. Evaluation of picloram plus 2,4-D applied in the spring or fall with various additives for leafy spurge control (Lym and Manthey).

Application time/ additive	Rate[a]	Location/evaluation date (MAFT)[b] Valley City 3/9	Valley City 12	Valley City 24	Sheyenne 3/9	Sheyenne 12	Sheyenne 24	Mean[c] 12	Mean 24
	- % -				%				
June									
None	..	47	18	49	84	51	80	35	64
Pluronic L63	0.5	56	13	70	90	39	73	26	71
Tetronic 1504	0.5	36	12	45	88	48	75	30	60
Triton X-100	0.5	31	13	46	91	44	74	29	60
Triton CS7	0.5	39	7	51	80	19	33	13	42
Surftac	0.5	38	9	48	87	31	63	20	56
X-77 + L-77	0.25 + 0.25	31	9	44	83	46	70	28	57
Mapeg 400 MO	0.5	38	13	43	84	43	72	28	58
LI-700	0.5	34	9	42	77	24	40	17	41
X-77	0.5	36	8	51	81	25	51	17	51
Gafac RA-600	0.5	38	3	43	85	40	71	22	57
Triton N57	0.5	35	12	47	79	36	47	24	47
LSD (0.05)		NS	NS	13	NS	NS	27	NS	25
September									
None	..	79	10	19	92	20	32	15	26
Pluronic L63	0.5	91	18	38	94	27	37	22	37
Tetronic 1504	0.5	87	8	31	95	10	20	9	25
Triton X-100	0.5	84	13	29	94	3	29	8	29
Triton CS7	0.5	82	11	29	96	23	26	17	27
Surftac	0.5	79	3	11	95	46	49	25	30
X-77 + L-77	0.25 + 0.25	85	24	54	96	23	37	24	45
Mapeg 400 MO	0.5	82	15	30	97	26	46	21	38
LI-700	0.5	89	18	32	96	27	40	23	36
X-77	0.5	88	12	23	93	25	41	19	32
Gafac RA-600	0.5	82	6	16	93	13	43	10	29
Triton N57	0.5	86	13	23	97	21	38	17	31
LSD (0.05)		NS	NS	NS	NS	NS	NS	NS	NS

[a]Picloram was applied at 0.25 or 0.5 lb/A plus 2,4-D at 1 lb/A in June and September, respectively.
[b]Months after first treatment
[c]Mean 12 or 24 MAFT for spring or fall applied treatments, respectively, (LSD = 0.05).

The effects of pyridine herbicides in combination with atrazine for grass establishment in yellow starthistle habitat. Lass, L.W. R.H. Callihan and F. E. Northam. Yellow starthistle (Centaurea solstitialis L. (CENSO)) has become a dominant species within the Columbia River drainages of the Pacific Northwest, and has entered the Great Basin. Yellow starthistle easily invades semiarid and subhumid range sites, particularly where annual grasses prevail. Yellow starthistle co-habits with annual weedy grasses like downy brome (Bromus tectorum L.) and medusahead (Taeniatherum caput-medusae (L.) Nevski). Controlling yellow starthistle with herbicides often releases undesirable annual grasses that are poor forages. The aggressive reinvasion by yellow starthistle in such annual grass sites has prevented effective economical range rehabilitation with a single herbicide application. Competitive grasses should be established to reduce the frequency of herbicide applications and prevent reinvasion by the weeds. The purpose of this study was to evaluate the tolerance of selected grasses to herbicides for controlling annual grasses used to revegetate rangeland.

The grasses used in the study were:

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

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

The experiment was established near Lapwai, ID. on a Linville-Waha silt loam. The field was in wheat production in 1988 and was placed in the U.S.D.A. Conservation Reserve Program (CRP) in 1989. The soil pH was 5.89 and organic matter was 2.92%. The field slope was 20 to 35%, facing SE. The field was plowed, harrowed, and rodweeded prior to planting. The grasses were planted 1 inch deep on May 12 to 15, 1989 using a drill seeder with 7 inch spacing and packer wheels. Prior to grass emergence, 0.5 lb ai/a glyphosate was applied on May 20, 1989 for control of emerged weeds. Pyridine and atrazine herbicides were applied on June 21 using a tractor sprayer with a 25 ft boom. The herbicides were applied without a surfactant. The sprayer delivered 31 gal/a water at 1.13 mph. The air temperature was 71F and the sky was clear; the wind was 0 to 3 mph. Soil temperatures were 104F at the soil surface, 68F at 2 inches, and 64F at 6 inches. The relative humidity was 50% and no dew was present.

Yellow starthistle and grass stands were estimated by counting the number of plants in two 1.34-square meter rectangular quadrats in each plot in mid-July 1989. Visual estimates of chlorophyll loss were recorded on July 12, 1989. Visual estimates of grass and yellow starthistle density were recorded on March 27, 1990 and June 29, 1991.

1989 results:

The average number of yellow starthistle in the untreated check was 7.5 plants per square meter. The number of living yellow starthistle plants in the clopyralid- and picloram-treated areas were fewer than one per square meter. The addition of atrazine at 1.5 lb ai/a decreased living yellow starthistle plants by more than 75%. The numbers of grass plants in clopyralid and picloram treatments were not different from those in check. Atrazine at 0.5 and 1.0 lb ai/a did not reduce the number of grass plants.

Atrazine symptoms were detected in 12 of 13 established grasses in the picloram main plots, in 10 of 13 established grasses in the clopyralid plots, and in 7 of 13 established grasses, where no pyridine herbicides were applied. Atrazine did not appear to interact with pyridine herbicides to the detriment of the seedling grasses, and additive effects were not apparent. All grasses showed 50% or more chlorosis except for Tualatin tall oatgrass, Paiute orchard grass, Alkar tall wheatgrass, Nordan crested wheatgrass, and Sodar streambank wheatgrass when treated with atrazine at 1.0 lb ai/a in combination with clopyralid or picloram. In 1989, Canby bluegrass failed to establish.

1990 results:

The picloram and clopyralid treatments completely prevented yellow starthistle growth in 1990. Atrazine alone at rates of 1.0 lb ai/a reduced yellow starthistle density by about 50% and 1.5 lb ai/a reduced the yellow starthistle density by 33% or more. Paiute orchard grass, Alkar tall wheatgrass, Ephraim intermediate wheatgrass, Luna pubescent wheatgrass, Nordan crested wheatgrass, and Oahe intermediate wheatgrass in combination with 1.5 lb ai/a atrazine suppressed 99% of the yellow starthistle when compared to the density of the check.

1991 results:

The pyridine treatments continued to control 90 to 100% of the yellow starthistle in 1991. Yellow starthistle plants were in the clopyralid treatments but levels were low and generally inconsistent among replicates (Table 1). After three years, direct residual affects of atrazine alone were not visible. Plots treated with only atrazine at 1.0 and 1.5 lb ai/a tended to have less yellow starthistle if perennial grasses were tall and/or provided a more dense cover than the checks. When compared to the untreated check, the only grass showing reduced yellow starthistle when treated with 1.5 lb ai/a atrazine alone was Luna pubescent wheatgrass. The lack of significant reduction of yellow starthistle populations in Alkar tall wheatgrass, Tualatin tall oatgrass, and Oahe intermediate wheatgrass was due in part to lower yellow starthistle populations in the non-chemical-treated check plots planted to these grasses.

1992 results:

The effects of clopyralid were declining and some yellow starthistle plants were present in most plots (Tables 1 and 2). Grasses with lower populations of yellow starthistle were Durar hard fescue, Tualatin tall oatgrass, Alkar tall wheatgrass, Oahe intermediate wheatgrass, and Secar wheatgrass. The lower yellow starthistle populations were generally found in grass plots with substantial cover (Table 3). Yellow starthistle height (Table 2) was reduced in clopyralid-treated areas within Tualatin tall oatgrass and Alkar tall wheatgrass plots.

Since yellow starthistle has not fully reestablished in the pyridine treatments, subsequent evaluations will be necessary to further define the long-term competitive nature of these grasses in combination with the herbicides tested. (Univ. of Idaho, Dept. of Plant, Soils, & Ent. Sci., Moscow, 83843)

Table 1. Effects of pyridine herbicides in combination with atrazine and grass competition on yellow starthistle populations.

Treatment		Canby Blueg.	Covar Sheep Fescue	Durar Hard Fescue	Tutal. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Wheatg.	Ephr. Inter. Wheatg.	Hycr. Wheatg.	Luna Pub. Wheatg.	Nord. Wheatg.	Oahe Int. Wheatg.	Secar Wheatg.	P-27 Sib. Wheatg.	Sodar Stream. Wheatg.
(lb ai/A)		(Number per square meter)													
Check +															
Atrazine	0	500 A	425 A	450 A	351 A	450 A	145 BA	500 A	450 A	475 A	500 A	500 A	425 A	500 A	500 A
Atrazine	0.5	500 A	450 A	500 A	166 BA	450 A	182 A	450 A	475 A	463 A	475 A	388 A	500 A	500 A	363 B
Atrazine	1	500 A	500 A	500 A	236 A	400 A	153 A	500 A	475 A	425 A	475 A	438 A	500 A	500 A	488 A
Atrazine	1.5	500 A	475 A	425 A	251 A	396 A	88 ABC	351 A	433 A	475 A	475 A	400 A	475 A	475 A	425 AB
Clopyralid 0.12 +															
Atrazine	0	206 B	54 CB	30 B	5 B	80 B	10 C	126 B	138 B	148 BC	176 BC	13 B	6 C	228 B	24 C
Atrazine	0.5	200 B	60 CB	11 B	19 B	131 B	2 C	138 B	188 B	201 B	206 B	31 B	96 BC	220 B	39 C
Atrazine	1	130 B	38 CB	2 B	0 B	3 B	6 C	93 B	105 BC	156 BC	147 BC	51 B	2 C	168 BC	26 C
Atrazine	1.5	205 B	125 B	75 B	4 B	83 B	21 BC	125 B	163 B	216 B	150 BC	56 B	150 B	169 BC	27 C
Picloram 1.0 +															
Atrazine	0	0 C	0 C	0 B	0 B	0 B	0 C	0 B	0 C	0 C	1 C	0 B	0 C	0 C	0 C
Atrazine	0.5	0 C	0 C	0 B	0 B	0 B	0 C	0 B	0 C	0 C	0 C	0 B	0 C	0 C	0 C
Atrazine	1	0 C	0 C	0 B	0 B	0 B	0 C	0 B	0 C	0 C	0 C	0 B	0 C	0 C	0 C
Atrazine	1.5	0 C	0 C	0 B	0 B	0 B	0 C	0 B	0 C	0 C	0 C	0 B	0 C	0 C	0 C

1. Any two means having a common letter are not significantly different at the 5 % level of Significance, using the Protected Duncan's Test.

Table 2. Effects of pyridine herbicides in combination with atrazine and grass competition on yellow starthistle height.

Treatment		Canby Blueg.	Covar Sheep Fescue	Durar Hard Fescue	Tutal. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Wheatg.	Ephr. Inter. Wheatg.	Hycr. Wheatg.	Luna Pub. Wheatg.	Nord. Wheatg.	Oahe Int. Wheatg.	Secar Wheatg.	P-27 Sib. Wheatg.	Sodar Stream. Wheatg.
(lb ai/A)		(cm)													
Check +															
Atrazine	0	43 AB	33 AB	49 A	39 A	40 A	52 AB	33 BC	33 AB	36 AB	37 BC	54 A	59 AB	57 A	48 A
Atrazine	0.5	64 A	50 A	47 A	33 AB	46 A	74 A	67 A	49 AB	33 AB	43 AB	36 AB	60 AB	53 A	54 A
Atrazine	1	55 A	50 A	59 A	28 AB	42 A	40 ABC	48 AB	32 AB	40 AB	35 BC	34 AB	62 A	47 A	55 A
Atrazine	1.5	33 ABC	48 A	50 A	20 BC	39 A	23 BCD	58 AB	35 AB	22 B	25 CD	39 AB	57 AB	55 A	67 A
Clopyralid 0.12 +															
Atrazine	0	32 ABC	58 A	55 A	8 CD	40 A	11 CD	37 BC	44 AB	48 A	44 AB	51 A	20 BC	61 A	34 AB
Atrazine	0.5	9 BC	54 A	48 A	3 D	48 A	34 BCD	35 BC	56 A	27 AB	54 AB	39 AB	36 AB	38 A	49 A
Atrazine	1	32 ABC	50 A	3 B	0 D	36 A	25 BCD	30 BC	49 AB	28 AB	66 A	33 AB	24 AB	50 A	36 AB
Atrazine	1.5	50 A	20 AB	41 A	1 D	41 A	11 CD	8 CD	28 B	34 AB	60 AB	37 AB	35 AB	53 A	52 A
Picloram 1.0 +															
Atrazine	0	0 C	0 B	0 B	0 D	0 B	0 D	0 D	0 C	0 C	0 D	0 B	0 C	0 B	0 B
Atrazine	0.5	0 C	0 B	0 B	0 D	0 B	0 D	0 D	0 C	0 C	0 D	0 B	0 C	0 B	0 B
Atrazine	1	0 C	0 B	0 B	0 D	0 B	0 D	0 D	0 C	0 C	0 D	0 B	0 C	0 B	0 B
Atrazine	1.5	0 C	0 B	0 B	0 D	0 B	0 D	0 D	0 C	0 C	0 D	0 B	0 C	0 B	0 B

1. Any two means having a common letter are not significantly different at the 5 % level of Significance, using the Protected Duncan's Test.

Table 3. Effects of pyridine herbicides in combination with atrazine on grass cover.

Treatment		Canby Blueg.	Covar Sheep Fescue	Durar Hard Fescue	Tutal. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Wheatg.	Ephr. Inter. Wheatg.	Hycr. Wheatg.	Luna Pub. Wheatg.	Nord. Wheatg.	Oahe Int. Wheatg.	Secar Wheatg.	P-27 Sib. Wheatg.	Sodar Stream. Wheatg.
(lb ai/A)		(%)													
Check +															
Atrazine	0	0 A	11 BC	4 A	44 B	3 C	78 AB	0 E	14 BC	21 D	1 EF	8 C	19 AB	0 B	3 A
Atrazine	0.5	0 A	5 C	1 A	58 AB	16 C	61 B	0 E	2 C	25 CD	1 F	27 BC	0 B	0 B	13 A
Atrazine	1	0 A	1 C	3 A	56 AB	7 C	79 AB	1 DE	1 C	28 BD	3 EF	19 BC	0 B	0 B	1 A
Atrazine	1.5	0 A	0 C	3 A	43 B	6 C	85 AB	10 DE	13 BC	29 BD	7 EDF	40 B	1 B	8 AB	4 A
Clopyralid 0.12 +															
Atrazine	0	1 A	26 ABC	23 A	81 A	53 A	83 AB	29 BD	40 A	53 ABC	34 ABC	73 A	24 AB	22 AB	20 A
Atrazine	0.5	3 A	15 ABC	25 A	84 A	24 BC	85 AB	25 BE	30 AB	48 ABC	23 CDE	73 A	20 AB	16 AB	23 A
Atrazine	1	1 A	10 BC	25 A	83 A	55 A	78 AB	11 DE	34 A	49 ABC	25 BCD	75 A	23 AB	14 AB	18 A
Atrazine	1.5	1 A	3 C	21 A	83 A	53 A	93 AB	14 BE	35 A	48 ABC	38 ABC	75 A	4 AB	19 AB	24 A
Picloram 1.0 +															
Atrazine	0	0 A	38 AB	32 A	88 A	50 A	94 A	46 A	38 A	68 A	50 A	86 A	38 A	16 AB	26 A
Atrazine	0.5	1 A	40 A	25 A	88 A	53 A	100 A	51 A	40 A	63 A	45 AB	88 A	34 AB	13 AB	28 A
Atrazine	1	0 A	6 C	25 A	85 A	43 AB	91 AB	34 AB	48 A	63 A	28 BCD	83 A	25 AB	33 A	21 A
Atrazine	1.5	0 A	4 C	25 A	88 A	48 A	95 A	40 AB	40 A	56 A	43 ABC	78 A	22 AB	24 AB	21 A

1. Any two means having a common letter are not significantly different at the 5 % level of Significance, using the Protected Duncan's Test.

Effects of winter and spring applied herbicides on picloram resistant yellow starthistle. Lass, L. W. and R. H. Callihan and F.E. Northam. A semiarid pasture containing picloram-resistant and susceptible yellow starthistle (*Centaurea solstitialis* L. (CENSO)) was used to evaluate high doses of four soil-persistent herbicides applied in either spring or fall. The objective was to determine whether these herbicides, some of which were applied at above-normal doses, would eliminate the yellow starthistle that may survive normal doses of picloram.

Metsulfuron was applied in late fall (December 13, 1989) and mid-spring of the following year (May 10, 1990) at a rate of 0.08 kg ai/ha (1.1 oz ai/a). Triclopyr at 5.0 kg ae/ha (4.5 lb ae/a), picloram 1.2 kg ae/ha (1.1 lb ae/a) and tebuthiuron 10.8 kg ai/ha (9.6 lb ai/a) were applied on December 13, 1989 and April 19, 1990. A standard treatment of picloram at 0.24 kg ae/ha (0.25 lb ae/a) was applied on May 10, 1990. Water with 0.5% non-ionic surfactant (R-11) was used as a carrier and was applied at a rate of 54.1 l/ha in December and 51.9 l/ha in April and May. A non-sprayed control was included in each of the four replications. The plot design was a randomized complete block. In the spring of 1991, an application consisting of 1 kg ai/ha 2,4-D and 0.2 kg ai/ha dicamba was applied by the landowner to the complete pasture, including the experiment.

Yellow starthistle populations in picloram, triclopyr, and metsulfuron treatments oversprayed the following year (1991) with dicamba + 2,4-D did not differ from populations in the check in the summer of 1992. In the spring of 1992, plants present in all treatments, including the checks, expressed leaf curling typical of hormone herbicide symptoms. In no case did the symptoms appear to reduce plant stands or flower production (data not shown). The only herbicide still showing control of yellow starthistle was tebuthiuron; however no vegetation grew in plots treated with this nonselective treatment. Previous years' results from this study have shown that high doses of herbicides will reduce populations in the initial years after treatment, but these results show that as the herbicide has degraded, the yellow starthistle has returned. The concentration of herbicide remaining should in normal circumstances be high enough to kill or suppress normal yellow starthistle, but these results indicate that the resistant plants appear to survive. (University of Idaho, Dept. of PSES, Moscow, 83843)

Table. The effects of late fall and spring applied herbicides on picloram resistant yellow starthistle oversprayed with dicamba and 2,4-D.

			Spring 1992			Summer 1992
Treatment	Rate	Timing	Population	Injury	Rosette Diameter	Population
	kg/ha		(plts/m2)	(%)	(cm)	(plts/m2)
Check	0		110 *	18 C	4 A B C	166 A B
Metsulfuron	0.08	F '89	275 *	25 B C	6 A	175 A B
Metsulfuron	0.08	S '90	124 *	21 B C	6 A	155 A B
Picloram	0.24	S '90	220 *	5 C	4 A B C	150 A B
Picloram	0.24	F '89	77 *	40 A B C	5 A B	200 A
Picloram	0.24	S '90	92 *	1 C	5 A B	188 A
Tebuthiuron	10.8	F '89	5	75 A B	1 C	0 C
Tebuthiuron	10.8	S '90	10	80 A	2 B C	0 C
Triclopyr	5.0	F '89	188 *	50 A B C	4 A B C	160 A B
Triclopyr	5.0	S '90	143 *	17 C	5 A B	105 B

* means of the spring populations were not different using the Wilcoxon rank sum test. Means followed by the same letter are not different at the 0.05 level using the LSMEANS test.

Yellow starthistle control in semiarid annual non-crop grassland. Lass, L. W., R.H. Callihan and F. E. Northam. Yellow starthistle *Centaurea solstitialis* L. has reduced land productivity to the point where many infested sites are sold to purchasers who do not intend to use the land for grazing purposes. These sites often are in transition to home or industrial sites, but may be classified as non-crop sites for many years until construction begins. The purpose of this study is to examine the effects of herbicides with moderate residual periods on yellow starthistle on such lands.

The plot design was a split block with 4 replications. Treatments in block 1 were MON-13200 at 8 and 16 oz ai/a; MON-13200 + glyphosate at 3+8, 8+8, and 16+8 oz ai/a; MON-13200 + 2,4-D at 8+12 oz ai/a; MON-13200 + picloram at 8+2 oz ai/a; MON-12000 at 0.25, 0.5, and 0.75 oz ai/a and a check. Treatments in block 2 were UBI-C4243 at 0.75, 1.5, and 3 oz ai/a and a check. Block 3 contained standard treatments of picloram at 1, 2, and 4 oz ai/a; dicamba at 4 and 8 oz ai/a; 2,4-D at 12 oz ai/a; Curtail at 1 and 2 pts product/a; atrazine at 16 oz ai/a; glyphosate at 8 oz ai/a;
and a check.

Treatments were applied on April 15, 1992 with a CO_2 back pack sprayer with 8002 flat fan nozzles. The sprayer pressure was 40 PSI operated at a speed of 2.4 mph to deliver 23 gal/a. The plot size was 10 by 25 ft on a site with a 15% slope and a northern exposure. There was 80 to 90% trash cover over yellow starthistle plants 1 to 1.5 inches in diameter. After application the air temperature was 75F and the soil temperature was 82F at the surface, 58F at 2 inches depth and 49F at 6 inches depth. The relative humidity was 55% with no cloud cover. The wind speed was 1 mph from the west and no dew was present.

Yellow starthistle plants present at the time of application were not killed with MON-13200 at rates of 8 and 16 oz ai/a. MON-13200 at 8 oz ai/a reduced yellow starthistle height about half. The addition of glyphosate to MON-13200 killed emerged yellow starthistle plants and population counts reflected this. Populations of yellow starthistle treated with glyphosate alone or MON-13200 + glyphosate were not different, indicating that yellow starthistle continued to germinate after the application of MON-13200. The addition of 2,4-D to MON-13200 reduced plant populations, and plants surviving this treatment were escapes from direct application because of the heavy cover. The addition of picloram to MON-13200 killed all yellow starthistle. MON-12000 alone stunted yellow starthistle plants, but did not reduce yellow starthistle population counts.

UBI-C4243 significantly reduced yellow starthistle height when applied at 1.5 and 3.0 oz ai/a. Plant populations were not reduced with UBI-C4243.

Picloram and dicamba at all rates killed all of the yellow starthistle. The application of 2,4-D and glyphosate reduced yellow starthistle numbers, but many plants escaped because of the cover provided by old yellow starthistle stems. (University of Idaho, Dept. of PSES, Moscow, 83843)

Effects of experimental and standard herbicides on yellow starthistle.

Treatments	Rate	Yellow starthistle Height		Field bindweed
	(oz ai/a)	(in)	(plts/yd2)	(plts/plot)
(Experimental block 1)				
Check	0	58 B A	142 A	4 A
MON-13200 + glyphosate	3 + 8	15 E F D	39 D C	11 A
MON-13200 + glyphosate	8 + 8	20 E F D	41 B D C	17 A
MON-13200 + glyphosate	16 + 8	23 E F D C	10 D	25 A
MON-13200	8	28 D C	94 B A C	10 A
MON-13200	16	38 B D C	110 A	9 A
MON-13200 + 2,4-D	8 + 12	5 E F	15 D	26 A
MON-13200 + picloram	8 + 2	0 F	0 D	11 A
MON-12000	0.25	30 D C	135 A	8 A
MON-12000	0.5	38 B D C	135 A	10 A
MON-12000	0.72	33 D C	123 A	14 A
(Experimental block 2)				
Check	0	61 A	106 B A	9 A
UBI-C4243	0.75	46 B A C	143 A	19 A
UBI-C4243	1.5	38 B D C	146 A	4 A
UBI-C4243	3	28 D C	113 A	15 A
(Experimental block 3; commercial standards)				
Check	0	25 E D C	89 B A C	8 A
Picloram	1	0 F	0 D	12 A
Picloram	2	0 F	0 D	13 A
Picloram	4	0 F	0 D	10 A
Dicamba	4	0 F	0 D	9 A
Dicamba	8	0 F	0 D	5 A
2,4-D	12	18 E F D	43 B D C	5 A
Curtail	1	5 E F	38 D C	8 A
Curtail	2	0 F	0 D	8 A
Atrazine	16	23 E F D C	17 D	15 A
Glyphosate	8	18 E F D	15 D	10 A

Duncan's multiple range test is used to separate means within columns. Means with the same letter within a block are not significantly different.

Canada thistle management combining four mowing intervals during the growing season with fall-applied herbicides. Sebastian, J.R. and K.G. Beck. An experiment was established near Kersey, CO to evaluate Canada thistle (CIRAR) control with picloram, clopyralid + 2,4-D, dicamba, and chlorsulfuron. The experiment was designed as a split-block with four replications. Herbicides and rates comprised the main plot (arranged as a randomized complete block) and treatments of 0,1,2, or 3 times mowing constituted the split.

Mowing was initiated the first year June 25, 1991 (1st mowing), August 7, 1991 (2nd mowing), and September 16, 1991 (3rd mowing) followed by an October 18, 1991 herbicide application. The second year mowings June 25, 1992 (1st), September 8, 1992 (2nd), and September 30, 1992 (3rd) were followed by an October 26, 1992 fall application of herbicides. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 11 gal/a, 14 psi. Other application information is presented in Table 1. Main plot size was 10 by 60 feet and sub-plots were 10 by 15 feet.

Visual evaluations compared to non-treated control plots were taken October 16, 1992 before the fall 1992 herbicide application. All control ratings refer to Canada thistle control with 2 consecutive years of mowing and a fall 1991 application of herbicide. All picloram and picloram + 2,4-D (all rates) combined with mowing (all rates) provided good to excellent CIRAR control while picloram (0.3 oz ai/a) and picloram (0.3 oz ai/a) + 2,4-D (oz ai/a) with no mowing provided only fair CIRAR control. Non-mowed plots followed by clopyralid + 2,4-D (all rates) provided poor CIRAR control and plots mowed 2 or 3 times followed by clopyralid + 2,4-D (all rates) provided good to excellent control. Dicamba (32 oz ai/a) had poor control with 0 or 1 mowings and good control with 2 or 3 mowings. Telar provided good to excellent CIRAR control regardless of the number of mowings and rate of herbicide treatment. Mow only treatments with no herbicides provided poor CIRAR control with 0 and 1 mowing and fair to good control with 2 and 3 mowings respectively.

Wetter than normal conditions existed in 1992 which may have contributed to greater than normal stress on Canada thistle plants in this subirrigated meadow. The rush density dramatically increased and Canada thistle density decreased in non-treated plots in response most likely to this additional moisture. All treatments will be invoked again in 1993 (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application data for Canada thistle management combining different mowing intervals during the growing season followed by fall-applied herbicides.

Environmental data		
Application date	October 18, 1991	October 26, 1992
Application time	10:30 AM	11:30 AM
Air temperature, C	19	18
Cloud cover, %	0	0
Relative humidity, %	45	48
Wind speed, mph	0	0 to 3
Soil temperature, (2.0 in.), C	13	12

Application date	species	number of mowings	growth stage	height (in.)	density (shoots/ft^2)
October 18,1991	CIRAR	0	post flower	24 to 27	3 to 5
		1	post flower	15 to 20	3 to 5
		2	green vegetative	2 to 6	3 to 5
		3	green vegetative	2 to 4	3 to 5
October 26, 1992	CIRAR	0	post flower	20 to 24	1 to 3
		1	post flower	5 to 7	1
		2	rosette	1	0 to 1
		3	rosette	1	0 to 1

Table 2. Canada thistle management combining different mowing intervals during the growing season followed by fall-applied herbicides.

Herbicide	Rate	Canada thistle 10-16-92 No Mow	1 Mow	2 Mow	3 Mow
	(oz ai/A)	(% of Check)			
Picloram	3	73	89	95	97
	4	89	90	100	100
	8	97	98	100	100
	16	100	100	100	100
Picloram + 2,4-D	3 16	54	81	93	100
	4 16	92	93	96	96
	8 16	98	100	100	100
Clopyralid + 2,4-D	5 25	46	56	78	97
	7 38	44	64	84	88
	9 50	51	81	93	100
	14 76	70	73	92	95
Dicamba	32	65	63	88	91
Telar	0.8	90	93	96	100
Check		0	58	74	85
LSD (0.05)				21	

Control of musk thistle (Carduus nutans L.) with various herbicides. Whitson, T.D., R.J. Swearingen, J. Schin, L. Justesen, L. Hicks. Musk thistle populations have been rapidly increasing on rangeland, meadows and recreation areas in Wyoming. This biennial is much easier to control in early spring before heights reach 6 to 8 ft. The seed life of musk thistle has been reported to be 3 to 4 years, therefore, two applications of a herbicide every other year providing 100% control of 1st and 2nd year plant, should eliminate the seed bank and provide complete control until seed is reintroduced. This experiment was initiated as a four year study to test the previous theory. An initial herbicide was applied on June 5, 1992 when musk thistle sizes ranged from seedling to 2nd year plants in early bolting. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information: temperature 65F, soil surface 62F, 2 inches 62F, 4 inches 61F with 41% relative humidity and east winds 2 to 5 mph. Soil was a sandy loam (61.9% sand, 23.7% silt and 14.3% clay) with 4.7% organic matter and a pH of 6.1. Evaluations were made July 22, 1992 for total biomass reduction and on August 24, 1992 for seedling control. Treatments controlling more than 90% of the biomass and 100% of the seedlings were picloram at 0.5 lb ai/A and the combinations of picloram+2,4-D(LVE) at 0.25+1.0 lb ai/A and clopyralid+2,4-D at 0.19+1.0 lb ai/A. This experiment will be re-evaluated in 1993 and retreated with the same herbicides in 1994. (Department of Plant, Soil and Insect Science, University of Wyoming, Laramie, WY 82071 SR 1681).

Control of Musk Thistle With Various Herbicides
Summary Data

Herbicide[1]	Rate lb ai/A	% Biomass Reduction[2]	% Rossette Control[3]
metsulfuron+X-77	.2 oz+.25%	36	5
metsulfuron+X-77	.4 oz+.25%	38	24
metsulfuron+X-77	.6 oz+.25%	51	49
metsulfuron+X-77	1.0 oz+.25%	44	64
metsulfuron+2,4-D(LVE)+X-77	.2 oz+1.0+.25%	55	21
metsulfuron+2,4-D(LVE)+X-77	.4 oz+1.0+.25%	59	21
2,4-D(LVE)+X-77	1.0+.25%	23	33
2,4-D(LVE)+X-77	2.0+.25%	23	13
picloram	0.25	78	90
picloram	0.5	95	100
picloram	0.25	9	5
picloram	0.5	16	3
picloram+2,4-D(LVE)	0.25+1.0	94	100
dicamba+2,4-D(LVE)	0.25+1.0	38	26
clopyralid+2,4-D (Curtail)	1 qt/A	55	99
clopyralid+2,4-D (Curtail)	2 qt/A	91	100
CHECK	-----	0	0

[1] Herbicides were applied June 5, 1992.
[2] Evaluations were made July 22, 1992.
[3] Evaluations were made August 24, 1992.

Control of Musk Thistle with Various Herbicides
% Rosette Control

Herbicide[1]	Rate lb ai/A	Rep 1	Rep 2	Rep 3	Rep 4	Average % Control
Escort+X-77 (metsulfuron)	.2 oz+.25%	20	0	0	0	5
Escort+X-77	.4 oz+.25%	27	50	0	20	24
Escort+X-77	.6 oz+.25%	80	40	75	0	49
Escort+X-77	1.0 oz+.25%	90	95	50	20	64
Escort+2,4-D(LVE)+X-77	.2 oz+1.0+.25%	0	60	5	20	21
Escort+2,4-D(LVE)+X-77	.4 oz+1.0+.25%	10	0	45	35	21
2,4-D(LVE)+X-77	1.0+.25%	10	0	50	70	33
2,4-D(LVE)+X-77	2.0+.25%	40	0	0	10	13
Tordon (Picloram)	0.25	98	100	80	80	90
Tordon	0.5	100	100	100	100	100
Banvel (Dicamba)	0.25	0	0	0	20	5
Banvel	0.5	0	0	0	10	3
Tordon+2,4-D(LVE)	0.25+1.0	100	98	100	100	100
Banvel+2,4-D(LVE)	0.25+1.0	35	0	70	0	26
Curtail (clopyralid+2,4-DA)	0.09+0.5	98	98	100	100	99
Curtail	0.19+1.0	100	100	100	100	100
CHECK		0	0	0	0	0

[1] Herbicides were applied 6/5/92. Evaluations were made 8/24/92.

PROJECT II

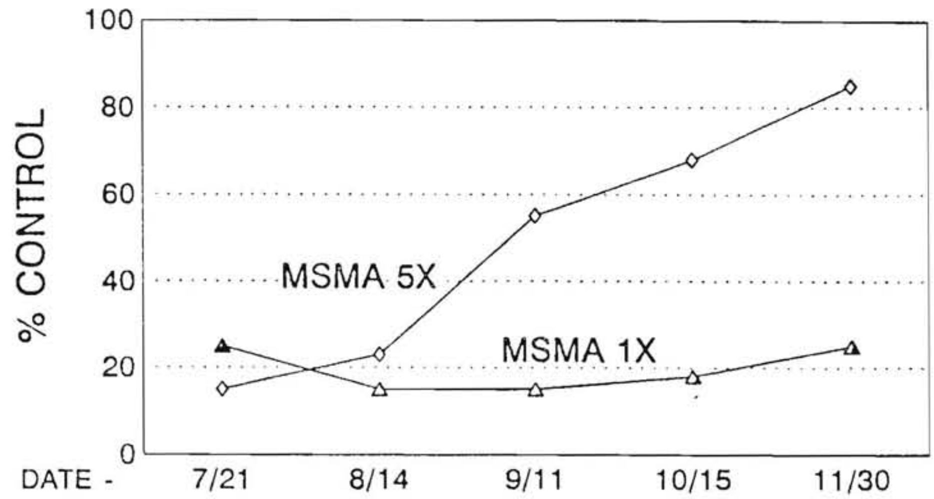
WEEDS OF HORTICULTURAL CROPS

Jill Schroeder - Project Chairperson
Mark Sybouts - Project Chairperson-Elect

The control of smutgrass with multiple applications of MSMA. Shaw, D.A., D.W. Cudney, and C.L. Elmore. Smutgrass, a perennial weed introduced from tropical Asia, invades turf in the coastal regions of California causing an unsightly clumpiness to the turf sward. Also, the unevenness of smutgrass-invaded turf reduces its value for golf and other sports uses. There is no single herbicide treatment which has been found to selectively remove smutgrass from desirable turf species. MSMA has been noted to reduce smutgrass growth particularly when more than one treatment is applied.

A trial was established in San Diego, California on a hybrid bermudagrass sward which had been invaded with smutgrass. Smutgrass accounted for about 20% of the turf cover. MSMA (2 lbs/a) was applied either as a single (1X) treatment (7/17/92) or as 5 applications (5X) at 3 to 6 wk intervals (7/17, 8/7, 8/27, 10/5, and 11/23/92). Plots were 10 by 10 feet in size and each treatment was replicated 4 times. Treatments were made using a constant pressure CO_2 backpack sprayer calibrated to deliver 30 gallons of spray solution per acre. Evaluations were made for % control of the smutgrass at monthly intervals during the trial period. There was no injury from MSMA treatment to the hybrid Bermuda turf. MSMA applied as a single application did not control smutgrass. However, when multiple applications of MSMA were used, control gradually increased until there was 85% control at the end of the season. Smutgrass in the plots which had received multiple applications was greatly weakened or dead and was being replaced by hybrid bermudagrass. (University of California, Riverside, CA 92521).

SMUTGRASS, % CONTROL
SAN DIEGO, CA



MSMA 1X	25	15	15	18	25
MSMA 5X	15	23	55	68	85
LSD 0.05	13	14	12	15	8

Postemergence control of *Oxalis corniculata L.* and *Euphorbia maculata L.* in turfgrass. Elmore, C.E. and J.M. Breuninger. This study was to evaluate the effect of late summer application of postemergence herbicides on *Oxalis corniculata L.* (creeping woodsorrel) and *Euphorbia maculata L.* (prostrate spurge). Triclopyr has been effective for the control of creeping woodsorrel and partially effective for the control of prostrate spurge in cool season turfgrass. Information was needed on the effect of isoxaben alone or in combination with triclopyr for the control of these two weeds.

A turfgrass mixture of perennial ryegrass and common bermudagrass was selected that had a good population of both weeds in the experiment site. Herbicides were applied using a CO_2 pressured backpack sprayer at 30 psi in 50 gpa on August 15, 1991.

Water was withheld for 48 h after application. Percent cover of creeping woodsorrel and prostrate spurge were taken August 15, September 1, and September 18, 1991 over either the whole plot (excluding the outer 6 inches of the plot) or within 4 one-quarter m^2 contiguous quadrats and averaged for each plot (data not shown). (Section of Botany, University of California, Davis, CA 95616; DowElanco, 3941 N. Freeway Blvd., Ste. 170, Sacramento, CA 95834).

Initial cover of Oxalis and Spurge and control with postemergence herbicides in a ryegrass/bermudagrass turf

Herbicide	Rate lb/a	Oxalis percent cover Initial	17DAT	25DAT	Spurge percent cover Initial	17DAT	25DAT
isoxaben (75w)	1.0	20	25.8 a	28.3 a	9.2	10	12.5
triclopyr (4E)	.25	20	13.3 b	13.3 b	8.3	10	6.7
triclopyr	.5	16.7	10 b	8.3 bc	5.0	1.7	5.0
isoxaben+triclopyr (4E)	1+.25	25	10 b	4 c	16.7	18.3	15.0
isoxaben+triclopyr	1+0.5	20	11.7 b	5 c	10.0	6.7	12.7
untreated		28.3	30 a	34.2 a	15.0	16.7	15.8
P = 0.05		N.S.			N.S.	N.S.	N.S.

Prunella vulgaris L. and *Trifolium repens L.* control in turfgrass. Elmore, C.L. and J.M. Breuninger. *Prunella vulgaris L.* (heal-all) is a perennial herb found in turfgrass. It is tolerant to a wide range of moisture and sun conditions. Where found, it is an invasive yet colorful weed. *Trifolium repens L.* (white clover) is a common herbaceous perennial found in many moist or low nitrogen turf sites.

A perennial ryegrass turf with high population of heal-all was selected to evaluate postemergence herbicides. The clover was present as a mixture, but was not uniform in the plots. A single application of herbicides was made on August 15, 1991 to recently mowed turf. A CO_2 pressurized backpack sprayer was used to apply herbicides in 100 gpa water at 30 psi using 3 Teejet flatfan nozzles. All plots were 5 x 10 feet and were replicated three times in a randomized block design. Irrigation was withheld for 48 h after application.

Both weed species were evaluated visually before spraying by rating control (1 = no control; 10 = complete control) and percent cover by using the mean of four contiguous 0.25 meter square quadrats. Both weeds were evaluated at 1, 3, and 9 months after treatment using the same methods.

Data were analyzed by ANOVA following an arcsin transformation on the percent cover and a square root transformation on the visual ratings. Significance was tested at 0.5%.

Results:

Prunella was reduced from the original cover by all treatments 1 month after application. After 3 months *Prunella* treated with triclopyr was regrowing and there was recovery of the *Prunella* when triclopyr was added to the mixture of 2,4-D, dicamba and mecoprop (Trimec) thus showing an antagonistic effect on Trimec alone. Percent cover of ***Prunella*** was reduced by a single application of Trimec (84%), triclopyr plus isoxaben (96%) or triclopyr, isoxaben and Trimec (86%) mixture respectively 9 months after treatment. *Prunella* cover increased in the untreated plots and areas treated with triclopyr 9 months after treatments. *Prunella* was reduced only 13% when treated with triclopyr in combination with Trimec.

White clover increased in plots untreated with herbicides. All treatments reduced cover by 1 month after treatment. After 3 months only triclopyr at 0.5 lb/a plus isoxaben at 1.0 lb/a and Trimec reduced clover cover compared to other treatments. The clover cover was significantly reduced by the same two treatments and a combination of triclopyr at 0.5 lb/a, isoxaben at 1.0 lb/a and Trimec compared to untreated clover.

The addition of triclopyr to Trimec reduced the control of clover compared to Trimec alone when evaluated at 3 or 9 months.

Though isoxaben was not used alone in this postemergence study, it increased control of clover when used with triclopyr or in the mixture of triclopyr plus Trimec. (Section of Botany, University of California, Davis, CA 95616; DowElanco, 3941 N. Freeway Blvd., Ste. 170, Sacramento, CA 95834).

Prunella - heal all control with
postemergence herbicides in turfgrass

	Initial % Cover	1 mo	2 mo	9 mo
1. triclopyr	40	28.3	28.3	50 a
2. triclopyr+isoxaben	26.7	6.7	3.3	1 b
3. trimec	38.3	14	5.7	6 b
4. triclopyr+trimec	35	15	21.7	28.3 ab
5. triclopyr+trimec+isoxaben	16.7	8.3	5.3	2.3 b
6. control	21.7	26	41.7	48.3 a
L.S.D. (0.05)	21.6	17.1	32.9	35.6

Littleseed canarygrass and london rocket control in bok choy with benefin and DCPA. Butler, M.D., D.R. Howell, and B.R. Tickes. Control of littleseed canarygrass and london rocket is a major concern in the winter vegetable production area of southwest Arizona.

Research was conducted at the Yuma Valley Agricultural Center to evaluate the control of littleseed canarygrass and london rocket in bok choy with benefin and DCPA. The benefin was applied preplant and double disc incorporated, while the DCPA was applied after planting November 26, 1986. Carrier volume was 20 gal/a delivered at 40 psi through 8002 flat fan nozzles. The 14 ft by 30 ft plots were replicated four times in a randomized complete block design.

Benefin was effective against littleseed canarygrass but reduced the stand by 2 to 5 percent and resulted in 2 to 5 percent stunting of bok choy at the 1.5 and 2.5 lb ai/a rates, respectively. DCPA did not visibly affect the bok choy, but provided unacceptable control of both littleseed canarygrass and london rocket. (Oregon State University, Central Oregon Agricultural Research Center, Madras, OR 97741 and University of Arizona Extension, Yuma, AZ 85364).

Bok choy injury and littleseed canarygrass and London rocket control at Yuma, Arizona

Herbicide	Rate	Bok choy Stand reduction	Bok choy Stunting	Littleseed canarygrass control	London rocket control
	(lb ai/a)	%			
benefin	1.5	98 a*	2 a	90 a	12 bc
benefin	2.5	95 a	5 a	95 a	30 ab
DCPA	6	100 a	0 a	50 b	32 ab
DCPA	10	100 a	0 a	52 b	38 a
check	0	100 a	0 a	0 c	0 c

* Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$

Precision post-directed spraying and flaming in broccoli. Eskelsen, S.R., L. Ranasinghe, and G.D. Crabtree. A propane flame and aqueous nitrogen fertilizers were directed at the base of broccoli plants to test for crop injury and weed control.

Spray nozzles and propane burners (Flame Engineering, Inc, LaCrosse, KS, model number lt 2 by 8 red dragon v-burner) were mounted on free floating skids that were attached onto a tractor tool bar (Direct spray attachment for John Deere 6000 high cycle sprayer). The flamer and the spray nozzles were positioned so that only the lower stems of the broccoli plant were exposed. Broccoli was flamed on August 26, 1992 (broccoli plants were at 15 cm with 12 leaves) and aqueous nitrogen fertilizers were applied on August 25, 1992 (broccoli plants at 15 cm with 12 leaves). Treatments (table) were unreplicated. Enquik was diluted in some treatments (1:1 water:Enquik).

All rates of AN-20 (table) slightly injured broccoli and did not control weeds effectively. Weeds included redroot pigweed, crabgrass, Canada thistle, and common dandelion. Enquik injured broccoli more than AN-20 but controlled weeds better. Injury was confined to the lower leaves. There seemed to be no difference in weed control between 50%-Enquik and Enquik treatments. Future research may include the application of Enquik at different timings.

There was a high level of crop injury in flaming at 1.7 mph. Injury intensity and weed control seemed to decrease at 2.5 and 4 mph. For flaming, future research may include experimenting with shields or with directed air that protect broccoli foliage from rising heat. (Department of Horticulture, Oregon State University, ALS 4017, Corvallis, OR 97331-7304).

Postemergent weed control in broccoli with directed application of a propane flame and aqueous nitrogen fertilizer.

Treatment		Spray volume (GPA)	Plant injury (0-100 scale)	Weed control %
AN 20		29	0	0
AN 20		39	5	10
AN 20		41	5	30
AN 20		54	5	50
50% Enquik		30	30	50
50% Enquik		40	50	70
50% Enquik		45	30	80
50% Enquik		58	30	90
Enquik		30	35	80
Enquik		60	30	80
Enquik		77	30	85
Enquik		71	30	90
Flaming	Tractor speed 1.7 MPH	NA	40	80
Flaming	Tractor speed 2.5 MPH	NA	20	85
Flaming	Tractor speed 4 MPH		5	50
Flaming	Nozzles directed to rows		90	90
Check			0	0

Linuron evaluations in carrots. Bell, C.E. This report discusses two experiments testing linuron use in fresh market carrots. Objectives were to evaluate linuron crop phytotoxicity and control of purple nutsedge. Trials were conducted on commercial carrot fields in the Imperial Valley in southeastern California.

Experimental design was a randomized complete block with four replications. Plot size was 1 bed (1 m wide each) by 7.5 m long. All treatments were made postemergence to the crop and the weeds. Postemergence treatments were made at three different timings; 1) when the crop was in the cotyledon to one true leaf stage, 2) when the crop was 8 cm tall, and 3) at timing 2 plus another treatment one week later. Applications were made at 280 L/ha carrier volume, at 140 kPa pressure using a single 8003LP nozzle per bed. Herbicide treatments began in the first experiment on October 7, 1991 and in the second experiment on November 26, 1991.

In the first experiment, there was a heavy infestation of purple nutsedge. Weed density was determined by counting 3m of each bed before treatment and one week after the last herbicide application. In both experiments, crop production was measured by harvesting all carrots per 3 m of beds. These carrots were counted and weighed (see Table 2). Carrot harvest data and the purple nutsedge density values were subjected to Analysis of Variance and mean separation (LSD).

According to analysis of variance, there were no significant differences between treatments for purple nutsedge control (Table 1). A single degree of freedom orthogonal contrast, using the ratio of pre to post treatment nutsedge density, did show a significant difference between treated and untreated plots (data not shown, $F = 4.628$, $p = 0.043$). Linuron apparently has an effect on purple nutsedge, but it is not commercially acceptable. There were no significant differences between treatments for carrot density and yield (Table 2). The second experiment had very few weeds. There was no effect of treatment on carrot yield in this experiment. Although there was a significant difference in carrot number in experiment 2, the differences did not clearly relate to any treatment regime. (Cooperative Extension, University of California, Holtville, CA 92250.)

Table 1. Purple nutsedge control in carrots.

Treatment	Rate kgai/ha	Timing[a]	CYPRO density[b] Oct. 7	Nov. 4	Ratio[c]
untreated control		-	59.3	244.0	5.4
linuron	.56	1	85.3	228.0	3.2
linuron	1.12	1	91.5	270.3	3.2
linuron	1.12	2	39.5	166.0	4.8
linuron	1.70	2	72.8	235.5	4.2
linuron	1.12+1.12	2+3	78.8	223.8	3.1
linuron	0.84+1.4	2+3	62.8	282.5	4.3
linuron	1.4+0.84	2+3	69.8	259.0	3.8
	LSD (0.05)				ns

a - Timing: 1 - cotyledon to one true leaf stage (Oct. 7), 2 - when the crop was 8 cm tall (Oct. 21), 3 - one week after timing 2 (Oct. 28).
b - Number of purple nutsedge shoots per 3 m of plot, mean of 4 replications.
c - Ratio of nutsedge density after treatment to density before treatment.

Table 2. Linuron effect on carrot number and yield.

Treatment	Rate kgai/ha	Timing[a]	Exp 1[b] #	Yield	Exp 2 #	Yield
untreated control		-	295.0	18.9	245.5	22.8
linuron	.56	1	248.3	16.7	285.0	19.4
linuron	1.12	1	272.5	18.3	256.0	21.4
linuron	1.12	2	295.5	19.0	223.5	21.3
linuron	1.70	2	258.8	17.0	241.3	21.6
linuron	1.12+1.12	2+3	274.3	16.9	255.5	19.5
linuron	0.84+1.4	2+3	255.0	15.3	265.0	19.8
linuron	1.4+0.84	2+3	305.0	17.8	232.5	23.1
	LSD (0.05)		ns	ns	29.2	ns

a - Timing: 1 - cotyledon to one true leaf stage (Experiment 1 - Oct. 7, exp 2 - Nov. 26), 2 - when the crop was 8 cm tall (exp 1 - Oct. 21, exp 2 - Jan 17, 1992), 3 - one week after timing 2 (exp 1 - Oct. 28, exp 2 - Jan. 24).
b - # - number of carrot plants per 3 m of bed, mean of four replications; Yield - kg per 3 m of bed, mean of four replications.

Herbicide evaluation in carrots. Bell, C.E. This research was conducted at the UC Desert Research and Extension Center in Holtville, CA to compare the efficacy of various herbicides for weed control in fresh market carrots.

The trial compared trifluralin, pendimethalin, and linuron. Experimental design was a randomized complete block with four replications. Plot size was 4 beds (1 m wide each) by 7.5 m long. The crop was sown on October 10, 1991. Treatments were made either preplant incorporated or preemergence on the same day as the crop was sown. Mechanical incorporation was with a PTO driven rototiller, set to operate 7 cm deep. Applications were made at 82 L/ha carrier volume, at 140 kPa pressure using a single 8002LP nozzle per bed. The weeds present were Wright's groundcherry, nettleleaf goosefoot, and junglerice.

Data collected were; visual evaluation of weed control by species on Nov. 11, and yield on April 8, 1992. Two meters of the two inner beds from each plot were harvested for yield evaluations. Results are shown in the Table.

Linuron and pendimethalin applied preemergence both controlled Wright's groundcherry very well, while trifluralin and the preplant incorporated pendimethalin treatment did not work. All herbicide treatments controlled the other weeds. Herbicide treated plots produced significantly better yields then the untreated control. Single degree of freedom class comparisons indicate that the linuron treated plots had significantly higher yields then the trifluralin or pendimethalin treated plots. A class comparison of trifluralin to pendimethalin was insignificant. (Cooperative Extension, University of California, Holtville, CA 92250.)

Table 1. Weed control in carrots in Holtville, CA.

Treatment	Rate kgai/ha	Timing[a]	% Weed Control[b] PHYWR	CHEMU	ECHCO	Yield[c] kg
trifluralin	.84	PPI	0	93	100	26.3
trifluralin	.84	PREE	7	98	100	31.8
pendimethalin	.84	PPI	0	100	100	34.7
pendimethalin	.84	PREE	99	99	100	30.0
linuron	.56	PREE	98	99	99	35.5
linuron + COC	.84	PREE	100	99	99	36.9
linuron	1.12	PREE	100	100	100	37.5
untreated control			0	0	0	13.8
		LSD(0.05)				7.0

Class comparisons of yield	F	P
treated vs. untreated	58.271	<0.001
trifluralin vs. pendimethalin	1.906	0.182
linuron vs trifluralin and pendimethalin	10.639	0.004

a - Timing: PPI = preplant incorporated; PREE = preemergence.
b - Visual evaluation of percent weed control, mean of four replications, PHYWR = Wright's groundcherry, CHEMU = nettleleaf goosefoot, ECHCO = junglerice.
c - Yield - fresh weight of harvested carrots from 2 m of 2 inner beds of each plot, mean of four replications.

Weed control in newly established Christmas trees with various herbicides. Whitson, T.D. and M.E. Green. A herbicide rotation program in Christmas tree plantings is essential to prevent weed population shifts and herbicide resistance. This study was conducted with seedling scotch pine transplants, the first season after transplanting. Trees were 6 to 8 inches tall at the time of treatment, on March 27, 1992 and were beginning to break dormancy. Plots 10 by 20 ft were treated as single blocks with each block containing four live trees at the time of treatment. Herbicides were broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Application information March 27, 1992: temperature, air 60F, soil surface 64F, 1 inch 61F, 2 inches 60F, 4 inches 59F with 50% relative humidity and calm winds. Soil was loamy sand (71% sand, 21% silt and 8% clay) with 1.2% organic matter and a pH of 7.2. Evaluations were made May 8, 1992 and or June 17, 1992 to determine the % control of annual broadleaf and grassy weeds. Broadleaf weeds included kochia, nutseed lambsquarters, hairy nightshade and redroot pigweed, while annual grasses included longspine sandbur, green foxtail and barnyard grass. None of the herbicides caused damage to the transplanted trees. Those areas treated with the combinations of bromoxynil+MCPA+oryzalin at 0.25+0.25+2.0 lb ai/A and bromoxynil+MCPA+oxyfluorfen at 0.25+0.25+1.0 lb ai/A were the same and provided 95% control of annual weeds on May 8, 1992 and 70% on June 17,1992. Either of these combinations should be used as a part of a herbicide rotation system in combination with the currently used soil active herbicide, hexazinone. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071 SR 1679)

Herbicide[1]	Rate lb ai/A	% Control of Annual Weeds[2]	
		5/8/92	6/17/92
Bromoxynil+MCPA	0.13+0.13	70	10
Bromoxynil+MCPA	0.25+0.25	75	10
Bromoxynil+MCPA	0.25	50	0
Bromoxynil+MCPA	0.5	90	10
Bromoxynil+MCPA+Oryzalin	0.13+0.13+1.0	80	60
Bromoxynil+MCPA+Oryzalin	0.25+0.25+2.0	95	70
Bromoxynil+Oryzalin	0.25+1.0	75	50
Bromoxynil+Oryzalin	0.5+2.0	90	50
Bromoxynil+MCPA+Oxyfluorfen	0.13+0.13+0.5	70	20
Bromoxynil+MCPA+Oxyfluorfen	0.25+0.25+1.0	95	70
Bromoxynil+Oxyfluorfen	0.25+0.5	50	10
Bromoxynil+Oxyfluorfen	0.5+1.0	95	25

[1]Herbicides were applied March 27, 1992.
[2]Evaluations were made May 8, 1992 and June 17, 1992.

Cole crop tolerance and weed control with pyridate. VanGessel, M.J., P. Westra, and T. D'Amato. This experiment was designed to evaluate 1) efficacy of pyridate for a number of common weed species; and 2) impact of pyridate on phytotoxicity for numerous cole crop varieties. Cole crops were seeded in greenhouse and transplanted into field plots at the two true-leaf stage. The cole crops (varieties) included: cabbage ('Atria', 'Sure Vantage', 'Tasty', 'Bravo', and 'Golden Acre'); broccoli ('Citation'; 'Commander', and 'Greenbelt'); cauliflower ('Snowball 123' and 'Glacier'); and brussel sprouts ('Roger' and 'Lunet'). Experimental design was a randomized block arranged as a strip-plot with three replications. Plants were transplanted on July 30, 1992 at 30 cm spacing between plants and rows 75 cm apart. All plots had one row of each variety. Herbicide treatments were applied perpendicular to the rows. A PRE treatment, DCPA and oxyfluorfen at 10.0 and 0.6 kg ha^{-1}, respectively, was applied prior to transplanting. Pyridate at 0.5, 1.0, and 2.0 kg ha^{-1} was applied 2 weeks after transplanting (WAT) (crops at four true-leaf stage); split application at 2 and 3 WAT; or 3 WAT. Herbicide treatments were applied with flat fan nozzles at 197 L ha^{-1}, 175 kPa, and 5 km hr^{-1}. Ridomil+Bravo (80 W, 2.2 lb prod ha^{-1}) was applied at 1 and 4 WAT for control of damping off disease. Weed control and crop injury were visually evaluated 4 and 8 WAT. Injury was more severe when rated 4 WAT compared to 8 WAT but patterns were similar, thus only ratings 8 WAT are discussed.

Redroot pigweed (Amaranthus retroflexus L., AMARE), common lambsquarters (Chenopodium album L., CHEAL), hairy nightshade (Solanum sarrachoides Sendt., SOLSA), and common purslane (Portulaca oleracea L., POROL) were present. Pigweed and nightshade control was good (> 88%) for all pyridate treatments (Table 1). Purslane control was reduced as treatments were delayed to late POST applications. Lambsquarters control at 0.5 and 1.0 kg ha^{-1} was reduced for late POST application. DCPA plus oxyfluorfen treatment did not provide acceptable control of any weed species.

Crop injury ratings did not differ between cole crops. Only with cabbages did varieties respond differently to herbicide treatments. Tasty was most susceptible to pyridate injury while Golden Acre was most tolerant.

Crop injury (averaged across all cole crops) differed for pyridate rate by timing interaction (Table 2). At 0.5 kg ha^{-1}, injury did not differ by time of application. At 1.0 kg ha^{-1}, crop injury was highest for both the early and split applications. At 2.0 kg ha^{-1}, injury was split > early > late. (Weed Research Laboratory, Colorado State Univ., Ft. Collins, CO 80523)

Table 1. Weed control with pyridate applied at various rates and timings when rated eights weeks after transplanting (five weeks after late POST treatments).

Herbicide	Rate	Time	Control			
			AMARE	CHEAL	POROL	SOLSA
			%			
Pyridate	0.5	EPOST	90 a	87 ab	85 a	97 a
Pyridate Pyridate	0.5 0.5	EPOST LPOST	95 a	87 ab	80 bc	100 a
Pyridate	0.5	LPOST	88 a	82 b	77 c	92 a
Pyridate	1.0	EPOST	98 a	96 a	93 a	100 a
Pyridate Pyridate	1.0 1.0	EPOST LPOST	98 a	95 ab	95 a	100 a
Pyridate	1.0	LPOST	95 a	90 ab	87 abc	100 a
Pyridate	2.0	EPOST	93 a	93 a	92 ab	97 a
Pyridate Pyridate	2.0 2.0	EPOST LPOST	97 a	99 a	95 a	100 a
Pyridate	2.0	LPOST	97 a	97 a	88 abc	100 a
DCPA Oxyfluorfen	10.0 0.6	PRE PRE	47 b	58 c	80 bc	47 b

Table 2. Cole crop injury with pyridate applications rate 4 and 8 WAT, rating 4 WAT are in parenthesis. Average value is injury averaged across all cole crops and varieties. Cabbage data are an average of five varieties, broccoli are three varieties, and cauliflower and brussel sprouts data are average of two varieties. See text for specific varieties. Ratings taken eights weeks after transplanting (five weeks after late POST treatments).

			Injury				
Herbicide	Rate	Time	Average	Cabbage	Broccoli	Cauliflower	Brussel Sprouts
			%				
Pyridate	0.5	EPOST	0.4 (4.6)	0.7 (5.4)	0.0 (7.8)	0.8 (1.8)	0.0 (3.3)
Pyridate Pyridate	0.5 0.5	EPOST LPOST	1.4 (4.9)	1.0 (6.4)	1.1 (5.6)	0.0 (2.7)	3.3 (5.0)
Pyridate	0.5	LPOST	0.6 (3.7)	0.7 (2.1)	0.0 (2.8)	0.0 (0.0)	1.7 (10.0)
Pyridate	1.0	EPOST	1.2 (11.0)	0.3 (11.0)	2.8 (13.9)	0.0 (7.5)	1.7 (11.7)
Pyridate Pyridate	1.0 1.0	EPOST LPOST	1.4 (12.0)	1.0 (13.3)	2.2 (17.2)	1.7 (5.0)	0.8 (12.5)
Pyridate	1.0	LPOST	0.2 (8.0)	0.3 (7.4)	0.6 (8.9)	0.0 (10.8)	0.0 (5.0)
Pyridate	2.0	EPOST	2.0 (14.8)	2.3 (16.7)	1.7 (16.7)	1.7 (13.3)	2.5 (12.5)
Pyridate Pyridate	2.0 2.0	EPOST LPOST	5.7 (36.4)	6.3 (44.0)	7.2 (45.0)	4.2 (27.5)	5.0 (29.2)
Pyridate	2.0	LPOST	0.8 (15.4)	1.0 (14.0)	0.6 (18.3)	0.8 (15.8)	0.8 (13.3)
DCPA Oxyfluorfen	10.0 0.6	PRE PRE	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Volunteer wheat control in iceberg lettuce with sethoxydim adjuvant combinations. Butler, M.D. and E.S. Heathman. In southwest Arizona wheat is used in rotation with winter vegetables where it can become a weed in following seasons. Research was conducted at the Yuma Valley Agricultural Center to evaluate several adjuvants in combination with sethoxydim for control of volunteer wheat in iceberg lettuce.

The double-row, raised-bed plots 42 in wide by 30 ft long were replicated four times in a randomized complete block design. Applications were made December 8, 1989 when the lettuce was at the six leaf stage and the wheat was at four leaves. Carrier volume was 20 gal/a delivered at 40 psi through 8002 flat fan nozzles.

There were no differences among adjuvants, including sethoxydim as Poast Plus. No visible evidence of injury to the lettuce was observed from any of the treatments. (Oregon State University, Central Oregon Agricultural Research Center, Madras, OR 97741 and Plant Science Department, University of Arizona, Tucson, AZ 85721).

Iceberg lettuce injury and volunteer wheat control at Yuma, Arizona

Herbicide/adjuvant	Rate	Lettuce injury	Volunteer wheat control
	(lb ai/a)	------------%------------	
sethoxydim + oil concentrate	0.2	0 a*	92 a
sethoxydim + oil concentrate	0.3	0 a	97 a
sethoxydim + Dash	0.2	0 a	89 a
sethoxydim + Dash	0.3	0 a	93 a
sethoxydim as Poast Plus	0.2	0 a	93 a
sethoxydim as Poast Plus	0.3	0 a	90 a
check	0	0 a	0 b

* Mean separation with Student-Newman-Kuels Tests at $P \leq 0.05$

Trifluralin effect on onion density. Bell, C. E. and J. Richardson. Trifluralin was investigated as a possible preemergence herbicide in dry bulb onions in the Imperial Valley of southeastern California. The value of trifluralin would be for control of annual bluegrass, a weed not adequately controlled by DCPA, the currently used herbicide. This research was conducted on a commercial onion field in the Imperial Valley.

The experiment was a randomized complete block design with four replications. Plot size was 2 beds, each 1 m wide by 5 m long. The crop was sown on October 22, 1991, treated on the same day, and irrigated with sprinklers on October 24. Trifluralin was applied as a liquid or as a granule. Liquid treatments were applied with a CO_2 pressured sprayer at 120 L/ha spray volume at 138 kPa pressure through 8002LP nozzles. Granules were applied by hand with a small jar with holes punched in the lid, salt shaker style.

Crop density was assessed twice (Nov. 12, 1991 and Feb. 14, 1992) with a stand count. This stand count was the actual number of emerged onion plants per 3 m of each bed. Analysis of variance, mean separation (LSD), and selected single degree of freedom class comparisons were conducted on these data. Class comparisons indicate that herbicide treatment had a significant effect on stand count on both dates ($P < 0.05$). In addition, the granular form of trifluralin reduced crop density more than the corresponding amount of herbicide applied as a liquid ($P < 0.01$). From this experiment, it does not seem that trifluralin has sufficient crop safety for use on dry bulb onions, except perhaps at low rates in the liquid form. (Cooperative Extension, University of California, Holtville, CA 92250 and DowElanco Co., Hesperia, CA 92345.)

Trifluralin effect on onion density
in the Imperial Valley, CA

trifluralin kgai/ha	form[a]	density assessment[b] Nov. 12, 1991	Feb. 14, 1992
0.42	L	189.5	318.0
0.56	L	181.3	313.8
0.84	L	163.5	265.0
1.12	L	178.3	274.8
0.56	G	164.0	226.0
0.84	G	147.5	209.0
1.12	G	143.5	192.8
untreated control		184.8	338.5
	LSD(0.05)	23.1	49.7

Single degree of freedom class comparisons

	F	P
treated vs. untreated		
Nov. 12, 1991	4.562	0.05
Feb. 14, 1992	20.329	<0.01
liquid vs granule		
Nov. 12, 1991	12.451	<0.01
Feb. 14, 1992	29.735	<0.01

[a] - L = liquid emulsifiable concentrate, G = 10% granule.
[b] - number of emerged onion plants per 3 m of bed by 2 beds, mean of four replications.

Precision post-directed spraying and flaming in snapbeans. Eskelsen, S.R., L. Ranasinghe, and G.D. Crabtree. A propane flame and herbicides were directed at the base of snapbean plants to test for crop injury and weed control. Spray nozzles and propane burners (Flame Engineering, Inc, LaCrosse, KS, model number lt 2 by 8 red dragon v-burner) were mounted on free floating skid plates that were attached onto a tractor tool bar (Direct spray attachment for John Deere 6000 high cycle sprayer). Snapbeans were flamed on August 11, 1992 (plants were at 15 cm with 4 trifoliate leaves or more) and herbicides were applied on August 25, 1992 (beans were about 20 cm tall with 6 or more trifoliate leaves). Treatments (table) were arranged in a randomized complete block design with four replications.

The variation in weed density and crop growth were high; therefore only visual observations on weed control and crop injury were collected 6 DAT. The dominant weed flora found in the unweeded plots were redroot pigweed, crabgrass, Canada thistle, and white clover. Treatment means are listed in the table. Weed control was good in the lactofen, acifluorfen, oxyfluorfen, and flaming at 1.7 mph treatments. However, crop injury was high in oxyfluorfen and flaming at 1.7 mph. There were no visible signs of lactofen injury on beans 3 DAT (data not shown in the table). Acifluorfen only slightly injured snapbeans and was the best weed control treatment. Both lactofen and acifluorfen were excellent in controlling broadleaf weeds but the control in grassy weeds was unsatisfactory. Imazethapyr showed poor weed control. Flaming at 2.5 and 4 mph caused less damage to the crop than flaming at 1.7 mph. Flaming at 2.5 mph controlled weeds better than flaming at 4 mph.

For flaming, future research may include experimenting with shields or with directed air that protect snapbean foliage from rising heat and comparing costs of flaming with post-emergence herbicides. For herbicides, future experimenting may include applications of acifluorfen and lactofen at different timings. (Department of Horticulture, Oregon State University, ALS 4017, Corvallis, OR 97331-7304).

Weed control in bush beans with directed application of herbicides and a propane flame.

Treatment	% weed control[b]	% plant injury[b]
Flaming[a] Tractor speed 1.7 MPH	82 ab	62 a
Flaming[a] Tractor speed 2.5 MPH	62 bc	18 b
Flaming[a] Tractor speed 4 MPH	52 cd	1 b
Oxyfluorfen 0.5 lbs ai/A	85 ab	65 a
Lactofen 0.2 lbs ai/A	90 a	10 b
Acifluorfen 0.5 lbs ai/A	88 a	3 b
Imazethapyr 0.0625 lbs ai/A	35 d	1 b
Unweeded check	0 e	0 b
CV %	25	91
Std. error	2	3

[a] Nozzles were 8009. Propane pressure was 60 psi.
[b] Values with the same letter are not significantly different at the 0.05 probability level of the DMRT.

Weed control in strawberries with mulches and herbicides. Stahler, Margaret and G.D. Crabtree. Grass straw or composted mint straw mulches were applied to a depth of 3-4 inches on bare ground between established strawberry plants. Mulch materials were applied in November, 1991 following herbicide treatments of a combination of simazine (1.12 kg ha^{-1}) and napropamide (4.48 kg ha^{-1}) on October 14, 1991. Treatment combinations are shown in the table. The grass straw mulch, which consisted of residues from orchardgrass and red fescue seed fields, contained viable grass seeds. When these grass seeds germinated and emerged through the mulch they constituted a weed problem so the total plot area was sprayed with sethoxydim (0.5 kg ha^{-1}) on March 3, 1992. The sethoxydim application did not effectively control the grasses, especially the fescue, so they were present at the time of plot evaluation (July 31, 1992) and weed removal in August.

From the table it is apparent that some perennial weeds were present. These were established perennials at the time of herbicide application and mulching and, as expected, were not controlled with the applied weed control treatments.

Results of this trial show that grass straw mulches generally reduced the diversity of weed species present and weeds would have been a minor problem if grass seeds in the mulch had not germinated. Even though the weed biomass was relatively low in the grass mulch plots, time required to remove these weeds was high. Herbicides reduced the weed biomass to less than half of the average of the plots receiving no herbicide. This difference was not shown in the weeding time data, reflecting the presence of a small number of large weeds in the plots without herbicide. Among mulch treatments grass mulches suppressed weed growth more than the composted mint straw which was ineffective in reducing weed biomass development.

This study would indicate that combinations of herbicides and mulches can effectively reduce weed growth in strawberries and that grass straw may be more effective than mint straw compost providing no viable grass seeds are present in the grass straw mulch. (USDA and Department of Horticulture, Oregon State University, Corvallis, OR 97331)

Weed control in strawberries with mulches and herbicides

Treatment	Weed dry weight (kg 27 m^{-2})	Weeding time (minutes 27 m^{-2})	Predominant weed species (in order of estimated biomass)
Simazine + napropamide			
Grass mulch	0.44	53	CIRAR DACGL FESRU RUMCR SONOL
Mint mulch	0.62	46	LACSE SONOL CIRAR RUMCR ANGAR POROL SENVU TAROF FESRU HRYRA
No mulch	0.30	45	SONOL POROL CONAR SENVU RUMCR POLAV DAUCA LACSE TAROF ANTCO
No herbicide Grass mulch	0.45	73	DACGL FESRU LACSE CVPSE SONOL
Mint mulch	1.31	56	SONOL SENVU LACSE ANGAR FESRU POROL TAROF POLAV HRYRA AMARE
No mulch	1.53	36	SONOL CIRVU DACGL EPIPC ANTCO SENVU HRYRA POLAV GNAPA ECHCG

SPECIES KEY

AMARE redroot pigweed
ANGAR scarlet pimpernel
ANTCO mayweed chamomile
CIRAR Canada thistle
CIRVU bull thistle
CONAR field bindweed
CVPSE bristly hawksbeard
DACGL orchardgrass
DAUCA wild carrot
ECHCG barnyardgrass
EPIPC panicle willoweed
FESRU red fescue
GNAPA lowland cudweed
HRYRA spotted catsear
LACSE prickly lettuce
POLAV prostrate knotweed
POROL common purslane
RUMCR curly dock
SENVU common groundsel
SONOL annual sowthistle
TAROF dandelion

<u>Precision post-directed flaming in sweetcorn</u>. Eskelsen, S.R., L. Ranasinghe, and G.D. Crabtree. A propane flame was directed at the base of corn plants to test for weed control and crop injury.

Propane burners (Flame Engineering, Inc, LaCrosse, KS, model number 1t 2 by 8 red dragon v-burner) were mounted on free floating skids that were attached onto a tractor tool bar (Directed spray attachment for John Deere 6000 high cycle sprayer). The flamer was positioned so that only the lower stems of the corn plant were exposed. Corn was flamed on August 11, 1992 (corn plants were 0.5 m). Treatments (table) were arranged in a randomized complete block design with four replications.

There was high variability in observed weed control and crop injury data. This may have reduced the real differences among these treatments. There were no significant differences in weed control among the flaming treatments however, the flaming treatments were significantly higher than the check (table). The predominant weed species in the trial were Canada thistle, dandelion, redroot pigweed, white clover, and large crabgrass. The 1.7 mph flaming treatment had a significantly higher degree of crop injury than the other flaming treatments (see table). As expected, flaming did not control Canada thistle which was the predominant weed at the experimental site. Annual broadleaf weeds were best controlled at the seedling stage (2 to 6 leaves).

Future research may involve different timings of application, varying exposure times, varying propane pressure, and varying nozzle sizes. (Department of Horticulture, Oregon State University, ALS 4017, Corvallis, OR 97331-7304).

Postemergent weed control in sweetcorn with a directed <u>propane</u> flamer.

Flaming treatment (Tractor speed MPH)	Average weed control (%)	Average crop injury (0-100 scale)
1.7	51 a	15 b
2.5	45 a	7 a
4.0	60 a	4 a
Unweeded check	0 b	0 a
CV %	57	70
Std. error	5	1

Values followed by the same letter are not significantly different at the 0.05 level of DMRT

Use of herbicides for velvetleaf control in two varieties of bush lima beans. Mitich, L.W., E.J. Roncoroni, and G.B. Kyser. Four herbicides, including the unregistered material imazethapyr, were evaluated in 5 treatments in 2 varieties of bush lima beans for velvetleaf (ABUTH) control and crop tolerance. Bentazon, a formerly registered material of great utility in dry bean production, was also included for comparison; a preplant incorporated treatment of pendimethalin + metolachlor was included as a standard registered treatment.

The experiment was conducted on a field of Yolo clay loam soil infested in previous years with a heavy stand of velvetleaf.

On 9 June 1992, trifluralin was applied and incorporated over the whole field for grass control. The pendimethalin + metolachlor treatment was also applied at this time. These treatments were incorporated to 3 inches.

'UC 92' bush lima beans and 'UC Luna' baby bush limas were planted 10 June in 4 alternating strips of four 30-inch rows. Herbicide treatments were randomized within each of 5 replications; each treatment plot was 20 ft wide (including 4 rows of each bean variety) by 20 ft long.

An early postemergence treatment of imazethapyr was applied 3 July. During the following 24 hours, temperatures reached a maximum of 90F and a minimum of 58F. Spray was directed at the base of crop plants. At this time bean plants were 6 to 8 inches tall with 3 to 4 true leaves; velvetleaf plants were in the second leaf stage. Remaining treatments were applied 15 July (late postemergence) over the top of crop and weeds; temperatures during the following day peaked at 97F and reached a low of 62F. Bean plants were 12 to 15 inches tall, and velvetleaf was 6 to 8 inches tall.

All treatments were applied with a CO_2 backpack sprayer delivering 25 gpa at 30 psi through 8002 nozzles.

The trial was rated for velvetleaf control 21 July and 2 September; a count of velvetleaf plants/meter was also taken on the latter date. In each evaluation, pendimethalin + metolachlor appeared to control velvetleaf most effectively. Crop chemical injury was also evaluated 21 July. High rates of imazethapyr caused moderate injury (as high as an average of 34% in baby limas at the highest rate), though this injury did not severely impact yields. Baby limas appeared more susceptible to injury.

Beans were cut 28 September. After drying, two 20-ft rows of each plot were harvested. Average weight harvested from baby lima plots (2087 g/40 ft) was approximately twice the average weight harvested from large lima plots (1071 g/40 ft), primarily because weather problems kept large lima pods from drying fully by threshing time. Highest yields were obtained from plots treated with pendimethalin + metolachlor, followed by plots treated with the highest rate of imazethaypyr; lowest yields were found in control plots. Yield differences were significant at the 10% level, but not at the 5% level. (Division of Plant Biology, University of California, Davis, CA 95616.)

Table. Evaluation of herbicides for velvetleaf control and crop injury in baby and large lima beans, UC Davis

Treatment	Rate (lb/a)	Application time, type	ABUTH control 7/21[3,4]	ABUTH control 9/2[3,4]	ABUTH plants/ meter[3]	Bean type	Crop injury 9/2[3,4]	Yield, 40 row ft (g)[3]
pendimethalin + metolachlor	1 + 1	PPI	97 A	89 A	1.1	baby	0	2635
						large	0	1361
imazethapyr[1]	0.047	early post	63 AB	45 CD	2.8	baby	2	1788
						large	2	858
imazethapyr[1]	0.032	late post	60 AB	40 D	3.4	baby	14	2214
						large	4	994
imazethapyr[1]	0.047	late post	63 AB	56 C	3.4	baby	34	2265
						large	14	1182
bentazon[2]	1	late post	96 A	72 B	2.1	baby	10	1974
						large	0	1093
control	---		19 B	15 E	7.9	baby	0	1642
						large	0	938

[1]Applied with 0.25% v/v X-77 surfactant.
[2]Applied with 1 qt crop oil per acre.
[3]All values average of five replications. Values followed by the same letter are not significantly different at the 5% level.
[4]Values are in percent; 0 = no weed control, no crop injury; 100 = complete weed control, complete crop kill

PROJECT III

WEEDS OF AGRONOMIC CROPS

Chris Boerboom - Project Chairperson
Neal Hageman - Project Chairperson-Elect

Weed control in fall-seeded alfalfa with imazethapyr alone or in combination with 2,4-DB, bromoxynil and selected surfactants. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on August 17, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of fall-seeded alfalfa (var. Champ) and weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 10 by 30 ft in size. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied postemergence on September 9, 1992 when alfalfa was in the 2nd trifoliolate leaf stage and weeds were small. X-77 was applied at 0.25% v/v, 28% N at 1.0% v/v, and Sun-It II at 0.5 and 1.0% v/v. Barnyardgrass (ECHCG) infestations were moderate, redroot pigweed (AMARE), and black nightshade (SOLNI) infestations were light throughout the experimental area.

Visual evaluations of weed control, crop injury and stand count were made on September 24, 1992. Treatments all gave excellent control of AMARE and SOLNI. ECHCG control was excellent with all treatments except imazethapyr applied at 0.063 lb ai/A. There was no sign of crop injury in any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control in fall-seeded alfalfa

Treatment	Rate lb ai/A	Plants/ ft^2	Weed Control[1] SOLNI	AMARE	ECHCG
			----------	%	----------
imazethapyr/X-77/28%N	0.047	45	100	100	98
imazethapyr/X-77/28%N	0.063	50	100	100	98
imazethapyr/X-77/28%N	0.094	56	100	100	94
imazethapyr/Sun-It II/ 28%N	0.047	51	100	100	99
imazethapyr/Sun-It II/ 28%N	0.063	58	100	100	94
imazethapyr/Sun-It II/ 28%N	0.094	56	100	97	95
imazethapyr/Sun-It II/ 28%N[2]	0.047	51	100	100	99
imazethapyr/Sun-It II/ 28%N[2]	0.063	42	100	100	98
imazethapyr/Sun-It II/ 28%N[2]	0.094	41	100	100	90
imazethapyr/2,4-DB/ Sun-It II/28%N	0.063/0.25	45	100	100	96
imazethapyr/2,4-DB/ X-77/28%N	0.063/0.25	46	100	100	94
imazethapyr/bromoxynil/ X-77/28%N	0.063/0.125	41	100	100	89
imazethapyr/bromoxynil/ Sun-It II/28%N	0.063/0.125	42	100	100	98
imazethapyr	0.063	40	100	100	67
handweeded check		52	100	100	100
check		37	0	0	0
av weeds/M^2			5	4	13

1. Based on a visual scale from 0-100, where 0 = no control and 100 = dead plants.
2. Sun-It II applied at 1.0% v/v.

Application timing for trifluralin granules for dodder control in alfalfa. Bell, C.E. Dodder is present in most fields in the Imperial Valley of southeastern California. This parasitic weed can be a serious weed of alfalfa, especially fields grown for seed production. Trifluralin granules are registered for dodder control in alfalfa seed crops; the label recommends treatment before the weed germinates and a second application 60 days later. In the Imperial Valley, the common practice has been to make the first application after the first spring harvest, with the second application after the second harvest. With the mild winter climate in this area, it may be that the first application is after the weed begins germination. This project was conducted to determine the proper application timing of trifluralin for the Imperial Valley, particularly a regime where the first application was in late winter. The experiment was done on a commercial alfalfa field near El Centro, CA.

The alfalfa field was in the fourth year of production and was known to have a heavy infestation of largeseed dodder. Experimental design was a split plot with four replications. Main plot size was a strip through the entire field (ca 400 m long) by 5.0 m wide. Subplots were one third of the length of the main plot (ca 133 m). Application of herbicides was with a ground driven, air assisted, granular applicator. All granule applications were with a 10% trifluralin granule at 2.24 kgai/ha.

Main plot factors were; 1) treatment before the first spring harvest (January 9, 1992, 2) treatment immediately following the first harvest (March 5, 1992), and 3) untreated. Subplot factors were; 1) untreated, 2) treatment after the second harvest (April 22, 1992), and 3) treatment after the third harvest (May 27, 1992). Dodder control was assessed as the number of colonies per treatment. All plots were walked on June 24, 1992; colonies that were encountered in 100 paces were recorded.

Analysis of variance of the colony counts indicated significant differences between main plot factors ($P = 0.09$) and no differences between the subplot treatments ($P > 0.10$). The interaction of main plot and subplot was not significant. The lowest number of colonies were in the plots treated before the first harvest. (Cooperative Extension, University of California, Holtville, CA 92250.)

Dodder control with 10% trifluralin granules in alfalfa in El Centro, CA

Main plot timing	Subplot timing	Colonies/ 100 paces[a]
pre 1st harvest	untreated	0.75
	2nd harvest	0.5
	3rd harvest	1.25
1st harvest	untreated	8.5
	2nd harvest	4.75
	3rd harvest	1.25
untreated	untreated	6.75
	2nd harvest	0.25
	3rd harvest	10.75

[a] - mean of four replications

Winter annual weed control with bromoxynil and imazethapyr in alfalfa. Bell, C.E. Winter annual weeds are problems in alfalfa fields in the Imperial Valley of southeastern California, particularly in older fields with a sparse alfalfa stand. This research project was initiated to study two herbicides; bromoxynil and imazethapyr, for control of three weeds; annual sowthistle, wild oats, and creeping wartcress. The experiment was conducted at the University of California Desert Research and Extension Center in Holtville, CA.

The alfalfa field was in the fourth year of production. Experimental design was a randomized complete block with four replications. Plot size was 1.5 m by 3.0 m. Application of herbicides was on November 18, 1991. Carrier volume was 215 l/ha at 138 kPa pressure using 8002LP flat fan nozzles. The alfalfa had been harvested before treatment, there was little regrowth. The weeds were in the 2 to 4 true leaf stage.

Visual evaluations of weed control and crop injury were made on November 25, 1991, and on January 13, 1992. Crop yield and weed biomass were assessed at the first spring harvest by taking a 0.5 m^2 sample per plot on March 12, 1992. At the first visual evaluation, creeping wartcress control by bromoxynil was good, while imazethapyr was not very good. Annual sowthistle control at this time by bromoxynil was very good at all rates, imazethapyr did not affect this weed. Phytotoxicity to the crop by bromoxynil was evident, but not unacceptable. At the later evaluation, results were similar, except that creeping wartcress control by imazethapyr had improved. Wild oat control by imazethapyr was fair at this time.

There were no significant differences between treatments for alfalfa biomass. Creeping wartcress biomass for the imazethapyr treatments was lower than the untreated. Conversely, the biomass of annual sowthistle in the imazethapyr treatments was significantly greater than the untreated and the bromoxynil treatments. Wild oat biomass was generally higher in the bromoxynil treated plots then in either the imazethapyr or untreated plots. It appears that the most intense interspecific competition was taking place between the annual sowthistle and the wild oats, with both alfalfa and creeping wartcress as bystanders. When the annual sowthistle was controlled by the bromoxynil treatments, the wild oat biomass increased greatly. When the creeping wartcress and wild oat biomasses were reduced by the imazethapyr treatments, the annual sowthistle biomass was greater, even higher than the untreated. These results suggest that the most likely recipient of a selective herbicide may be another weed rather then the crop. (Cooperative Extension, University of California, Holtville, CA 92250.)

Imazethapyr and bromoxynil for winter annual weed control in seedling alfalfa in Holtville, CA

Visual evaluations

Treatment	Rate kgai/ha	Weed Control -- Nov 25-- COPSQ	SONOL	---- Jan 13------ COPSQ	SONOL	AVEFA	Crop Injury
		----------	----------	----- % -----	----------	----------	----------
imazethapyr	.036	15	0	96	0	54	0
imazethapyr	.053	21	0	98	0	79	0
imazethapyr	.071	17	0	76	0	76	0
bromoxynil	.28	88	98	42	85	0	12
bromoxynil	.42	88	98	91	98	0	10
bromoxynil	.56	98	98	93	99	0	24
untreated control		0	0	0	0	0	0

Biomass - March 12, 1992

Treatment	Rate kgai/ha	Grams dry weight per .5 m^2 Alfalfa	COPSQ	SONOL	AVEFA
imazethapyr	.036	23.5	4.3 bc	50.8 a	21.8 b
imazethapyr	.053	23.8	1.9 c	55.8 a	31.7 b
imazethapyr	.071	28.2	2.6 c	44.4 ab	10.4 b
bromoxynil	.28	22.8	15.6 ab	5.2 c	61.4 ab
bromoxynil	.42	29.7	9.1 abc	4.3 c	84.1 ab
bromoxynil	.56	17.9	12.0 abc	1.2 c	123.4 a
untreated control		25.6	16.1 a	30.2 b	8.1 b

Numbers in a column followed by the same letter are not significantly different according to DMRT (0.05).

Weed control with a trifluralin/metribuzin granule in alfalfa. Bell, C. E., B. R. Tickes, and C. E. Engle. Winter annual weeds are common problems in alfalfa hay crops in the valleys along the lower Colorado River. This experiment was conducted to investigate the efficacy of a granular formulation of trifluralin (10%) and metribuzin (3%) applied preemergence to the weeds in established alfalfa. This research was done at the University of California Desert Research and Extension Center in Holtville, CA.

The alfalfa field was in the fourth year of production. Experimental design was a randomized complete block with four replications. Plot size was 5.2 m by 60 m. Application of herbicides was with a ground driven, air assisted, granular spreader on October 28, 1991. The crop had recently been harvested, there was very little regrowth when the herbicides were applied.

Weed control was assessed visually for the two most prevalent species on November 25, 1991. The weeds present were annual sowthistle and creeping wartcress. Crop and weed biomass samples were taken as a measure of weed control efficacy and crop phytotoxicity. Weed biomass was collected on December 20, 1991 and on March 11, 1992. Crop biomass was taken on March 11. Samples were a composite of 5, .05 m^2 subsamples per plot. These subsamples were dried at 50° C for 3 days before weighing.

The visual evaluation suggested that the herbicide treatments were controlling both weeds well, with the exception of annual sowthistle at the lower rates. Quantitative measurements, however, did not support the visual data. It appeared to the authors that the herbicide treatments had reduced the weed population in the treated plots, but that the remaining weeds had grown sufficiently to compensate for the decreased density. (Cooperative Extension, University of California, Holtville, CA 92250, Cooperative Extension, University of Arizona, Yuma, AZ 85364, and Miles, Inc., Fallbrook, CA 92028.)

Weed control in established alfalfa with a trifluralin/metribuzin granule in Holtville, CA

Treatment	Rate kgai/ha	Weed control[a] SONOL	COPSQ	Biomass[b] Weeds 12/20	3/11	Alfalfa 3/11
		%				
trif/metr[c]	1.12/.34	62	82	77.9	124.1	56.0
trif/metr	2.24/.68	82	92.5	60.2	139.6	93.0
untreated control		0	0	83.9	107.8	60.2
	LSD (0.05)			ns	ns	ns

a - SONOL = annual sowthistle, COPSQ = creeping wartcress

b - biomass = grams dry weight per .25 m^2, mean of four replications.

c - trif/metr = granular formulation of 10% trifluralin plus 3% metribuzin.

Summer annual grass control in established alfalfa. Bell, C.E., B. R. Tickes, and N. Jackson. Summer annual grasses are common to most alfalfa fields in the Lower Colorado River Desert. These grasses are controlled by preemergence applications of trifluralin granules, by postemergence application of sethoxydim, or combinations of the two herbicides. The purpose of this experiment was to compare an experimental herbicide, MON13200, in various formulations, to trifluralin and sethoxydim. This project was conducted at the University of California Desert Research and Extension Center in Holtville, CA.

The alfalfa field was in the third year of production and known to have an infestation of the two most common summer annual grasses in this desert, junglerice and prairie cupgrass. Experimental design was a randomized complete block with three replications. Plot size was 5 m by 15 m. Application of preemergence herbicides was on March 6, 1992. Sethoxydim application was on June 22, 1992 and included a crop oil concentrate surfactant at 2.5 l/ha. Carrier volume for liquid treatments was 215 l/ha at 138 kPa pressure using 8002LP flat fan nozzles. Granules were applied with a ground driven, air assisted, spreader.

Weed control was assessed visually four times (see Table 1. below). Consistent control of these summer annual grasses was accomplished by the granular formulations of the MON13200, the highest rate of the water dispersible granule formulation (WDG), and the trifluralin granules. The exception was the 0.056 kgai/ha rate of the 5G MON13200, which did not control the grasses well. This may have been due to an error in application, it was not consistent with other results. The sethoxydim treatment did not control these grasses well in this experiment.

Crop and weed biomass were assessed at each harvest by taking four .25 m^2 subsamples per plot. Alfalfa and grass were separated in each subsample, dried at 50^{o} C for three days, and weighed. There were no significant differences ($P > 0.05$) at any harvest between alfalfa weights (Table 2). Biomass of the summer annual grasses did vary between treatments at the third and fourth harvests. Grass population variability was such that it is difficult to demonstrate statistically significant differences when there are large numerical differences. In general, the grass biomass appears to be correlated to the visual evaluation of weed control. (Cooperative Extension, University of California, Holtville, CA 92250, Cooperative Extension, University of Arizona, Yuma, AZ, and85364, and Monsanto Agricultural Co., Corona, CA 91719.)

Table 1. Summer annual grass control in established alfalfa in Holtville, CA

Treatment	Rate kgai/ha	Weed Control May 1	May 28	Aug 5	Aug 25
		%			
MON13203 5G	0.028	100	100	93	95
MON13203 5G	0.042	100	75	91	95
MON13203 5G	0.056	100	25	87	79
MON13203 5G	0.084	100	100	99	100
MON13256 4G	0.028	100	96	98	96
MON13280 50WDG	0.021	100	55	50	70
MON13280 50WDG	0.028	100	70	83	77
MON13280 50WDG	0.042	100	75	93	95
Trifluralin 10G	2.24	100	99	98	97
Sethoxydim	0.042	0	0	75	61
untreated control		0	0	0	0

Table 2. Alfalfa biomass as affected by herbicide treatment in Holtville, CA

Treatment	Rate kgai/ha	Alfalfa biomass g/m^2 May 6	June 8	July 17	Aug 25
MON13203 5G	0.028	206.7	315.7	270.9	195.8
MON13203 5G	0.042	232.0	324.4	215.7	146.9
MON13203 5G	0.056	256.7	360.3	243.3	169.9
MON13203 5G	0.084	253.4	289.0	272.1	191.4
MON13256 4G	0.028	236.2	320.9	278.3	162.2
MON13280 50WDG	0.021	213.1	318.9	225.3	153.9
MON13280 50WDG	0.028	250.1	324.7	277.6	130.2
MON13280 50WDG	0.042	235.9	371.8	252.8	178.9
Trifluralin 10G	2.24	218.9	327.9	241.3	172.0
Sethoxydim	0.042	258.0	303.9	240.7	184.9
untreated control		273.9	340.1	266.2	168.7
	LSD(0.05)	ns	ns	ns	ns

Table 3. Summer annual grass biomass as affected by herbicide treatment in Holtville, CA

Treatment	Rate kgai/ha	Grass biomass g/m^2 May 6	June 8	July 17	Aug 25
MON13203 5G	0.028	0	0	0 c	0 b
MON13203 5G	0.042	0	0	0.8 bc	37.8ab
MON13203 5G	0.056	0	0	5.7a	78.8ab
MON13203 5G	0.084	0	0	0 c	0 b
MON13256 4G	0.028	0	0	0 c	0 b
MON13280 50WDG	0.021	0	7.8	3.0abc	71.1ab
MON13280 50WDG	0.028	0	0	0.5 bc	74.3ab
MON13280 50WDG	0.042	0	0	0.5 bc	18.0ab
Trifluralin 10G	2.24	0	0	0.7 bc	7.9 b
Sethoxydim	0.042	0	10.2	2.1abc	47.9ab
untreated control		0	10.6	4.0ab	118.9a
	LSD(0.05)	ns	ns	3.6	95.0

Numbers in a column followed by the same letter are not significantly different according to DMRT(0.05)

Dodder control in seed alfalfa. Dewey, S.A., J.O. Evans, J.A. Gale and R.W. Mace. Many herbicides used to control dodder in alfalfa have been eliminated. Alfalfa seed production in Utah still requires attention to dodder control. Six herbicides were applied on a mature stand of seed alfalfa at Delta, Utah to evaluate their efficacy on dodder.

The plots were arranged in a randomized complete block design with three replications. The soil was an alluvial silty clay loam. The herbicides were applied on April 24, 1992 using a bicycle sprayer with 8001 flatfan nozzles spaced every eighteen inches on a ten foot boom. At 39 psi, sixteen gallons per acre of spray was distributed on plots 10 by 30 feet. The granular herbicides were mixed with sand and spread uniformly in three passes on each plot. The alfalfa stand was eight years old and was lightly infested with white top, dandelion and kochia. The treatments were applied immediately after the first cutting and were flood irrigated four days later with eight inches of water.

The treatments were evaluated mid-season and at seed harvest by counting the number of dodder plants within each plot. Dodder stand counts were compared to the non-treated checks and converted to percent control. The dodder infestation in the control plots was light, averaging one to two plants per square meter.

Trifluralin in granular form and pendimethalin were superior to other treatments, at both rates of application, in controlling dodder at mid season and at harvest. There was no evidence of crop injury due to treatments. The MON 13000 products at the higher rates also performed well. The emulsifiable concentrate MON 13200 appeared more effective than other formulations. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Dodder control in seed alfalfa
Delta, Utah

Treatment	Rate (lb ai/A)	Dodder control 7-9-92	Dodder control 9-12-92
		-----% of ck-----	
Trifluralin EC	1.0	45	15
Trifluralin EC	2.0	87	58
Trifluralin G	2.0	88	91
Trifluralin G	4.0	96	97
Pendimethlin EC	2.0	99	89
Pendimethlin EC	4.0	97	95
Pronamide EC	3.0	50	58
Pronamide EC	4.0	61	54
MON 13200 EC	0.5	65	57
MON 13200 EC	1.0	94	93
MON 13280 DF	0.5	74	66
MON 13280 DF	1.0	74	82
MON 13203 G	0.5	18	14
MON 13203 G	1.0	78	79
Imazethapyr EC	0.063	8	14
Imazethapyr EC	0.094	12	11
Check		0	0
LSD (.05)		30	40

Broadleaf and grass weed control in seedling alfalfa. Stephens, R., R. W. Downard and D. W. Morishita. An experiment was conducted at the Kimberly Research and Extension Center to evaluate crop tolerance and weed control with imazethapyr and two adjuvants, as well as metribuzin and bromoxynil. Alfalfa (var. 'WL 320') was planted May 7, 1992, at 15 lb/A. Plots were 8 by 25 ft and herbicide treatments were arranged in a randomized complete block design with four replications. Soil type was a Portneuf silt loam with a pH of 8.0, 1.45% o.m., and CEC of 15 meq/100 g soil. Herbicides were applied with a hand-held sprayer with 11001 flat fan nozzles and 16-inch spacing at 10 gpa. Application data are listed on Table 1. Visual evaluations for crop injury and weed control were made June 22 and July 6. Plots were harvested August 23 and the alfalfa was separated from the broadleaf and grass weeds by hand.

Bromoxynil and bromoxynil + metribuzin injured the alfalfa compared to the check. The observed injury may be attributed to very high winds immediately after application and irrigation the day after application. Redroot pigweed (AMARE) and common lambsquarters (CHEAL) were best controlled with tank mixtures of imazethapyr + 2,4-DB or bromoxynil using SUN-IT II + 28% N at 1 pt + 1 qt/A as the adjuvants. None of the herbicide treatments satisfactorily controlled either barnyardgrass (ECHCG) or green foxtail (SETVI). Imazethapyr at 0.75 to 1.5 oz ai/A + SUN-IT II at 1.0 or 2.0 pt/A + 28% N at 1 qt/A controlled the two grass species best, but the average weed control was barely acceptable. The check had the highest total forage yield among all treatments. The highest alfalfa yielding treatments included those containing imazethapyr + SUN-IT II + 28% N. (Dept. of Plant, Soil, and Entomological Sciences, Univ. of Idaho, Twin Falls, ID 83303).

Table 1. Application data information.

Application date	6/5	6/12
Air temperature	67	76
Application timing	Post	4-5 trifoliate
Soil temperature (F)	60	82
Relative humidity (%)	33	20
Wind velocity (mph)	0 to 2	4 to 14

Table 2. Evaluation of postemergence herbicides for weed control in alfalfa near Kimberly, Idaho.

			Weed Control[1]										Yield			
			Crop Injury		AMARE		CHEAL		ECHCH		SETVI		Alfalfa	Grass	Broadleaf	Total
Treatment	Rate	Timing	6/22	7/6	6/22	7/6	6/22	7/6	6/22	7/6	6/22	7/6	7/23			
	(oz ai/A)		%										lb/A			
Check			0	0	0	0	0	0	0	0	0	0	441	1993	3262	5696
Imazethapyr +	0.75	Post	0	1	46	46	11	0	20	35	20	30	761	1811	1966	4537
Surfactant[2]	0.25															
28% N[3]	1.0															
Imazethapyr +	1.0	Post	1	0	41	45	10	5	31	49	29	49	1111	1567	1982	4659
Surfactant	0.25															
28% N	1.0															
Imazethapyr +	1.5	Post	0	0	49	59	0	0	33	55	33	55	816	1374	1602	3792
Surfactant	0.25															
28% N	1.0															
Imazethapyr +	0.75	Post	0	0	43	66	0	0	26	53	26	53	1217	1367	1859	4443
SUN-IT II[4]	1.0															
28% N	1.0															
Imazethapyr +	1.0	Post	0	0	81	89	3	13	39	64	39	64	717	1305	1300	3322
SUN-IT II	1.0															
28% N	1.0															
Imazethapyr +	1.5	Post	0	0	79	91	10	10	59	73	59	73	1437	1167	1622	4225
SUN-IT II	1.0															
28% N	1.0															
Imazethapyr +	0.75	Post	0	1	78	86	34	3	68	73	68	73	1272	1026	1243	3540
SUN-IT II	2.0															
28% N	1.0															
Imazethapyr +	1.0	Post	0	4	70	90	6	10	34	69	34	69	1491	983	995	3469
SUN-IT II	2.0															
28% N	1.0															
Imazethapyr +	1.5	Post	0	1	76	90	50	10	29	53	34	53	1016	1189	773	2979
SUN-IT II	2.0															
28% N	1.0															

Table 2 Cont.

					Weed Control[1]								Yield			
			Crop Injury		AMARE		CHEAL		ECHCH		SETVI		Alfalfa	Grass	Broadleaf	Total
Treatment	Rate	Timing	6/22	7/6	6/22	7/6	6/22	7/6	6/22	7/6	6/22	7/6	7/23			
	(oz ai/A)		%										lb/A			
Imazethapyr +	1.0	Post	1	1	58	51	66	68	38	64	39	64	902	1572	744	3217
2,4-DB	4.0															
Surfactant	0.25															
28% N	1.0															
Imazethapyr +	1.0	Post	0	0	75	85	75	95	35	49	35	49	1195	1743	698	3635
2,4-DB	4.0															
SUN-IT II	1.0															
28% N	1.0															
Imazethapyr +	1.0	Post	4	3	66	83	70	58	25	38	25	38	752	1480	486	2717
bromoxynil	2.0															
Surfactant	0.25															
28% N	1.0															
Imazethapyr +	1.0	Post	4	1	85	82	81	81	43	44	43	44	692	2133	336	3160
bromoxynil	2.0															
SUN-IT II	1.0															
28% N	1.0															
Metribuzin	3.0	4-5 trifol	0	1	28	8	28	23	4	3	4	3	752	1627	1509	3887
Bromoxynil	4.0	4-5 trifol	13	5	58	25	69	55	0	0	0	0	278	2750	1132	4161
Metribuzin +	3.0	4-5 trifol	29	16	48	15	75	60	21	5	21	5	173	2862	1248	4283
bromoxynil	0.125															
LSD (0.05)			8	5	25	23	24	30	23	22	23	21	705	912	1005	1305

[1]Weed evaluated for control were redroot pigweed (AMARE), common lambsquarters (CHEAL), barnyardgrass (ECHCG), and green foxtail (SETVI).
[2]Nonionic surfactant was applied at 0.25% v/v.
[3]28% N was applied at 1.0 qt/A.
[4]SUN-IT II was applied at 1.0 or 2.0 pt/A.

Herbicide evaluation for season-long control in alfalfa. Norris, R.F., J.A. Roncoroni, and E.J. Roncoroni. Various herbicides were applied alone and in combination to an established alfalfa field on U C Davis experimental farm to determine their effectiveness in the control of yellow foxtail. Plots 25 ft by 8 ft with 4 replications were established in a randomized complete block design. Treatments were applied with a CO_2 backpack sprayer set at 30 psi with 4-8003 flat fan nozzles delivering 30 gpa to a strip 7 ft wide through the plot. Herbicide rates evaluated, and application dates are listed in the table.

Yellow foxtail emergence began before the trifluralin application on February 6, 1992. It was fully emerged and growing at 3-4 inches at the time of the trifluralin and metribuzin treatments of April 24, 1992. The first three cuttings of the alfalfa were April 20, May 15,and June 4,1992.

Visual ratings made using a 0-10 scale(0-no control; 10 complete control) were taken on three dates: June 13; July 18; and November 9, 1992. Ratings and mean seperations by Duncan's Multiple Range test are listed in the table.

Analysis of the data shows that MON-13203 treatments of at least 0.5 lb/a a.i., alone or in combination with other herbicides, were the best treatments for the duration of the trial. The poor performance of the trifluralin and metribuzin treatments was attributed to the emergence of yellow foxtail prior to application. (Section of Botany, University of California, Davis).

Table. Evaluations of herbicide treatments for yellow foxtail control in alfalfa.

Treatment[2]	Rate (lb/a)	Application dates			Foxtail control ratings[1]		
					6/13	7/18	10/9
hexazinone	0.5	1/17/92			1.5 def	0.75 de	0.75 ef
trifluralin	1		2/6/92		1.5 de	0.75 de	1.25 e
sethoxydim	0.33 + 0.33		5/4/92	6/23/92	8.5 b	9.5 a	6.25 c
hexazinone + trifluralin	0.5 + 1	1/17/92	2/6/92		1.0 ef	1.25 d	3.5 d
hexazinone + (sethoxydim)	0.5 + (0.33 + 0.33)	1/17/92	(5/4/92)	(6/23/92)	6.75 c	9.25 ab	5.25 cd
trifluralin	2		4/24/92		3.25 d	7.25 c	7.0 bc
metribuzin	0.6		4/24/92		0.5 ef	0.0 e	3.75 fg
trifluralin + metribuzin (10 + 3 granules)	(2 + 0.6)		4/24/92		3.25 d	6.5 c	6.75 bc
MON-13023	0.25	11/20/91			9.0 ab	8.5 bc	7.0 bc
MON-13023	0.5	11/20/91			9.75 ab	9.75 a	8.5 ab
MON-13023	1	11/20/91			9.75 ab	9.75 a	9.25 a
MON-13023 + trifluralin	0.5 + 1	11/20/91	2/6/92		9.5 ab	9.25 ab	8.5 ab
MON-13023 + (sethoxydim)	0.5 + (0.33 + 0.33)	11/20/91	(5/4/92)	(6/23/92)	10.0 a	10.0 a	9.25 a
hexazinone	0.5	1/17/92			1.0 ef	0.25 de	1.0 ef
untreated					0.75 ef	0.5 de	0.25 fg
untreated					0.25 f	0.0 e	0.0 g

[1]Ratings average of 4 replications; based on visual evaluations conducted on a 0 to 10 scale (0=no foxtail control, 10=complete control). Values followed by the same letter do not differ significantly at the 5% level.
[2]Sethoxydim applied with crop oil at 1 quart/acre. Trifluralin alone applied as 10% granules.

Annual weed control in spring-seeded seedling alfalfa. S.B. Orloff and D.W. Cudney. Annual weeds can be a serious problem during alfalfa stand establishment in the intermountain valleys of northern California. Two trials were established in spring seeded alfalfa. The first trial was established on May 14, 1992 in an alfalfa field in the fourth trifoliate leaf stage. There was a broad spectrum of broadleaf weeds consisting of redmaids (4" diam), henbit (1-2" tall), knotweed (3-4" tall), wild buckwheat (3-4" tall), wild radish (8-10" diam.), lambsquarter (1.5-2" tall), redstem filaree (4" diam), and hairy nightshade (3" diam.). The second trial was established on July 14, 1992. The alfalfa was in the 3-5 trifoliate leaf stage. Weeds present were hairy nightshade (2" tall), redroot pigweed (1-3" tall), lambsquarter (3-4" inches tall), and oats (3 leaf stage). Plots in both trials measured 10 by 20 feet and were replicated four times. Applications were made using a CO_2 pressurized backpack sprayer calibrated to deliver 20 gallons of spray solution per acre at 30 psi. The herbicides tested included imazethapyr with a nonionic surfactant, x-77, and a new sunflower oil-based adjuvant, Sunit. Bromoxynil was tested at two rates, 0.25 and 0.375 lb ai/A. 2,4-DB amine was evaluated at 0.75 lb ai/A both with and without an adjuvant (X-77 at 0.25%). A combination of imazethapyr and bromoxynil was also evaluated.

No significant alfalfa injury was observed in either trial. In the first trial in Scott Valley, the alfalfa and weeds were moisture stressed before and after treatment which may account for reduced control of many of the weeds present in this trial. The second trial in Butte Valley was well irrigated and control of weeds common to both trials was improved. Imazethapyr was the most effective herbicide for the control of red-maids, henbit, wild buckwheat, wild radish, and filaree. There was a trend for greater weed control with increasing rate of imazethapyr. Imazethapyr plus Sunit tended to be more effective than imazethapyr plus X-77. However, this difference was not consistent and was not always statistically significant. Bromoxynil was most effective for the control of lambsquarters and hairy nightshade but did not control filaree. Weed control with 2,4-DB amine was improved when a nonionic surfactant was added. None of the herbicides or herbicide combinations controlled 100% of the weeds. However, the overall most effective treatment on a broad spectrum of weeds was the combination of imazethapyr and bromoxynil.

Control[1] of Annual Weeds in Spring Seeded Alfalfa, Scott Valley

Treatment	Rate lb/a	Alfalfa Injury 8/13	Alfalfa Injury 8/31	Hairy Nightshade 8/13	Redroot Pigweed 8/13	Redroot Pigweed 8/31	Lambsquarters 8/13	Lambsquarters 8/31	Oats 8/13	Oats 8/31
Imazethapyr	0.047	0.1	0.1	6.5	7.5	10.0	5.5	6.0	4.8	4.8
Imazethapyr	0.063	0.9	0.0	7.4	8.3	10.0	5.5	5.0	5.8	6.3
Imazethapyr	0.094	1.8	1.4	7.9	9.3	10.0	7.0	6.8	6.4	6.5
+Adjuvant[2]	0.047	1.1	0.1	8.3	8.5	9.0	6.5	6.8	5.3	4.9
+Adjuvant[2]	0.063	0.9	0.4	7.3	9.1	10.0	5.8	6.8	4.0	3.5
+Adjuvant[2]	0.094	1.0	0.4	9.1	9.3	10.0	8.9	8.0	4.6	5.6
Bromoxynil	0.25	0.6	0.0	9.5	4.3	5.8	10.0	10.0	0.5	0.8
Bromoxynil	0.375	1.0	0.5	10.0	5.0	6.0	10.0	10.0	0.0	0.8
2,4-D B amine	0.75	1.1	0.0	9.6	8.6	10.0	9.0	10.0	1.8	1.0
2,4-D + x77	0.75	0.5	0.0	10.0	8.8	10.0	10.0	10.0	0.0	0.0
Imazethapyr + Bromoxynil	0.63+.125	0.4	0.0	10.0	10.0	10.0	10.0	10.0	3.3	4.3
Check		0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LSD 0.05		0.7		1.3	1.1	1.1	1.6	1.4	2.5	2.3

Control[1] of Annual Weeds in Spring Seeded Alfalfa, Butte Valley

Treatment	Rate lb/a	Red Maids	Henbit	Prostrate Knotweed	Wild Buckwheat	Wild Radish	Lambs-quarter	Redstem Filaree	Hairy Nightshade
Imazethapyr	0.047	3.8	4.1	1.5	0.5	6.1	1.8	6.0	3.0
Imazethapyr	0.063	5.9	5.4	3.0	5.5	7.3	2.3	8.5	7.9
Imazethapyr	0.094	7.8	7.0	3.0	5.5	7.9	3.1	8.8	6.3
+Adjuvant[2]	0.047	7.5	6.4	3.5	5.3	8.3	3.8	7.8	6.3
+Adjuvant[2]	0.063	8.0	5.8	3.5	6.0	8.8	3.3	9.3	6.3
+Adjuvant[2]	0.094	8.1	6.8	3.5	6.5	9.0	3.5	9.1	7.5
Bromoxynil	0.25	3.8	2.3	1.4	3.8	4.8	10.0	0.0	8.6
Bromoxynil	0.375	6.3	4.3	2.3	5.8	5.8	10.0	0.0	10.0
2,4-D B amine	0.75	2.3	1.8	0.5	0.8	1.5	4.0	1.0	7.5
2,4-D + x77	0.75	3.5	2.3	7.3	1.0	1.9	7.5	2.5	8.4
Imazethapyr + Bromoxynil	0.63+ 0.125	6.8	7.3	3.0	6.3	7.9	7.9	6.0	9.1
Check		0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0
LSD 0.05		1.7	1.7	2.0	1.4	1.6	1.6	1.9	2.0

1 0 = no effect, 10 = all plants dead
2 Sunit

Weed control and seedling alfalfa yield response to postemergence imazethapyr treatments. Ransom, C.V. , J.O. Evans, and S.A. Dewey. Applications of various herbicide and surfactant rates and a tank mix of imazethapyr were applied to 10 by 30 ft plots of 'WL 316' alfalfa. The herbicides were applied May 25, 1992 using a bicycle sprayer delivering 16 gpa at 40 psi through 80015 flat fan nozzles spaced 18 inches apart.

The number of weeds was determined by counting them in a square meter quadrat randomly placed in each plot and recording the number and weed species present. Counts were taken pre-application, 2 and 4 weeks post- application, and 2 weeks after first harvest. Each weed count was taken from the same location within plots. Yield data was collected by harvesting the one square meter plots used to conduct weed counts. Yield samples were separated into alfalfa and weeds, the samples were dried and weighed, and the alfalfa and weed samples were recombined prior to grinding and analysis using NIRS. The table reflects only the first cutting yields and one weed count taken 4 weeks after herbicide application. (Utah Agricultural Experiment Station, Logan, Utah 84322-4820) .

Alfalfa yield and numbers of weeds in response to postemergence herbicide applications to seedling alfalfa, Smithfield, Utah

		Yield		Weed counts		
Herbicide	Rate	Alfalfa	Weed	CAPBP	CHEAL	SETVI
	(lb ai/A)	----kg/ha----		-------- number/3m^2 --------		
Imazethapyr X-77, (0.25%) N28%, (1 pt/A)	0.047	4210	70a	6a	9	34
Imazethapyr X-77, (0.25%) N28%, (1 pt/A)	0.063	4028	1a	1a	7	1
Imazethapyr SUN-IT, (1 pt/A) N28%, (1 pt/A)	0.047	4264	2a	17a	16	5
Imazethapyr SUN-IT, (1 pt/A) N28%, (1 pt/A)	0.063	3542	11a	24a	5	34
Imazethapyr 2,4-DB amine X-77 , (0.25%) N28%, (1 pt/A)	0.063 0.25	3975	37a	29a	8	56
Imazethapyr X-77, (0.25%)	0.063	4393	57a	9a	15	3
N 28%, (1 pt/A)	-	4186	169ab	99b	22	5
Control	-	4302	320b	89b	18	71
LSD (0.05)		NS	177	17	NS	NS

Yellow foxtail control with Mon 13200 (thiazopyr). Vargas, Ron. A two year old stand of Falcon nondormant alfalfa, known to be infested with yellow foxtail, was divided into plots 10 by 50 feet and replicated three times in a randomized complete block design. Herbicides were applied on February 2, 1992 with a Gandy airflow applicator and a CO_2 plot sprayer calibrated at 26 psi delivering 12 gal/a. Yellow foxtail had not germinated at the time of application.

An evaluation on May 8 indicated 100 percent control of yellow foxtail with all treatments except the 0.25 and 0.38 lb ai/a rate of Mon 13203 and hexazinone. Control declined with all treatments into mid June. Most treatments were giving poor to fair control on August 13. The 1.00 lb ai/a rate of both Mon 13203 and 13280 were providing acceptable control at 83 and 90 percent respectively. Hexazinone did not enhance control of either thiazopyr formulation when applied as a tank mix.

Yellow Foxtail Control

Herbicide	Rate	May 8	Control June 25	August 13
	(lbs ai/a)		%	
Mon 13203-5G	.25	73	70	46
Mon 13203	.38	66	90	50
Mon 13203	.50	100	86	70
Mon 13203	.75	100	90	76
Mon 13203	1.00	100	93	83
Mon 13280-DF	.25	100	90	73
Mon 13280	.38	100	90	73
Mon 13280	.50	100	93	76
Mon 13280	.75	100	90	86
Mon 13280	1.00	100	100	90
Mon 13203+hexazinone	.25 + .7	100	90	66
Mon 13203+hexazinone	.38 + .7	100	86	76
Mon 13203+hexazinone	.50 + .7	100	76	86
Mon 13280+hexazinone	.25 + .7	100	96	43
Mon 13280+hexazinone	.38 + .7	100	86	76
Mon 13280+hexazinone	.50 + .7	100	96	63
hexazinone	.7	13	26	40
control	--	0	0	0

Hoary cress control in alfalfa with imazethapyr. Zamora, D.L. To determine the effectiveness of imazethapyr for controlling hoary cress (*Cardaria draba*) in dryland alfalfa a trial was established near Lewistown, Montana.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 25 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied on 6/9/92 to hoary cress in the flowering stage of growth. The alfalfa had been established for one year. A visual estimate of control (necrosis, chlorosis, growth reduction) and alfalfa injury was made on 6/24/92. Seeds were collected from randomly selected plants in each plot for determination of percentage germination. The seed was placed on moistened filter paper in petri dishes and maintained at room temperature (70 F).

The hoary cress and alfalfa were drought stressed at the time of application. There was virtually no control of mature hoary cress; however, the few young hoary cress plants observed were severely injured by imazethapyr. Alfalfa injury was negligible. No seeds germinated from any treatment. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Effect of imazethapyr[1] on hoary cress at Lewistown, MT.

Rate	Alfalfa injury	Control
(lbs ai/a)	(%)	(%)
0.47	1	0
0.063	0	0
0.094	2	0
Check	0	0
LSD (0.05)	N.S.	N.S.

[1] All treatments included a nonionic surfactant with at least 80% active ingredient at 0.5% v/v.

Spring seedling alfalfa herbicide trial. Canevari, M., D. Colbert. A postemergence herbicide trial was established to evaluate various rates and combinations of bromoxoynil, imazethapyr and clethodim in spring planted alfalfa. The experiment was a randomized complete block design with four replications. Plots were 10 ft by 20 ft. Treatments were made on 3/19/92 with CO_2 sprayer at a spray volume of 20 gpa using 8002 flat fan nozzles. Evaluations were made twice, 14 and 26 DAT.

Summary

Bromoxynil at both use rates (.25 and .375 lb/ai) gave excellent control of smartweed, mustard and 80% control of knotweed at the .375 rate and 11% crop injury with the EC formulation. The A.S. formulation of bromoxynil increased crop injury by 10%. When the combination of bromoxynil plus clethodim was used a 15% control loss on knotweed was observed. The negative effect from this tank mix was not apparent on other weed species.

Imazethapyr provided excellent control of all weeds. Excellent weed control was shown in the combination of imazethapyr + bromoxynil with little crop injury at rates of .063 + .188 ai respectively. A significant increase in crop injury was noted in the spring months when the crop oil concentrate Sunit II was used with imazethapyr at the highest rates. Under warmer temperature conditions it appears that a lower rate of imazethapyr can be used with Sunit II at 1.5 pt acre and still achieve excellent control. (University of California Cooperative Extension, Stockton, CA 95205).

Crop/weeds population

Alfalfa		3-5 trifoliate	1-4" ht.
Knotweed	Polygonum aviculare L.	5-9 leaf	½ - 4" ht.
Mustard	Brassica nigra	4-8 leaf	5 - 8" ht.
Shepherdspurse	Capsella bursa-pastoris	6-10 leaf	1 - 4" dia.
Canarygrass	Phalaris minor Retz.	3 leaf tillered	1 - 5" ht.
Smartweed	Polygonum amphibium L.	3-4 leaf	2-4" dia.
Chickweed	Stellaria media		2 - 4" ht.

RATING SCALE	
0 =	No crop injury, weed control
100 =	Crop, weeds dead
X77 =	Surfactant
COC =	Agridex
Sunit II =	COC methylated sunflower oil

% CONTROL

Treatments	Rate ai/acre	Crop Injury	Knotweed		Smartweed		Canary grass	Mustard		Shepherds purse	Chick weed
		4/14	4/2	4/14	4/2	4/14	4/14	4/2	4/14	4/2	4/2
Bromoxynil	.25	8	83	69	100	99	0	100	100	100	28
Bromoxynil	.375	10	87	80	100	100	0	100	100	100	0
Bromoxynil Imazethapyr + x77 ¼%	.187 .063	13	94	93	100	100	88	98	100	100	100
Bromoxynil Imazethapyr + x77 ¼%	.25 .063	23	96	97	100	100	80	100	100	100	100
Bromoxynil Imazethapyr + x77 ¼%	.25 .045	20	91	87	100	100	70	100	100	100	98
Bromoxynil Clethodim coc 1 qt	.25 .188	12	58	53	100	100	100	100	100	100	17
Bromoxynil Clethodim coc	.375 .188	21	82	70	100	100	100	100	100	100	15
Imazethapyr x77 + Clethodim	.063 .188	16	82	90	94	100	100	80	99	87	97
Clethodim + coc	.188	0	0	0	0	0	100	0	0	0	0
Imazethapyr + x77 2,4-DB	.063 .5	22	81	88	93	100	75	94	98	85	92
Clethodim + coc 2,4-DB	.188 .5	12	40	75	63	40	100	55	75	53	22
Imazethapyr Sunit	.063 1.5 pt/a	27	82	96	90	100	94	88	100	87	92
Imazethapyr Sunit	.094 1.5 pt/a	33	85	95	98	100	96	90	100	92	99
Imazethapyr Bromoxynil Sunit	.063 .187 1.5 pt/a	20	94	91	100	100	91	100	100	100	100
Imazethapyr + x77 ¼%	.094	20	79	97	93	100	92	90	100	85	95
Imazethapyr + x77 ¼%	.045	13	73	93	92	100	83	78	93	83	96
Imazethapyr + Sunit	.045 + 1.5 pt/a	10	87	80	91	100	70	85	100	91	92
Check		0	0	0	0	0	0	0	0	0	0

Postemergence weed control in seedling alfalfa. Canevari, M., D. Colbert. This experiment was a randomized complete block design with four replications. Plots were 10 ft by 20 ft in size. A postemergence application of four herbicides was made to seedling alfalfa on 12/13/92 with a CO_2 sprayer at a 30 gpa volume. Evaluations were made 47 and 82 DAT on weed control and crop injury. Comparisons of two adjuvants, x77 surfactant and Sunit II crop oil concentrate were compared to three rates of imazethapyr. Sunit II is a methylated sunflower oil.

Summary

Good control was achieved with gramoxone at .25 ai on shepherdspurse, chickweed, groundsel and bluegrass and fair to poor control on other weed species. Bromoxynil provided excellent control on shepherdspurse, swinecress, groundsel, and thyme leaf speedwell and no control of remaining weeds. 2,4-DB gave poor control to most weed present. Imazethapyr provided good control to most weeds at the high use rate of .094 lb. a.i. plus Sunit II 1 pt acre. Sunit II improved the weed control over x77 by an average of 15%. Crop injury increased 5% with the use of Sunit II but was still in the acceptable range for seedling alfalfa.

Where winter conditions of cold and foggy weather exist, the use of new improved crop oil concentrate such as Sunit II appear to enhance certain type herbicides such as in the case of imazethapyr. (University of California Cooperative Extension, Stockton, CA 95205).

Crop/weeds population and size

Shepherdspurse	Capsella bursa	8-10/sq ft	6-9 leaf	1½ - 3" dia.
Swinecress	Coronopus didymus	2/sq ft	7-10 leaf	1½ - 3" dia.
Chickweed	Stellaria media	5 sq ft		1-2" stems
Groundsel	Senecio vulgaris	1 sq ft	4-6 leaf	1 - 2½" ht.
Henbit	Lamium amplexicaule	½ sq ft	4-8 leaf	½" ht
Bluegrass	Poa annua	2 sq ft	3 tillers	1" ht
Malva	Malva parviflora	1 sq ft	4-6 leaf	2 - 3" ht
Burning nettle	Urtica urens	.1 sq ft	6-10 leaf	2" ht
Redstem filaree	Erodium cicutarium	.5 sq ft	4-6 leaf	3-6" dia

Treatments	Lb/ai Rate	% Crop Injury		Shepherds-purse		Burning nettle	Swine Cress	Chickweed		Groundsel		Malva		Redstem Filaree	Blue grass	Henbit
		1/29	3/4	1/29	3/4	1/29	1/29	1/29	3/4	1/29	3/4	1/29	3/4	1/29	1/29	1/29
Imazethapyr x77	.047	2	0	48	25	43	39	59	35	43	35	55	28	38	15	33
Imazethapyr x77	.063	6	0	54	50	53	48	69	54	54	35	56	45	56	20	43
Imazethapyr x77	.094	11	2	70	68	67	56	81	61	65	53	68	60	56	38	53
Imazethapyr + Sunit II	.047	7	7	68	64	51	60	80	61	61	50	63	50	51	18	48
Imazethapyr + Sunit II	.063	10	10	77	79	60	68	86	75	68	55	71	64	68	23	64
Imazethapyr + Sunit II	.094	16	8	85	88	73	78	93	79	76	63	72	62	71	30	63
2,4-DB	1.5	6	7	55	91	25	76	18	5	23	30	28	50	43	0	33
Bromoxynil	.375	6	0	95	99	10	86	0	5	100	90	25	18	0	0	88
Check		0	0	0	0	0	0	0	0	00	0	00	0	0	0	0
Paraquat + x77 ¼%	.125	13	10	73	75	33	44	73	40	83	70	34	5	15	80	5
Paraquat + x77 ¼%	.25	25	20	80	81	61	69	83	50	90	80	35	15	28	84	15

0 = No crop injury, no weed control
100 = Crop and weeds dead

x77 = ¼% by volume
Sunit II = 1 pt acre

Postemergence herbicide and adjuvant comparison in seedling alfalfa. Canevari, M., D. Colbert. Various rates of imazethapyr comparing two adjuvants were evaluated for weed control and crop injury in fall planted seedling alfalfa in San Joaquin County of California. X77 surfactant at .25% was compared to Sunit II crop oil concentrate at .5, 1.0, and 1.5 pts/acre. Treatments were applied on 2/4/92 with a CO_2 sprayer at 30 gpa spray volume to plots 10 ft. by 15 ft. with four replications on a randomized complete block design. Ratings were made on 3/1 and 3/27/92, 26 and 48 DAT.

Summary

Sunit II compared equally with X77 at the .5 pt rate and averaged 11% increased efficacy of imazethapyr on the more difficult controlled weeds (henbit, burning nettle and minerslettuce) at the 1.5 pt rate.

The increased activity obtained with Sunit II at the 1.5 pt acre rate allows a lower use rate of imazethapyr be used on the more susceptible weed types. Where less susceptible weeds exist, or colder weather conditions favor poor control, the higher use rate of Sunit II would be an advantage to the standard surfactant under these conditions.

There was no significant difference in crop injury from the X77 and all rates of Sunit II with colder temperatures. (University of California Cooperative Extension, Stockton, CA 95205).

Crop/weeds

		SIZE/POPULATION		
Alfalfa		90% 3-4 trifoliate	10% 2 trifoliate	
Shepherdspurse	Capsella bursa-pastoris	8/sq. ft.	75% 10-20 leaf	4-6" dia.
Groundsel	Senecio vulgaris L.	2.5/sq. ft.	25% 6-8 leaf	1-2" dia.
Burning nettle	Urtica urens L.	7/sq. ft.	10-16 leaf	1-3" ht.
Henbit	Lamium amplexicaule L.	7/sq. ft.	9-12 leaf	½ - 1½" ht.
Chickweed	Stellaria media	5/sq. ft.	1-3" size	early flowering
Mallow	Malva neglecta	.05/sq. ft.	4-6 leaf	3-5" dia.
Minerslettuce	Montia perfoliata L.	5/sq. ft.	18-20 leaf	3-7" dia.

% Control

		Alfalfa % Crop Injury		Shepherdspurse		Henbit		Chick-weed	Burning nettle		Miners lettuce	Mal-low
Treatment	Rate lb/a	3/1	3/27	3/1	3/27	3/1	3/27	3/27	3/1	3/27	3/13	3/27
Imazethapyr + x77	.047 + .25%	6.3	0	63.8	90.2	70	46.3	51.3	45	35	50	96.5
Imazethapyr + x77	.063 + .25%	15	3.3	71.3	95	76.7	47.5	61.7	58.3	45	75	97
Imazethapyr + x77	.094 + .25%	17.5	8.8	85	98.5	77.5	62.7	81.3	70	42.5	88.8	100
Imazethapyr + Sunit II	.047 + .5 pt/a	7.5	0	67.5	90.3	53.3	57.5	70	52.5	42.5	35	97.7
Imazethapyr + Sunit II	.063 + .5 pt/a	10	6	77.5	92.5	66.3	50.5	65	67.5	37.5	67.5	95.7
Imazethapyr + Sunit II	.094 + .5 pt/a	16.3	14.3	82.5	98	70	53.3	77.7	75	57.5	72.5	98.7
Imazethapyr + Sunit II	.047 + 1.0 pt/a	5	.8	68.8	91.3	50	52.5	63.2	63.3	40	53.3	94.5
Imazethapyr + Sunit II	.063 + 1.0 pt/a	6.3	5	72.5	95	70	50	71.7	70	50	78.3	97.7
Imazethapyr + Sunit II	.094 + 1.0 pt/a	7.5	11.3	83.8	98	71.3	59.5	80.5	72.5	52.5	86.3	96.3
Bromoxynil	.25	0	0	100	92.7	0	40	43.3	0	25	23.3	26.7
Paraquat	.125	3.8	7.5	47.5	70	0	62.7	78.8	10	25	81.3	35
Check		0	0	0	0	0	0	0	0	0	0	0
Imazethapyr + Sunit II	.047 + 1.5 pt/a	3.8	5.0	63.8	97.5	60	53.3	73.2	60	52.5	85	98.8
Imazethapyr + Sunit II	.063 + 1.5 pt/a	6.3	4.3	78.8	98.8	76	60.3	78.3	73.8	56.3	90	100
Imazethapyr + Sunit II	.094 + 1.5 pt/a	11.3	8	84.5	100	75	69.3	83.2	77	76.5	95	100

0 = No crop injury or weed control
100 = 100% weed control, crop dead

Comparison of imazamethabenz formulations and adjuvants on spring barley. Downard, R. W. and D. W. Morishita. The study was conducted in Blaine County to evaluate crop injury and wild oat (AVEFA) control in spring barley 'Triumph'. Barley was planted April 18 at 110 lb/A. The experiment was a randomized complete block design with four replications. Plots were 8 by 25 feet. Soil texture was a loam with 1.4% o.m. and pH 8.1. Herbicides were applied broadcast with a hand-held sprayer equipped with 11001 flat fan nozzles on 16-inch spacing. The sprayer was calibrated to deliver 10 gpa at 38 psi. Additional application information is presented in Table 2. Wild oats were 1-to 2-leaf at a density of 24 plants/ft^2 and the crop was tillering at application. Crop injury and weed control were evaluated visually on July 24. A small-plot combine was used to harvest plots on August 27.

Crop was not injured by any treatment (Table 2). Wild oat control was significantly better with imazamethabenz + SUN-IT II at all rates compared to imazamethabenz + nonionic surfactant. Imazamethabenz formulation did not affect wild oat control or barley yield. All herbicide treatments had higher grain yields than the check, but yields were not significantly different among herbicide treatments. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	5/22
Air temperature (F)	80
Soil temperature (F)	70
Relative humidity (%)	31
Wind velocity (mph)	0

Table 2. Assert formulation and adjuvant study in spring barley, near Picabo, Idaho.

Treatment	Rate	Adjuvant[1]	Crop injury	AVEFA[2] control	Yield
	(lb ai/A)		------------	% ------------	(bu/A)
Check			0	0	51
Imazamethabenz LC[3]	0.47	NIS	0	43	81
Imazamethabenz LC	0.375	NIS	0	66	70
Imazamethabenz LC	0.31	NIS	0	66	81
Imazamethabenz SG[3]	0.47	NIS	0	59	75
Imazamethabenz SG	0.375	NIS	0	71	72
Imazamethabenz SG	0.31	NIS	0	65	80
Imazamethabenz SG + Difenzoquat	0.23 + 0.5	NIS	0	76	80
Imazamethabenz SG	0.47	MSO	0	97	79
Imazamethabenz SG	0.375	MSO	1	96	76
Imazamethabenz SG	0.31	MSO	1	95	83
Imazamethabenz SG + Difenzoquat	0.23 + 0.5	MSO	0	89	84
Imazamethabenz SG + MCPA LVE	0.375 + 0.5	NIS	0	90	84
Imazamethabenz SG + Bromoxynil & MCPA	0.375 + 0.5	NIS	0	81	84
Imazamethabenz SG + 2,4-D Amine	0.375 + 0.5	NIS	0	76	74
Imazamethabenz SG + Clopyralid & MCPA	0.375 + 0.7	NIS	0	94	79
Imazamethabenz SG + Thifensulfuron & tribenuron + MCPA LVE	0.375 + 0.031 + 0.25	NIS	0	63	76
Imazamethabenz SG + Difenzoquat + Thifensulfuron & tribenuron + MCPA LVE	0.23 0.5 0.031 + 0.25	NIS	1	94	78
Imazamethabenz SG + Thifensulfuron & tribenuron	0.375 + 0.031	NIS	0	68	70
LSD (0.05)			NS	19	18

[1]NIS = Nonionic surfactant added at 0.25% v/v, MSO = Methylate sunflower oil added at 2 pts/A.

[2]Weed species were: Wild oat (AVEFA) control was evaluated July 24.

[3]Formulations used were LC = liquid concentrate and SG = dry flowable

Field bindweed control with BAS 514 in malting barley. Morishita, D. W. and R. W. Downard. Field bindweed is a common problem in small grains. This research was conducted near Twin Falls, Idaho to examine field bindweed control and barley (var. 'Triumph') crop tolerance to BAS 514. Plots were 10 by 25 ft arranged in a randomized complete block design with four replications. Soil texture was a silt loam with a 7.8 pH, 1.5% o.m., and a CEC of 16 meq/100 g soil. Herbicides treatments were applied with a hand-held sprayer at 10 gpa using 11001 flat fan nozzles. Additional application data are shown in Table 1. Crop injury and weed control evaluations were taken on April 24, June 2 and July 28, 1992. Grain was harvested August 7, with a small-plot combine.

Spring treatments injured the crop while fall applied treatments did not (Table 2). Field bindweed and common lambsquarters control was excellent (90 to 100%) with fall applications of BAS 514 applied alone or in combination with 2,4-D or BAS 514 plus glyphosate & 2,4-D. Grain yields of all treatments, except BAS 514 applied alone in the spring were significantly higher than the check. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, Idaho, 83303).

Table 1. Application data.

Application date	10/8/91	4/16/92
Air temperature (F)	67	65
Soil temperature (F)	75	62
Relative humidity (%)	--	43
Wind velocity (mph)	0 to 6	0 to 6

Table 2. Field bindweed control with BAS 514 in malting barley, near Twin Falls, Idaho.

			Crop injury			Weed Control[1]					
						CONAR			CHEAL		
Treatment	Rate	Applic. timing	4/24	6/2	7/28	4/24	6/2	7/28	6/2	7/28	Grain Yield
	(lb ai/A)		%								(bu/A)
Check			0	0	0	0	0	0	0	0	60
BAS 514 + 2,4-D LVE[2]	0.375 + 0.50	Fall	0	0	0	100	88	95	84	90	91
BAS 514 + 2,4-D LVE[2]	0.375 + 0.50	Spring	18	8	0	18	73	80	98	98	104
BAS 514[2]	0.56	Fall	0	0	0	100	95	95	96	100	112
BAS 514[2]	0.56	Spring	11	8	0	11	64	63	93	90	81
Glyphosate & 2,4-D	1.3	Fall	0	1	0	93	84	91	66	81	102
BAS 514 + glyphosate & 2,4-D	0.375 + 1.3	Fall	3	1	0	100	98	96	95	85	114
LSD (0.05)			3	NS	NS	8	13	10	25	13	27

[1]Weeds evaluated for control were field bindweed (CONAR) and common lambsquarters (CHEAL).

[2]Sunit II added at 1 pt/A.

MCPA and 2,4-D formulations for broadleaf weed control in spring barley. Thompson, C.R. and D.C. Thill. A study was established to compare dry soluble formulations of MCPA and 2,4-D dimethylamine (DMA) on 'Gallatin' spring barley 4 miles northwest of Potlatch, ID. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 38 psi to 5 leaf barley, 1 to 2.5 in mayweed chamomile (ANTCO), 0.5 to 4 in. field pennycress (THLAR), and to 1 to 4 in. common lambsquarters (CHEAL) on May 12. Weed densities were counted within two 2 ft^2 areas within each untreated plot on May 29. Weed control was evaluated visually on July 6. Barley was harvested from a 4.5 by 27 ft area of each plot for grain yield on August 6. Treatments were arranged in a randomized complete block design and replicated four times.

Table 1. Application and soil analysis data

Temperature (F)	65
Soil temperature at 2 in. (F)	66
Relative humidity (%)	50
Wind speed (mph - direction)	2-S
Soil pH	5.7
OM (%)	4.0
CEC (meq/100g soil)	19.5
Texture	silt loam

All herbicide treatments in this study controlled field pennycress and common lambsquarters (Table 2). The dry formulation of 2,4-D at 0.563 lb ae/a controlled mayweed chamomile 88%. All other phenoxyalkanoic acid herbicide treatments controlled mayweed chamomile 70% or less. Barley treated with 2,4-D or MCPA at 0.5 lb ae/a or higher or with thifensulfuron-tribenuron plus bromoxynil yielded more grain than the untreated barley. No barley injury was observed (data not provided). (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. MCPA and 2,4-D formulations for broadleaf weed control in spring barley

Treatment	Rate	Barley yield	ANTCO[1]	THLAR	CHEAL
	lb ae/a	lb/a	-------	(% control[2])	-------
control		3850	--	--	--
2,4-D amine (LS)[3]	0.475	3950	50	99	98
2,4-D (DS)[4]	0.5	4350	55	99	99
2,4-D (DS)	0.563	4150	88	99	99
MCPA amine (LS)[5]	0.5	4300	70	99	99
MCPA (DS)[6]	0.5	4200	50	99	99
thifensulfuron-tribenuron+	0.008[7]				
bromoxynil	0.187[7]				
R-11	0.25% v/v	4150	98	99	98
$LSD_{(0.05)}$		300	24	NS	NS
Weed densities			11	11	8

[1] two replicates evaluated
[2] visual evaluation
[3] liquid soluble formulation of dimethylamine salt of 2,4-D (Weedar 64)
[4] dry soluble formulation of dimethylamine salt of 2,4-D (Savage™)
[5] liquid soluble formulation of dimethylamine salt of MCPA (MCP Amine 4)
[6] dry soluble formulation of dimethylamine salt of MCPA
[7] lb ai/a

Burning nettle control in barley silage. Wright, S. D. Burning or stinging nettle is a serious weed pest in small grain fields grown for silage.

Research plots were established on February 28, 1992, near Tulare, California. The experimental design was a randomized complete block with three replications. Individual plots were 10 by 40 feet in size. Treatments were applied with a CO_2 3-wheeled sprayer calibrated to deliver 20 gal/a at 32 psi. Stinging nettle population was moderate to heavy throughout the experimental area and plants were 2 to 18 inches tall. Barley was 4 to 18 inches tall from tillering to early jointing.

All treatments gave only partial weed control. Treatments progressively improved following days after treatment. 2,4-D gave the best control, although it was only fair. There was no crop injury observed.

(Univ. of Calif. Cooperative Extension, County Civic Center, Visalia, CA 93291-4584)

Results

	Treatments	Rate (lbs ai/a)	Burning Nettle Control 7 DAT	14 DAT	26 DAT	26 DAT Range
1.	Bromoxynil	.38	1.50	3.50	4.25	B
2.	Dicamba + MCPA	.125 + .19	2.25	3.75	4.50	B
3.	2,4-D amine	.71	3.00	3.75	6.25	A
4.	MCPA	.38	1.75	3.75	4.25	B
5.	Bromoxynil + MCPA	.38 + .5	4.25	4.00	5.25	AB
6.	Dicamba + MCPA + UN-32	.125 + .19 + 7.5 gal	2.75	3.75	5.50	AB
7.	UTC		0	0	0	C

LSD value = 1.507 (26 DAT)
0 = no control 10 = dead

Garbanzo Bean PPI and PRE Herbicide Trial. Canevari, M., D. Colbert. The following experiment was established on garbanzo beans to evaluate crop safety and efficacy on winter annual weeds. Four herbicides were applied at different rates, singly and in tank mix combinations with two application timings of selected herbicides (PPI and PRE).

Pendimethalin and imazethapyr were applied alone and in combination as a PPI treatment. The best treatment was the combination averaging 80% control of weeds 100 DAE. Crop injury was low at 12% and 17 %. However, the combination treatment applied preemergence caused 35% crop stunting 199 DAE.

Oxyfluorfen was applied pre-emergence alone and in combination with pendimethalin. Rates ranged from .25, .5 and 1.0 lb ai/a of oxyfluorfen. Crop stunting was severe and ranged from 50%, 68% and 80% of normal plant size at 100 DAE. Bean plants began to grow at a normal rate by April but never did obtain optimum size compared to check plots. Control of shepherdspurse and pineapple weed was excellent with all of these treatments but poor on yellow nutsedge and moderate control of chickweed.

Summary

Yields were low in this field but plot area was uniform in plant population for accurate yield comparison (CV 13.08%). There was significant yield reduction with oxyfluorfen treatments at 1.0 lb ai, and the sequential application of oxyfluorfen .25 + pendimethalin 1.5 lb ai. All oxyfluorfen treatments exhibited leaf burn coinciding with rainfall followed by clear, sunny days. Bean plants in these treatments were smaller in size and delayed in maturity. Yields of oxyfluorfen treatments at .5 and .25 lb ai were not statistically lower at the 95% level of confidence but were 15% lower yield than the control plot. (University of California Cooperative Extension, Stockton, CA 95205).

Treatments	Lb/ai Rate	Timing
Pendimethalin	1.5	PPI
Imazethapyr	.047	PPI
Pendimethalin	1.5	Pre
Oxyfluorfen	.25	Pre
Oxyfluorfen + Pendimethalin	.25 + 1.5	Pre, PPI
Imazethapyr	.047	Pre
Imazethapyr + Pendimethalin	.047 + 1.5	Pre
Imazethapyr + Pendimethalin	0.47 + 1.5	PPI
Oxyfluorfen	.50	Pre
Oxyfluorfen	1.0	Pre
Hand weeded		
Control		

DAE = days after emergence
PRE = Preemergence to crop
PPI = Preplant incorporated

Garbanzo herbicide trial

	Rating			
	% Emergence	Crop Injury		
Treatments	1/10/92	1/10/92	3/4/92	4/3/92
Pendimethalin	100	1	0.5	1.7
Imazethapyr	100	.33	0.5	1.2
Control	100	0	0	0
Oxyfluorfen	90	7.3	5.3	5
Oxyfluorfen + Pendimethalin	77	7	5.3	5
Imazethapyr	100	0	.8	1.2
Imazethapyr + Pendimethalin	95	2.25	5.3	3.5
Imazethapyr + Pendimethalin	95	.5	1.0	1.3
Oxyfluorfen	35	9	10.0	6.8
Oxyfluorfen	0	10	10.0	8.0
Hand weeded	100	0	0	0
Control	100	0	0	0

Rating	
Crop Injury	Weed Control
0 = no injury	0 = no weed control
10 = crop killed	10 = 100% weed control
% Emergence	
0 = no stand	100 = full stand

	Rating 4/3/92				
Treatments	Shepherdspurse	Pineappleweed	Chickweed	[1]Yellow Nutsedge	6/2/92
Pendimethalin	3.7	10	10	1.0	7.7
Imazethapyr	5.3	10	9.7	2.0	7.0
Pendimethalin	0.0	0	0	0	0
Oxyfluorfen	9.3	10	5.7	0	4.7
Oxyfluorfen + Pendimethalin	9	10	10	0	2.0
Imazethapyr	2.5	10	8	7	6.7
Imazethapyr + Pendimethalin	3.8	7.7	10	5.8	8.0
Imazethapyr + Pendimethalin	6.8	7.7	10	6.8	9.3
Oxyfluorfen	9.8	10	7.5	0	3.0
Oxyfluorfen	10	10	10	0	0
Hand weeded	0	0	0	0	8.3
Control	0	0	0	0	7.7

[1] Herbicide plots that reduced plant size showed more nutsedge due to lack of crop competition.

Yield and seed size
4 Rep Average

Treatment	Rate lb/a.i.	Yield lbs/acre		[1] Seed Size
Pendimethalin	1.5	763	A	62
Imazethapyr	.047	757	A	64
Control	--	752	A	62
Oxyfluorfen	.25	658	AB	58
Oxyfluorfen + Pendimethalin	.25 + 1.5	534	BC	61
Imazethapyr	.047	705	A	60
Imazethapyr + Pendimethalin	.047 + 1.5	453	C	62
Imazethapyr + Pendimethalin	.047 + 1.5	781	A	62
Oxyfluorfen	.5	624	AB	59
Oxyfluorfen	1.0	304	D	58
Hand weeded	--	771	A	59
Control	--	776	A	61

[1] Seed size = # beans/oz wt

LSD = 145 C.V. = 13.08%

Soil - Hanford sandy loam

Plot - 2 rows x 30' x 4 replications

Spray volume - 30 gpa

Incorporation - rolling cultivator

Variety - UC27

Rain - 3/8" 12/7/91

Pre-irrigation - 10/29/91

Planted - 11/23/91

PPI treatments - 11/22/91

PRE treatments - 11/23/91

Weed ratings - 4/3/92

Crop injury ratings - 1/10, 3/4, 4/3

Harvest - 6/18/92

Garbanzo preemergence herbicide trial. Canevari, M., D. Colbert. The following trial was conducted to evaluate alternative herbicides for control of winter annual weeds in the San Joaquin Valley. The herbicides compared were pendimethalin, imazethapyr, oxyfluorfen, and metolachlor, at different rates and combinations. The treatments were applied 12-3-91 post planting but pre-emergence to the weeds and crop. Rainfall occurred on 12-7-91 for incorporation of herbicides.

Pendimethalin provided excellent control of shepherdspurse, chickweed, fiddleneck, and annual bluegrass and poor control of hairy nightshade. Crop injury was moderate at 22% 90 DAE. Metolachor gave moderate to good control of all weeds present with very little crop injury (less than 5%).

Oxyfluorfen at .25 lb ai both alone and in combination averaged 50% crop stunting at 90 DAE. The bean plant began to grow out of the injury by April but fell short of obtaining the normal plant size by harvest in June by 10-15%. The combination of oxyfluorfen + metolachor provided excellent control of all weeds present. Oxyfluorfen alone was poor on chickweed and nightshade.

Imazethapyr applied at two rates (.047 and .063) provided excellent control of all weeds with no signs of crop injury. The combination of imazethapyr + pendimethalin caused 38% crop stunting at 90 DAE and still exhibited 20% reduction in plant size at harvest.

Summary

The plots were harvested on 7/7/92 with the highest yields from imazethapyr at .063 lb ai rate. There was no significant difference of yields at the 95% level of confidence for the pendimethalin treatment. All treatments with oxyfluorfen averaged 14% lower yields than the mean of the treatments in the higher statistical range. Beans in the oxyfluorfen treatments were delayed in maturity by approximately two weeks and plants were smaller in size. (University of California Cooperative Extension, Stockton, CA 95205).

Treatment	Rate lb/ai/a	Crop Injury ①	Crop Injury ②	Shepherds purse	Chick weed	Fiddle neck	H.Night shade
Pendimethalin	1.5	1.2	2.3	9.4	10.0	10.0	1.2
Imazethapyr	.047	0	0	9.5	9.9	9.3	9.6
Imazethapyr	.063	0	0	9.7	9.9	10.0	9.7
Pendimethalin + Imazethapyr	1.5 .047	2.8	3.8	10.0	10.0	10.0	9.0
Oxyfluorfen	.25	6.5	5.8	9.8	5.3	10.0	1.5
Oxyfluorfen + Pendimethalin	.25 1.5	7.3	5.6	10.0	9.8	10.0	0
Oxyfluorfen + Metolachlor	.25 2.5	7.0	6.1	10.0	9.9	10.0	6.5
Metolachlor	2.5	0	0	9.2	8.6	9.0	7.5
Check	--	0	0	0	0	0	0

0 = no injury 10 = crop killed
0 = no weed control 10 = 100% weed control
DAE = days after emergence

Yield and seed size

Treatment name	Rates lb/a.i.	Yield lbs/a		(3) Seed Size
Pendimethalin	1.5	1752	AB	56
Imazethapyr	.047	1849	AB	58
Imazethapyr	.063	2048	A	56
Pendimethalin + Imazethapyr	1.5 + .047	1692	AB	58
Oxyfluorfen	.25	1547	B	59
Oxyfluorfen + Pendimethalin	.25 + 1.5	1553	B	57
Oxyfluorfen + Metolachlor	.25 + 2.5	1661	B	58
Metolachlor	2.5	1655	B	58
Check		1553	B	57

(3) Seed size = # of bean/oz wt

LSD = 341 C.V. = 11.58%

Soil - Wyman clay loam

Plot - 2 rows x 30' x 4 replications

Spray volume - 30 gpa

Incorporation - rolling cultivator

Variety - UC27

Pre-irrigation - 11/4/91

Planted - 11/25/91

Pre-treatments - 12/3/91

Weed ratings - 3/28/92

Crop injury rating - ① 2/15/92, ② 3/28/92

Harvest - 7/7/92

Use of herbicides for velvetleaf control in two varieties of bush lima beans. Mitich, L.W., E.J. Roncoroni, and G.B. Kyser. Four herbicides, including the unregistered material imazethapyr, were evaluated in 5 treatments in 2 varieties of bush lima beans for velvetleaf (ABUTH) control and crop tolerance. Bentazon, a formerly registered material of great utility in dry bean production, was also included for comparison; a preplant incorporated treatment of pendimethalin + metolachlor was included as a standard registered treatment.

The experiment was conducted on a field of Yolo clay loam soil infested in previous years with a heavy stand of velvetleaf.

On 9 June 1992, trifluralin was applied and incorporated over the whole field for grass control. The pendimethalin + metolachlor treatment was also applied at this time. These treatments were incorporated to 3 inches.

'UC 92' bush lima beans and 'UC Luna' baby bush limas were planted 10 June in 4 alternating strips of four 30-inch rows. Herbicide treatments were randomized within each of 5 replications; each treatment plot was 20 ft wide (including 4 rows of each bean variety) by 20 ft long.

An early postemergence treatment of imazethapyr was applied 3 July. During the following 24 hours, temperatures reached a maximum of 90F and a minimum of 58F. Spray was directed at the base of crop plants. At this time bean plants were 6 to 8 inches tall with 3 to 4 true leaves; velvetleaf plants were in the second leaf stage. Remaining treatments were applied 15 July (late postemergence) over the top of crop and weeds; temperatures during the following day peaked at 97F and reached a low of 62F. Bean plants were 12 to 15 inches tall, and velvetleaf was 6 to 8 inches tall.

All treatments were applied with a CO_2 backpack sprayer delivering 25 gpa at 30 psi through 8002 nozzles.

The trial was rated for velvetleaf control 21 July and 2 September; a count of velvetleaf plants/meter was also taken on the latter date. In each evaluation, pendimethalin + metolachlor appeared to control velvetleaf most effectively. Crop chemical injury was also evaluated 21 July. High rates of imazethapyr caused moderate injury (as high as an average of 34% in baby limas at the highest rate), though this injury did not severely impact yields. Baby limas appeared more susceptible to injury.

Beans were cut 28 September. After drying, two 20-ft rows of each plot were harvested. Average weight harvested from baby lima plots (2087 g/40 ft) was approximately twice the average weight harvested from large lima plots (1071 g/40 ft), primarily because weather problems kept large lima pods from drying fully by threshing time. Highest yields were obtained from plots treated with pendimethalin + metolachlor, followed by plots treated with the highest rate of imazethaypyr; lowest yields were found in control plots. Yield differences were significant at the 10% level, but not at the 5% level. (Division of Plant Biology, University of California, Davis, CA 95616.)

Table. Evaluation of herbicides for velvetleaf control and crop injury in baby and large lima beans, UC Davis

Treatment	Rate (lb/a)	Application time, type	ABUTH control 7/21[3,4]	ABUTH control 9/2[3,4]	ABUTH plants/ meter[3]	Bean type	Crop injury 9/2[3,4]	Yield, 40 row ft (g)[3]
pendimethalin + metolachlor	1 + 1	PPI	97 A	89 A	1.1	baby	0	2635
						large	0	1361
imazethapyr[1]	0.047	early post	63 AB	45 CD	2.8	baby	2	1788
						large	2	858
imazethapyr[1]	0.032	late post	60 AB	40 D	3.4	baby	14	2214
						large	4	994
imazethapyr[1]	0.047	late post	63 AB	56 C	3.4	baby	34	2265
						large	14	1182
bentazon[2]	1	late post	96 A	72 B	2.1	baby	10	1974
						large	0	1093
control	---		19 B	15 E	7.9	baby	0	1642
						large	0	938

[1]Applied with 0.25% v/v X-77 surfactant.
[2]Applied with 1 qt crop oil per acre.
[3]All values average of five replications. Values followed by the same letter are not significantly different at the 5% level.
[4]Values are in percent; 0 = no weed control, no crop injury; 100 = complete weed control, complete crop kill

Dry bean injury from pre-cultivation tillage. VanGessel[1], M.J., L.J. Wiles[2], E.E. Schweizer[2], and P. Westra[1]. This research was initiated to determine the amount of pinto bean (Phaseolus vulgaris L.) injury from rotary hoeing and flex harrowing at various bean growth stages. The study was conducted in 1992 at Windsor, CO. The soil type was Kim clay loam with 36% sand, 32% silt, and 32% clay, organic matter content 1.5%, and pH 7.6. The soil was mold-board plowed in the fall of 1991 and disked and bedded in 1992, thus reducing the amount of crop residue on the soil surface. Prior to planting, ethalfluralin and EPTC was applied PPI at 1.12 and 3.36 kg ha^{-1},respectively. Pinto beans, 'Bill Z', were planted June 6, 1992. Plots were four rows wide (rows .76 m apart) and 24 m long. Study was designed as a randomized block with four replications. All flex harrow treatments were carried out at 8 km $hr^{-1}$and rotary hoe at 11 km hr^{-1}. Rotary hoe gangs directed over the crop row were modified so they did not disturb the soil or plants. Plots were rotary hoed or flex harrowed at the following bean growth stages: preemergence; crook stage; cotyledon stage to unifoliate stage; and second trifoliate stage. Eighteen days after the last treatments were applied bean height and stand counts were determined. Number of bean plants in 1.5 m of row were counted for four subsamples. At four subsamples maximum height of bean canopy was measured for five consecutive plants.

Stand count was reduced for flex harrow treatment at cotyledon to unifoliate stage. In two of the four plots the harrow began to accumulate plant debris and as a result soil built up, causing bean plants to be uprooted and destroyed. Bean height was reduced when the flex harrow treatments were applied at the cotyledon and second trifoliate stages. Neither flex harrowing at the preemergence stage and crook stage, nor rotary hoeing at any stage injured bean plants. ([1]Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523; [2]Agricultural Engineering Research Center, USDA-ARS, Fort Collins, CO 80521).

Dry bean stand counts and height for rotary hoeing and flex harrowing at various bean stages.

Treatment	Stand counts per 1.5 m	Dry bean height
	--no.--	--cm--
CHECK	21.5 a	26.5 a
Rotary hoe - preemergence	20.2 a	28.3 a
Rotary hoe - crook stage	19.7 a	27.5 a
Rotary hoe - cotyl./unifol.	20.9 a	27.7 a
Rotary hoe - 2 trifoliate	19.5 a	29.8 a
Flex harrow - preemergence	19.2 a	27.5 a
Flex harrow - crook stage	18.3 a	27.0 a
Flex harrow - cotyl./unifol.	14.2 b	21.7 b
Flex harrow - 2 trifoliate	18.0 a	22.8 b
LSD (.05) =	3.57	3.15
Standard Dev.=	2.45	2.16
CV =	12.84	8.14

Junglerice control with trifluralin granules in bermudagrass seed. Bell, C. E. and B. R. Tickes. Bermudagrass seed is a major crop in the Imperial Valley of southeastern California and in Yuma, Arizona. Junglerice is an important weed of this crop and is not controlled adequately by available herbicides. This research was conducted to determine whether trifluralin granules would control junglerice in a commercial bermudagrass seed field.

The experiment utilized a randomized complete block design with four replications. Trifluralin 10% granules were applied at three rates (1.12, 2.24, and 4.48 kgai/ha) on Aug. 21, 1991 using a ground driven, air-assisted, granular spreader. There was also an untreated control in each replication. Plot size was 11 m by 200 m. Application was made after the summer seed harvest, before the field was irrigated. Straw and chaff were raked from the field before application, although about 1 cm of organic material was still present.

A visual evaluation of the experiment was made on Oct. 11, 1991; there were no visually apparent differences between treatments. Yield was determined at the normal seed harvest on Jan. 22, 1992. An area 7 m by 130 m of each plot was harvested with a commercial seed combine. There were no significant differences ($P > 0.05$) between treatments and the untreated control. (Cooperative Extension, University of California, Holtville, CA 92250 and Cooperative Extension, University of Arizona, Yuma, AZ 85364.)

Tolerance of Kentucky bluegrass seedlings to three wild oat herbicides in greenhouse experiments. Swensen, J.B., M.J. Dial, G.A. Murray, and D.C. Thill. Fifty seeds of 'Glade' or 'South Dakota' Kentucky bluegrass *Poa pratensis* were seeded into separate 11.4 by 7.6 by 5.1 cm plastic planting trays filled with a commercially prepared planting media, consisting of equal parts by weight of sand and peatmoss. The Kentucky bluegrass seeds were evenly distributed on the surface of the planting media in each planting tray and covered with a 1 mm layer of finely ground vermiculite. Five wild oat (AVEFA) seeds were placed 1.9 cm deep in separate planting trays filled with the same planting media. Wild oat was included in the experiment to determine the growth stage of the Kentucky bluegrass relative to the growth stage of the wild oat at the time of herbicide treatment. The planting trays were placed on a greenhouse bench under a 16 hr photoperiod and temperature range of 15 to 25 C. Diclofop and imazamethabenz were applied when wild oat had 2 to 3 fully expanded leaves. Both cultivars of Kentucky bluegrass had 1.5 to 2 leaves and were 2.5 cm tall at this time. Difenzoquat treatment was applied when the wild oat had 4 fully expanded leaves. The Kentucky bluegrass seedlings had 4 fully expanded leaves and were 6.3 to 7.6 cm tall at this time. All herbicide treatments were applied with a CO_2 pressurized movable track greenhouse sprayer, calibrated to deliver 140 L/ha spray solution at 276 kPa. Treat

ments were arranged in a randomized complete block design replicated six times. Ten days following the herbicide treatment, the Kentucky bluegrass cultivars were scored visually for crop injury as percent of the untreated check (crop injury score of 0 = no injury and 100 = completely dead). Twenty days following the difenzoquat application the Kentucky bluegrass cultivars were again scored visually for crop injury, and Kentucky bluegrass and wild oat herbage were harvested, dried at 50 C for 48 hr, and weighed.

Glade was injured more by wild oat herbicide than South Dakota when evaluated 10 days after application (Table 1). However, neither injury nor herbage biomass differed among Kentucky bluegrass cultivars at harvest. The Kentucky bluegrass injury at harvest was greater than the injury 10 DAT due to continued imazamethabenz activity through the duration of the experiment. Kentucky bluegrass treated with difenzoquat was injured 9 percent at the harvest evaluation and had more herbage biomass than bluegrass treated with diclofop or imazamethabenz (Table 2). Imazamethabenz applied at 0.53 kg/ha injured Kentucky bluegrass seedlings more with crop oil concentrate than with a nonionic surfactant. Diclofop and imazamethabenz reduced bluegrass biomass similarly compared to the check.

Wild oat treated with diclofop at 1.12 kg/ha or 0.84 kg/ha with crop oil concentrate and imazamethabenz applied at 0.27 kg/ha with crop oil had the lowest herbage biomass (Table 3). All herbicide treatments reduced wild oat herbage biomass compared to the check. (Agricultural Experiment Station, Moscow, Idaho 83843).

Table 1. Response of seedlings of two Kentucky bluegrass cultivars to three wild oat herbicides. Values are means of eight herbicide treatments and six replications.

Cultivar	Injury 10 DAT	Injury Harvest	Herbage biomass
	----------% of check----------		g
Glade	41	81	0.12
South Dakota	35	80	0.10
LSD (0.05)	6	ns	ns

Table 2. Effect of three wild oat herbicides applied to Kentucky bluegrass seedings. Values are means of two Kentucky bluegrass cultivars and six replications.

Treatment	Formulation	Rate	Application	Injury 10 DAT	Injury Harvest	Herbage biomass
	kg/L	kg/ha	timing	---% of check---		g
check	--	--	----	--	--	0.18
diclofop	0.359	1.12	2 to 3 lf	93	99	0.04
diclofop	0.359	0.84	2 to 3 lf	84	99	0.04
diclofop+	0.359	0.84	2 to 3 lf	81	99	0.04
Sun-It II[1]	2.00% v/v					
imazamethabenz+	0.299	0.53	2 to 3 lf	9	83	0.10
R-11[2]	0.25% v/v					
imazamethabenz+	0.299	0.27	2 to 3 lf	10	86	0.08
R-11	0.25% v/v					
imazamethabenz+	0.299	0.53	2 to 3 lf	14	93	0.06
Sun-It II	2.00% v/v					
imazamethabenz+	0.299	0.27	2 to 3 lf	6	83	0.07
Sun-It II	2.00% v/v					
difenzoquat+	0.239	1.12	4 to 5 lf	11	9	0.33
R-11	0.25% v/v					
LSD (0.05)				12	7	0.06

[1] Sun-It II is a vegetable oil base crop oil concentrate.
[2] R-11 is a nonionic surfactant.

Table 3. Effect of three wild oat herbicides on wild oat herbage biomass. Values are means of six replications.

Treatment	Formulation	Rate	Application	Herbage biomass
	kg/L	kg/ha	timing	g
check	----	----	---------	0.62
diclofop	0.359	1.12	2 to 3 lf	0.33
diclofop	0.359	0.84	2 to 3 lf	0.37
diclofop+	0.359	0.84	2 to 3 lf	0.22
Sun-It II[1]	2.00% v/v			
imazamethabenz+	0.299	0.53	2 to 3 lf	0.39
R-11[2]	0.25% v/v			
imazamethabenz+	0.299	0.27	2 to 3 l	0.37
R-11	0.25% v/v			
imazamethabenz+	0.299	0.53	2 to 3 lf	0.45
Sun-It II	2.00% v/v			
imazamethabenz+	0.299	0.27	2 to 3 lf	0.32
Sun-It II	2.00% v/v			
difenzoquat	0.239	1.12	4 to 5 lf	0.45
R-11	0.25% v/v			
LSD (0.05)				0.13

[1] Sun-It II is a vegetable oil base crop oil concentrate.
[2] R-11 is a nonionic surfactant, rate is expressed as % v/v.

Broadleaf weed control in field corn with early postemergence herbicide tank mixes. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 6, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and broadleaf weeds to herbicide tank mixes. 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 treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied postemergence on May 21, 1992 when corn was in the 3 to 4 leaf stage and weeds were small. Prostrate pigweed (AMABL) and redroot pigweed (AMARE) infestations were heavy, cutleaf nightshade (SOLTR) infestations were moderate, kochia (KCHSC) and Russian thistle (SASKR) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 25, 1992. All treatments gave good to excellent control of all broadleaf weeds. Dimethenamid in combination with atrazine plus dicamba (a packaged premix) applied at 1.125 plus 1.0 lb ai/A caused the highest injury rating of 3. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Broadleaf weed control evaluations in field corn with early postemergence herbicide tank mixes.

Treatment	Rate lb ai/A	Crop[1] Injury	--------Weed Control[1]-------- KCHSC	SASKR	AMARE	AMABL	SOLTR
		-------------------	-------------------	%	-------------------	-------------------	-------------------
dimethenamid[2]	0.88	0	100	100	100	97	100
dimethenamid[2]	1.0	1	100	100	100	100	100
dimethenamid[2]	1.125	3	100	100	100	100	100
alachlor[2]	2.0	1	100	100	100	100	100
metolachlor[2]	1.5	0	100	100	100	100	100
dimethenamid[3]	0.88	2	100	99	98	96	100
dimethenamid[3]	1.0	2	100	100	100	97	100
dimethenamid[3]	1.125	1	100	100	98	97	100
alachlor[3]	2.0	1	100	100	100	100	100
metolachlor[3]	1.5	1	100	100	97	94	100
handweeded check		0	100	100	100	100	100
check		0	0	0	0	0	0
av weeds/M^2			6	3	14	30	9

1. Based on a visual scale from 0 to 100, where 0 = no control or crop injury and 100 = dead plants.
2. A packaged premix of atrazine plus dicamba was applied postemergence at 1.0 lb ai/A with treatments on May 21, 1992.
3. Dicamba was applied postmergence 0.25 lb ai/A with treatments on May, 21 1992.

Broadleaf weed control in field corn with preemergence herbicides followed by postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 6, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and broadleaf weeds to preemergence followed by postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence were applied on May 7, 1992 and immediately incorporated with 0.75 in of sprinkler applied water. Follow-up postemergence treatments were applied on May 21, 1992 when corn was in the 3 to 4 leaf stage and weeds were small. Prostrate pigweed (AMABL), cutleaf nightshade (SOLTR) and redroot pigweed (AMARE) infestations were heavy, and kochia (KCKSC), and Russian thistle (SASKR) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 25, 1992. All treatments gave good to excellent control of all broadleaf weeds. Dimethenamid applied at 1.125 lb ai/A followed by a postemergence treatment of dicamba at 0.25 lb ai/A and a premix treatment of atrazine plus dicamba at 1.0 lb ai/A gave the highest injury ratings of 7 and 13, respectively. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

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

Treatment	Rate lb ai/A	Crop[1] Injury	Weed Control[1] KCHSC	AMARE	AMABL	SASKR	SOLTR
		%					
dimethenami[2]	0.88	0	100	100	100	98	100
dimethenamid[2]	1.0	0	100	100	100	96	100
dimethenamid[2]	1.125	13	100	100	98	99	100
alachlor[2]	2.0	1	100	100	100	100	100
metolachlor[2]	1.5	1	100	100	99	100	100
dimethenamid[3]	0.88	0	100	100	100	100	100
dimethenamid[3]	1.0	5	100	100	100	100	100
dimethenamid[3]	1.125	7	100	100	100	100	100
alachlor[3]	2.0	3	100	100	100	100	100
metolachlor[3]	1.5	0	100	100	100	100	100
handweeded check		0	100	100	100	100	100
check		0	0	0	0	0	0
av weeds/M^2			7	19	18	2	19

1. Based on a visual scale from 0 to 100, where 0 = no control or crop injury and 100 = dead plants.
2. A premix of atrazine plus dicamba was applied postemergence on May 21, 1992 at 1.0 lb ai/A.
3. Dicamba was applied postemergence on May 21, 1992 at 0.25 lb ai/A.

Broadleaf weed control in field corn with preemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 6, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) 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 treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 7, 1992 and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL), and redroot pigweed (AMARE) infestations were heavy, and cutleaf nightshade (SOLTR), kochia (KCHSC) and Russian thistle (SASKR) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 8, 1992. All treatments gave excellent control of SOLTR, AMARE and AMABL. SASKR and KCHSC control was good to excellent with all treatments except metolachlor applied at 1.5 lb ai/A. Dimethenamid applied at 1.0 and 1.125 lb ai/A in combination with cyanazine at 1.0 lb ai/A gave the highest injury rating of 7 and 6, respectively. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Broadleaf weed control evaluations in field corn with preemergence herbicides.

Treatment	Rate lb ai/A	Crop[1] injury	Weed Control[1] AMARE	AMABL	KCHSC	SASKR	SOLTR
dimethenamid	0.88	0	100	99	95	97	100
dimethenamid	1.0	0	100	99	99	98	100
dimethenamid	1.125	4	100	100	99	98	100
alachlor	2.0	0	100	99	98	97	100
metolachlor	1.5	0	100	96	81	86	100
dimethenamid/ cyanazine	0.88/1.0	4	99	100	100	100	100
dimethenamid/ cyanazine	1.0/1.0	7	100	100	100	100	100
dimethenamid/ cyanazine	1.125/1.0	6	100	98	100	100	100
alachlor/ cyanazine	2.0/1.0	2	100	100	100	100	100
metolachlor/ cyanazine	1.5/1.0	0	100	100	100	100	100
handweeded check		0	100	100	100	100	100
check			0	0	0	0	0
av weeds/M^2			24	76	2	1	7

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

Weed control in field corn with postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 6, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and annual grasses to postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with four replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 21, 1992 when corn was in the 3 to 4 leaf stage and weeds were small. Barnyardgrass (ECHCG) and green foxtail (SETVI) infestations were light throughout the experimental area.

Stand counts were made on June 24, 1992 by counting individual plants per 10 ft of the third row of each plot. Visual evaluations for weed control were made on July 27, 1992. Plant heights were taken on September 30, 1992 by recording the height of three plants per plot. Dicamba was applied to all plots on May 21, 1992 for broadleaf weed control. All treatments gave excellent control of SETVI and ECHCG. Alachlor applied at 4.0 lb ai/A had the highest stand count of 18. Dimethenamid applied at 0.64 lb ai/A gave the highest plant height of 107 in. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in field corn with postemergence herbicides.

Treatment	Rate lb ai/A	Stand Count	Plant Height in	Weed Control[1] ECHCG	SETVI
				------%	-----
dimethenamid	0.64	16	107	100	100
dimethenamid	0.75	16	104	100	100
dimethenamid	0.88	17	105	100	100
dimethenamid	1.0	17	105	100	99
dimethenamid	1.125	16	105	100	100
dimethenamid	2.0	17	105	100	100
alachlor	4.0	18	104	100	99
metolachlor	1.5	16	106	100	99
metolachlor	3.0	17	104	100	100
alachlor	2.0	17	105	98	100
handweeded check		16	106	100	100
check		16	103	0	0
av weeds/M^2				8	5

1. Based on a visual scale from 0 to 100, where 0 = no control and 100 = dead plants.

Weed control in field corn with delayed preemergence herbicides. Arnold, R.N., E.J. Gregory, and M.W. Murray. Research plots were established on May 5, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and annual grasses to delayed preemergence herbicides. Soil type was Wall sandy loam with a pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with four replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 11, 1992 and immediately incorporated with 0.75 in of sprinkler applied water. Barnyardgrass (ECHCG) infestations were moderate and green foxtail (SETVI) infestations were light throughout the experimental area.

Stand counts were made on June 11, 1992 by counting individual plants per 10 ft of the third row of each plot. Visual evaluations for weed control were made on July 10, 1992. Plant heights were taken on September 30, 1992 by recording the height of three plants per plot. Dicamba was applied to all plots on May 21, 1992 at 0.25 lb ai/A for broadleaf weed control. All treatments gave excellent control of SETVI and ECHCG. Dimethenamid applied at 10 lb ai/A gave the lowest stand count of 15. Plant height varied 2 in from lowest to highest. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in field corn with delayed preemergence herbicides.

Treatment	Rate lb ai/A	Stand Count	Plant Height in	Weed Control[1] SETVI	ECHCG
				------%	-----
dimethenamid	0.64	17	106	100	99
dimethenamid	0.75	16	105	100	99
dimethenamid	0.88	16	106	100	99
dimethenamid	1.0	15	105	100	99
dimethenamid	1.125	16	105	100	100
dimethenamid	2.0	16	104	100	100
alachlor	2.0	17	104	100	99
alachlor	4.0	17	105	100	100
metolachlor	1.5	17	105	100	99
metolachlor	3.0	16	105	100	99
handweeded check		17	104	100	100
check		16	106	0	0
av weed/M^2				9	31

1. Based on a visual scale from 0 to 100, where 0 = no control and 100 = dead plants.

Weed control in field corn with preemergence herbicides. Arnold, R.N, E.J. Gregory and M.W. Murray. Research plots were established on May 5, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and annual grasses 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 treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 6, 1992 and immediately incorporated with 0.75 in of sprinkler applied water. Barnyardgrass (ECHCG) and green foxtail (SETVI) infestations were moderate throughout the experimental area.

Stand counts were made on June 8, 1992 by counting individual plants per 10 ft of the third row of each plot. Visual evaluations for weed control were made on July 6, 1992. Plant heights were taken on September 29, 1992 by recording the height of three plants per plot. Dicamba was applied to all plots on May 21, 1992 at 0.25 lb ai/A for broadleaf weed control. All treatments gave excellent control of SETVI and ECHCG. Alachlor applied at 4.0 lb ai/A gave the lowest stand count of 14. Dimethenamid applied at 1.0 lb ai/A gave the highest plant height of 105 in. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in field corn with preemergence herbicides.

Treatment	Rate lb ai/A	Stand Count	Plant Height in	Weed Control[1] SETVI	ECHCG
				------%	-----
dimethenamid	0.64	16	102	100	98
dimethenamid	0.75	17	104	100	95
dimethenamid	1.0	16	105	100	94
dimethenamid	1.125	17	103	100	98
dimethenamid	2.0	16	103	100	99
alachlor	2.0	17	103	100	99
alachlor	4.0	14	102	100	100
metolachlor	1.5	17	102	100	98
metolachlor	3.0	15	102	100	99
dimethenamid	0.88	18	104	99	97
handweeded					
check		17	104	100	100
check		17	102	0	0
av weed/M^2				10	23

1. Based on a visual scale from 0 to 100, where 0 = no control and 100 = dead plants.

Weed control in field corn with preplant incorporated herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 5, 1992 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. NK-S5340) and annual grasses to preplant incorporated 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 treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 4, 1992 and immediately incorporated with a tractor mounted rototiller to a depth of 2 to 4 in. Barnyardgrass (ECHCG) infestations were heavy and green foxtail (SETVI) infestations were moderate throughout the experimental area.

Stand counts were made on June 4, 1992 by counting individual plants per 10 ft of the third row of each plot. Visual evaluations for weed control were made July 6, 1992. Plant heights were taken on September 29, 1992 by recording the height of three plants per plot. Dicamba was applied to all plots on May 21, 1992 at 0.25 lb ai/A for broadleaf weed control. All treatments gave good to excellent control of SETVI and ECHCG. Alachlor applied at 2.0 lb ai/A had the highest stand count of 19 plants. Metolachlor applied at 3.0 lb ai/A, dimethenamid applied at 1.125 lb ai/A and the check had the highest plant height of 99. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in field corn with preplant incorporated herbicides.

Treatment	Rate lb ai/A	Stand Count	Plant Height in	Weed Control[1] SETVI	ECHCG
				------%	-----
dimethenamid	2.0	17	96	100	98
metolachlor	3.0	18	99	100	98
dimethenamid	0.75	18	97	99	98
dimethenamid	0.88	17	97	99	98
dimethenamid	1.125	17	99	99	93
alachlor	2.0	19	98	99	98
alachlor	4.0	17	97	99	99
metolachlor	1.5	17	97	99	98
dimethenamid	1.0	17	97	98	98
dimethenamid	0.64	17	95	94	93
handweeded check		17	97	100	100
check		17	99	0	0
av weeds/M^2				15	34

1. Based on a visual scale from 0 to 100, where 0 = no control and 100 = dead plants.

Postemergence control of velvetleaf and cocklebur in field corn. Canevari, M., R. Vargo. This trial was conducted to evaluate postemergence control of cocklebur and velvetleaf in the San Joaquin Valley of California. The experiment was a randomized complete block design with three replications. Plots were two rows (5 ft. by 30 ft.) in length.

Treatments were made on 6/15/92 to corn 14-18" ht. with a CO_2 sprayer at a spray volume of 30 gpa using 8003 flat fan nozzles. Rates of metribuzin were applied ranging from .14 lb. a.i. to .28 lb. alone and in combination with 2,4-D amine, bromoxynil and nicosulfuron. Two dates of rating were made on 6/22/92 and 7/6/92, 7 and 21 DAT for weed control and crop injury.

Summary

Crop injury was minimal in all treatments except the high rate of metribuzin (.28 lbs.) and metribuzin + 2,4-D (.188 + .47 lb. a.i.) which caused 20% and 15% phytotoxicity to the crop. Symptoms on corn included chlorosis and leaf burning that returned to normal after 21 days.

The best control of cocklebur was achieved with bromoxynil treatments. 2,4-D treatments provided good control on cocklebur in the 4-6 leaf stage or smaller. The best control of velvetleaf was treatment of nicosulfuron with bromoxynil and tank mix of metribuzin + bromoxynil. The best control was to smaller velvetleaf below 3" in ht. The highest use rate of metribuzin (.28 lb.) gave 80% control to velvetleaf except larger plants 6-10" ht. which turned chloractic but were not killed. Pigweed population was uneven throughout the trial. In plots where it was present, all treatments worked well. Barnyardgrass was most effectively controlled with treatments of nicosulfuron. Metribuzin at .28 lb. a.i. gave 65% control of barnyardgrass. All other treatments provided unacceptable control. (University of California Cooperative Extension, Stockton, CA 95205).

Corn herbicide trial

Treatment	Rate lb/a.i.	Crop Injury 6/22/92	Crop Injury 7/6/92	Cocklebur 6/22/92	Cocklebur 7/6/92	Velvetleaf 6/22/92	Velvetleaf 7/6/92	Pigweed 6/22/92	Watergrass 6/22/92	Watergrass 7/6/92
Metribuzin ①	.14	.7	.3	2.7	0	5.5	5.0	8.5	0	4.0
Metribuzin ②	.14 + UN32	.3	.7	2.3	1.0	7.7	3.3	9.0	0	3.0
Metribuzin ①	.188	.7	.7	2.7	2.7	3.0	3.7	6.5	0	4.7
Metribuzin ①	.28	.7	2.0	2.7	0	8.7	8.0	8.0	0	6.5
Metribuzin + 2,4-D ①	.188 + .47	0	1.5	5.7	7.7	6.7	5.7	8.0	0	7.0
Metribuzin + Bromoxynil ①	.188 + .375	1.7	.5	9.5	10.0	8.7	6.7	10.0	0	6.3
Nicosulfuron ②	.5 oz	0	.2	2.0	3.7	1.3	7.3	-	0	9.3
Nicosulfuron + Bromoxynil ②	.5 oz + .375	.7	0	9.7	9.7	9.5	9.7	10.0	9.3	9.7
Nicosulfuron + Metribuzin ②	.5 oz + .188	.7	.3	5.0	4.3	6.7	9.0	10.0	9.0	9.3
Bromoxynil ②	.375	.2	.2	9.0	9.7	8.0	6.7	-	0	2.0
2,4-D ②	.47	0	.2	4.3	9.3	3.3	8.0	-	0	2.0
Check	--	0	0	0	0	0	0	0	0	0

① = Applied 6/15/92; rain 1 hour later; wind 10-20; 60° F; overcast
② = Applied 6/16/92; 85° F; clear
6/22/92 = cultivated; 7/6/92 = after irrigation

Weeds		
Cocklebur	Xanthium spinosuml	4-6 leaf; 4-8" diameter
Velvetleaf	Abutilon theophrasti	2-4 leaf; 2-6" ht
Pigweed	Amaranthus retroflexus	4-8 leaf; 2-4" ht
Watergrass	Echinochloa crus-galli	3-5 leaf; 1-4" ht, midtillering

Postemergence control of Johnsongrass and velvetleaf in field corn. Canevari, M., R. Vargo. The following trial was established to evaluate new postemergence herbicides for the control of velvetleaf and Johnsongrass, two major weed pests in the Delta region of the San Joaquin Valley of California.

Twelve treatments of five herbicides were applied to corn 12-16" ht. on 5/15/92 at 30 gpa spray volume. Metribuzin was applied at two rates, .094 and .14 lb ai, alone and in combination with dicamba, 2,4-D, bromoxynil and nicosulfuron. Nicosulfuron was also evaluated in tank mix combinations with bromoxynil and dicamba.

The best control of velvetleaf was achieved with the combination of metribuzin plus 2,4-D or dicamba at 75% and 65% respectively, 18 DAT. The initial evaluation 12 DAT showed bromoxynil treatments with the highest control of velvetleaf but growing out of this condition at later ratings. All other single herbicide treatments performed unsatisfactorily on velvetleaf.

Johnsongrass control was best achieved in all treatments using nicosulfuron. There was a 17% reduction in Johnsongrass control from the metribuzin + nicosulfuron combination. There was no significant crop injury to the corn from any of the treatments used. (University of California Cooperative Extension, Stockton, CA 95205).

Trial Data
Empire Tract, San Joaquin County
Date applied: 5/15/92
Plot size: 6' x 25'; 3 reps
30 gal/a; 30 psi
Wind: 5-15 mph, west
Temperature: 73° F
Soil: peat, medium high moisture

Corn size: 12-16" ht; 6-8 leaf	Barnyardgrass: 4-8" ht; 6-10 leaf
Pigweed: 2-6" ht; 4-8 leaf	Lambsquarters: 4-10" ht; 6-10 leaf
Velvetleaf: 2-6" ht; 4-6 leaf	Nutsedge: 8-14" ht
Johnsongrass: 6-24" ht; 8-tillered	

Postemergence corn herbicide trial

Treatment	Lb/ai/a	Crop Injury	% WEED CONTROL: Pigweed 5/27	Pigweed 6/3	Lambsquarters 5/27	Lambsquarters 6/3	Velvetleaf 5/27	Velvetleaf 6/3	Johnsongrass 5/27	Johnsongrass 6/3
Metribuzin	.094	0	6	5.3	5.7	6.5	5.7	3.3	.3	0
Metribuzin	.14	.5	6.3	5	8	7	6	3.7	0	0
2,4-D	.47	.17	6.7	6	8	10	3.3	3.7	0	0
Dicamba	.5	.17	7.2	8.3	8.5	9.5	3	4.7	0	0
Bromoxynil	.375	0	6.2	2.5	7.5	--	6.5	2	0	0
Metribuzin + 2,4-D	.094 + .47	.33	10	10	10	10	7.2	7.5	0	0
Metribuzin + Dicamba	.094 + .5	.17	6.7	8.8	7.5	10	5.7	6.5	0	0
Metribuzin + Bromoxynil	.094 + .375	.33	7.7	6	9	10	7.3	4.7	0	0
Check		.67	0	0	0	0	0	0	0	0
Nicosulfuron + .25% x77	2/3 oz/A prod.	0	7.7	7.5	2	--	3.8	4	8.2	10
Nicosulfuron + .25% x77 + Bromoxynil	2/3 oz/A prod. + .375	.17	9.5	9.4	9.7	10	6.2	3.7	9	9.9
Nicosulfuron + Metribuzin	2/3 oz. prod. + .094 a.i. + x77	.17	7.3	7.3	7.3	7.5	4.3	3.3	8.3	8.3
Nicosulfuron + Dicamba	2/3 oz. prod. + .5 a.i. + x77	.33	8.5	9.3	5.6	10	4.5	4.7	7	9.3
Check		.33	0	0	0	0	0	0	0	0

0 = no crop injury; no weed control
10 = crop killed; 100% weed control

Sweet corn tolerance and wild-proso millet control. Carter, T.W., R.W. Downard and D. W. Morishita. Studies were established at two locations near Nampa, Idaho to evaluate herbicide treatments for control of wild-proso millet and tolerance of four sweet corn inbreds grown for seed. Five treatments were arranged in a randomized complete block with four replications at each location. Plot size was 12.5 by 25 ft. Each plot included four seed rows and one pollinator row. Soil texture each location was a silt loam with the following characteristics: 1.6 and 1.5% o.m., 7.2 and 7.7 pH, and CEC of 16 and 18 meq/100 g soil at location 1 and 2, respectively. All treatments were applied with a CO_2 pressurized sprayer. Application volume of the preplant incorporated (PPI) and postemergence (POST) applications was 20 and 10 gpa, respectively using 11001 flat fan nozzles with a ground speed of 3 mph. Post-directed (PDIR) applications were made using 15002 even fan nozzles at 15 gpa. PPI treatments were incorporated immediately after application by the cooperators. Refer to Table 1 for other application information.

Table 1. Herbicide application information.

Application date	4/24		5/27		7/1	
Timing[1]	PPI		POST		PDIR	
Location	1	2	1	2	1	2
Air temperature (F)	35	35	80	71	74	62
Soil temperature (F)	40	40	79	72	68	62
Relative Humidity (%)	72	72	30	30	60	84
Wind velocity (mph)	0	0	4	5	5	5
Soil moisture	good	good	wet	very dry	wet	good

[1]Abbreviations for application timing are as follows: PPI=preplant incorporated, POST=postemergence, and PDIR=post-directed.

Corn injury was minimal for all treatments except paraquat PDIR at location 1 which injured the corn an average of 5% (Table 2). EPTC + dichlormid provided some wild proso millet control initially at location 1, but rapidly declined to 15 to 25% by July 1. At location 2, wild proso millet control with EPTC + dichlormid was better, but not satisfactory (Table 3). EPTC + dichlormid treatments at 4.0 lb ai/A was handweeded at both locations after July 1. Nicosulfuron at location 1 controlled wild proso millet the best, while the PDIR sethoxydim application controlled wild proso millet best at location 2. Soil moisture conditions at location 1 were optimum for crop and weed growth and sub-optimum (very dry) for growth at location 2. This may help explain the difference in nicosulfuron performance at the two locations. Corn yield was the highest with the nicosulfuron treatment at location 1. At location 2, EPTC + dichlormid (PPI) and sethoxydim (PDIR) had the highest yield at 4065 pounds of seed per acre. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, ID 83303.)

Table 2. Sweet corn injury, wild proso millet control and seed yield at location 1, near Nampa, Idaho.

Treatment	Rate	Timing	Corn injury	PANMI control 7/1	7/10	7/18	7/31	Corn yield
	lbs ai/A		%					lbs/A
Check			0	0	0	0	0	366
Alachlor paraquat[1]	2.0 0.25	PPI PDIR	5	60	50	40	26	593
EPTC + dichlormid[2]	4.0	PPI	0	15	100	100	100	578
EPTC + dichlormid sethoxydim[3]	6.0 0.19	PPI PDIR	0	25	19	31	25	387
Nicosulfuron[4] 28% N	0.031	POST	0	89	86	84	78	833

[1]Post-directed paraquat and sethoxydim applied July 1.
[2]Hand-weeded after July 1.
[3]Crop oil concentrate added at 1 quart/A.
[4]Surfactant added at 0.25% v/v.

Table 3. Sweet corn injury, wild proso millet control and seed yield at location 2, near Nampa, Idaho.

Treatment	Rate	Timing	Corn injury	PANMI control 7/1	7/10	7/18	7/31	Corn yield
	lbs ai/A		%					lbs/A
Check			0	0	0	0	0	3536
Alachlor paraquat[1]	2.0	PPI PDIR	3	55	87	78	76	3500
EPTC + dichlormid[2]	4.0	PPI	4	60	98	100	100	3746
EPTC + dichlormid sethoxydim[3]	6.0 0.19	PPI PDIR	5	65	82	89	89	4065
Nicosulfuron[4] 28% N	0.031	POST	6	45	41	36	34	3180

[1]Post-directed paraquat and sethoxydim applied July 1.
[2]Hand-weeded after July 1.
[3]Crop oil concentrate added at 1 quart/A.
[4]Surfactant added at 0.25% v/v.

Wild proso millet control in sweet corn. Carter, T.W., D.W. Morishita and R.W. Downard. This study was established near Jerome, Idaho to compare several herbicides for wild proso millet control. Soil texture was a loamy sand with 1.2% o.m., CEC of 8 meq/100 g soil, and pH of 6.5. Plots were 10 by 25 ft. The study was established under sprinkler irrigation using a randomized complete block design with four replications. Treatments were applied with a CO_2 propelled hand-held or bicycle sprayer with water as the carrier. The sprayer was calibrated to deliver 10 gpa at 36 psi for all treatments except the post-directed (PDIR) applications which were applied at 15 gpa. Treatments were evaluated visually July 7, 1992, and two rows were harvested and weighed August 4.

Table 1. Application Data.

Application date	4/20/92	4/28/92	5/27/92	6/19/92	6/26/29
Application timing[1]	PPI	PRE	POST	POST	PDIR
Air temperature (F)	57	63	75	75	85
Soil temperature (F)	43	58	70	68	70
Relative humidity (%)	48	44	23	90	65
Wind velocity (mph)	2	0	8	4	0
Soil moisture	wet	wet	dry	dry	moist

[1]Abbreviations for application timing are as follows: PPI = preplant incorporated, PRE = preemergence, POST = postemergence, and PDIR = post-directed.

High densities of wild proso millet impeded proper application of the PDIR treatments resulting in unusually high crop injury (Table 2). Best control of wild proso millet was achieved using EPTC + dichlomid applied preplant incorporated (PPI) followed by nicosulfuron with 28% N applied postemergence (POST). This treatment averaged 85% control. Highest corn yield was achieved using nicosulfuron with 28% N. This treatment yielded almost 8000 lb/A. Corn yields were lowest in treatments that were injured severely or did not have a POST application following a PPI or premergence herbicide. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303.)

Table 2. Sweet corn injury, wild proso millet control and ear yield, near Jerome, Idaho.

Treatment	Rate	Timing	Crop injury	PANMI control[1]	Corn yield
	lbs ai/A		------------ % ------------		lbs/A
Check			0	0	3788
Pendimethalin +	0.75	PRE	24	75	3788
cyanazine /	1.0				
sethoxydim	0.19	PDIR			
SAN 582H	1.25	PRE	0	5	3409
SAN 582H	2.50	PRE	0	34	1894
Acetochlor	3.0	PRE	0	44	7576
Acetochlor /	2.0	PRE	5	75	7197
nicosulfuron1	0.024	POST			
28% N					
EPTC & dichlormid	4.0	PPI	0	16	3409
EPTC & dichlormid/	4.0	PPI	0	85	6818
nicosulfuron[2]	0.024	POST			
28% N					
Alachlor /	2.0	PPI	0	8	1894
alachlor	2.0	PRE			
Alachlor /	2.0	PPI	0	64	4167
nicosulfuron[2]	0.024	POST			
28% N					
CGA-180937 /	1.5	PPI	3	13	2273
CGA-180937	1.5	PRE			
CGA-180937 /	1.5	PPI	0	48	6439
nicosulfuron[2]	0.024	POST			
28% N					
EPTC & dichlormid/	6.0	PPI			
sethoxydim[3]	0.19	PDIR	33	55	1894
EPTC & dichlormid/	6.0	PPI			
sethoxydim[4]	0.19	PDIR	68	69	758
EPTC & dichlomid/	6.0	PPI			
sethoxydim[4]	0.19	PDIR	15	53	3409
EPTC & dichlormid	6.0	PPI			
paraquat[2]	0.25	PDIR	11	69	3030
Nicosulfuron[2]	0.024	POST	0	15	2273
Nicosulfuron[2]	0.024	POST	0	68	4167
28% N					
Nicosulfuron[2]	0.031	POST	10	20	3409
Nicosulfuron[2]	0.031	POST	1	74	7954
28% N					

[1]Wild proso millet (PANMI) control was evaluated July 7, 1992.
[2]Nonionic surfactant added at 0.25% v/v.
[3]Crop oil concentrate added at 1 quart/A.
[4]Dash added at 1 quart/A.

<u>The response of five crops to residues of postemergence sulfonyurea herbicides used on silage corn</u>. Evans, J.O. and R.W. Mace. Nicosulfuron, primsulfuron, and rimsulfuron were applied to corn on June 25, 1991 in 10 by 100 ft strips across the corn rows. There were three replications arranged in a RCB design. Herbicides were applied with a bicycle sprayer delivering 16 gpa at 40 psi using 8001 flatfan nozzles with 18 inch spacing. The soil was a silt loam with a water table at 1.5 to 2 feet below the surface.

Beginning in March, 1992 various crops as shown in Table 1 were planted across the herbicide treatments to evaluate residual herbicide effects. All crops were hand weeded every two weeks. The field received 4 cm of rain and 30 cm of irrigation water over the season. Height and visual injury evaluations were taken during the growing season with no significant symptoms observed. At harvest there were no significant yield variations in any of the crops as displayed in Table 2. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Table 1. Crop and planting design used in the plantback study.

Crop	Variety	Planting date	Planting depth	Row spacing	Seeding rate
			------in------		lb\A
Alfalfa	Fortress	3-26-92	1/2	8	12
Barley	Steptoe	3-27-92	1	6	74
Wheat	Freemont	3-27-92	1	6	78
Sugarbeets	HM-WS62	4-22-92	1	30	2
Pinto beans	UI-129	5-20-92	2	30	

Table 2. 1992 crop yields following corn treated with sulfonylurea herbicides.

Herbicide	Rate (5/25/91)	Alfalfa 1st	Alfalfa 2nd	Wheat	Barley	Pinto beans	Sugarbeets
	oz ai/A	----T/A----		bu/A	bu/A	Cwt/A	T/A
Nicosulfuron +X-77 0.25%	0.5	2.61	1.43	28.1	48.4	22.7	42.5
Nicosulfuron +X-77 0.25%	1.0	2.87	1.33	31.4	55.8	23.2	32.9
Nicosulfuron +X-77 0.25%	2.0	2.92	1.47	28.9	62.2	25.3	45.3
Rimsulfuron +X-77 0.25%	0.5	2.91	1.41	27.8	50.5	22.6	36.5
Rimsulfuron +X-77 0.25%	1.0	2.84	1.51	28.7	51.4	23.1	41.1
Primsulfuron +X-77 0.25%	0.5	2.86	1.39	23.3	51.5	21.7	45.3
Untreated		2.94	1.39	24.4	41.2	22.7	42.5
(LSD @ 0.05)		0.59	0.17	7.9	20.7	3.81	15.2

Evaluation of unregistered herbicides in field corn. Mitich, L.W., E.J. Roncoroni, and G.B. Kyser. Seven herbicides, including the unregistered materials nicosulfuron, pyridate, MON 12037, and MON 12041, were evaluated for weed control and crop tolerance in 'SeedTech 5908' field corn. The experimental field, composed of Yolo clay loam, has for several years had heavy infestations of barnyardgrass (ECHCG), velvetleaf (ABUTH), and purslane (POROL).

Corn was planted 15 June 1992. Preplant treatments were applied and incorporated the day of planting. Early postemergence treatments were applied 3 July; temperatures during the following 24 hours peaked at 90F and reached a low of 58F. Corn plants were in the third leaf stage; velvetleaf had up to 2 leaves; purslane had 1 to 3 leaves; and barnyardgrass was up to 2 inches tall. One late postemergence treatment (a second application of nicosulfuron) was applied 17 July, a day with a maximum of 97F and a minimum of 60 F.

All treatments were applied with a CO_2 backpack sprayer delivering 25 gpa of spray solution at 30 psi through 8002 nozzles.

Two evaluations were conducted: (a) a count of weeds in the crop row, performed 22 July; (b) a visual evaluation of weed control and crop tolerance, performed 3 August. The weed count indicates actual numbers of weeds, while the visual evaluation provides an indication of weed size and relative dominance. Nicosulfuron and MON 12037 alone produced relatively poor control of both barnyardgrass and broadleaf weeds. Low rates of MON 12041 produced poor weed control, but higher rates produced fair to good control of broadleaf weeds. Treatments most effective at controlling all weed species included alachlor + MON 12037 and alachlor + MON 12041, though the latter treatment produced the only significant crop phytotoxicity observed in the study.

Lowest yields of corn were obtained from control plots, plots treated wtih MON 12037 alone, plots treated with a low rate of alachlor + pyridate + atrazine, or plots treated with low rates of MON 12041 alone. Highest yields were obtained from plots treated with alachlor plus higher rates of atrazine or dicamba and/or pyridate, and from plots treated with sequential applications of nicosulfuron. Owing to the lack of crop injury and to the pattern of yield variance, it is felt that weed control was the primary influence on yield variation.

The unregistered chemicals nicosulfuron, and pyridate and MON 12037 in conjunction with alachlor, were judged potentially useful in field corn. MON 12041 did not distinguish itself in this trial. (Division of Plant Biology, University of California, Davis, CA 95616.)

Table. Results of weed counts and visual evaluations in Mitich field corn trial

				Weeds in 4 m of row, counted 7/22[1]			Visual evaluations 8/3 for crop phyto, weed control (%)[1,2]			Yield (g)[1], 20 ft
Preplant treatment	Rate (a.i./a)	Postemergence treatment	Rate (a.i./a)	Byg (53.3)	Vel (20.7)	Pur (38.3)	Phyto (4.08)	Byg (24.9)	Broadleaves (19.3)	(880.5)
		nicosulfuron	2/3 oz	44	6	93	0	65	60	5093
		nicosulfuron (sequential)	2/3 oz + 2/3 oz	51	12	89	2.5	75	55	5380
alachlor	2 lb	pyridate + atrazine[3]	0.45 lb + 0.6 lb	13	21	2	0	80	78	4070
alachlor	2 lb	pyridate + atrazine[3]	0.7 lb + 0.6 lb	15	4	0	0	80	88	5556
alachlor	2 lb	pyridate + atrazine[3]	0.9 lb + 1.2 lb	25	7	0	0	78	88	5350
alachlor	2 lb	pyridate + dicamba	0.45 lb + 0.25 lb	17	0	0	0	78	98	5347
alachlor	2 lb	atrazine[3]	1.2 lb	6	12	0	0	83	83	5499
		MON 12037[4]	0.016 lb	81	3	117	0	48	38	4093
		MON 12037[4]	0.032 lb	101	24	64	0	48	45	3712
alachlor	3 lb	MON 12037[4]	0.016 lb	1	0	0	0	98	93	5193
alachlor	3 lb	MON 12037[4]	0.032 lb	4	2	6	2.5	83	93	4985
alachlor	3 lb			4	10	37	0	90	73	4532
alachlor + cyanazine	3 lb + 2 lb			4	15	0	0	83	88	4658
MON 12041	0.065 lb			78	9	2	2.5	75	80	4263
MON 12041	0.091 lb			64	15	0	2.5	58	80	4142
MON 12041	0.125 lb			38	6	0	0	58	95	4675
MON 12041 + alachlor	0.065 lb + 3 lb			5	5	0	5.0	98	83	4868
MON 12041 + alachlor	0.125 lb + 3 lb			0	7	0	15.0	95	83	4307
control				100	19	106	0	10	8	3664

ABBREVIATIONS: Byg = barnyardgrass, Vel = velvetleaf, Pur = purslane, Phyto = crop phytotoxicity.

[1]All values averaged over 4 replications. Values in parentheses represent least significant differences at the 5% level.

[2]100% = complete weed control or crop phytotoxicity.

[3]Applied with 1 qt crop oil concentrate per acre.

[4]Applied with 0.5% v/v X-77 surfactant.

Simulated plant-back following application of ethofumesate or DPX-66037. Norris, R. F., and J. A. Roncoroni. This study was initiated to determine the effects of a simulated same-season plant-back after an herbicide application to a field that had been planted to sugarbeets. The experiment was conducted on Reiff very fine sandy loam soil on the U.C. Davis experimental farm. The crops used to determine the effects were 'ST 5908' corn, 'Yolano' pink beans, and 'E2502 Moran Sierra Gold' cantaloupes. The treatments applied were ethofumesate at 0.75 and 1.5 lbs a.i./a, DPX-66037 at 0.5, 1.0, and 1.5 oz a.i./a, and an untreated control. The plot layout was a split-split plot with three replications. The main plots were 7, 14, or 28 day delay in planting after application. The three crops were the split plot, and the herbicide treatments were the split-split plot.

Treatments were applied on June 2, 1992 to the top of shaped beds in a 12-inch band, using a CO^2 backpack sprayer with 8001E flat fan nozzles set at 30 psi and delivering 30 gal/a. Main plots were 35 ft wide (four-30 inch center beds per sub-plot with a guard bed between subplots) by 120 ft long. Sub-sub plots were 4 beds wide by 20 ft long. Prior to planting the beds were reshaped using a Lilliston rolling cultivator. The beans were planted to moisture. The corn and cantaloupes were irrigated after planting. All other irrigation was on an as needed basis. The planting dates were June 9 for the 7-day delay, June 15 for the 14-day delay, and June 30 for the 28-day delay. All plots were machine cultivated and handweeded to keep them weed-free throughout the growing season.

All corn was harvested on November 13, 1992, and all beans were harvested on October 26, 1992. The cantaloupes were multiple harvested as needed. The harvested area of all plots was 15 ft long from the center two rows. Data for corn was adjusted to 14% moisture; data for cantaloupes is on a fresh weight basis.

Split plot ANOVA for each crop showed that there was no significant differences (P = 0.5) between treatments at any planting date, or when combined across planting dates. Under the conditions of the experiment, the herbicides applied in this simulated plant-back situation did not affect growth and yield of corn, dry beans, or cantaloupes. (Section of Botany, University of California, Davis).

Table 1. Effect of simulated plant-back of corn, kidney beans, or cantaloupe following application of ethofumesate or DPX-66037.

Treatment	Rate	Corn	Beans	Cantaloupes
	a.i./a	--------------------kg/plot--------------------		
Ethofumesate	0.75 lb	5.65	1.43	24.2
Ethofumesate	1.5 lb	6.79	1.35	22.0
DPX-66037	0.5 oz.	6.64	1.29	24.9
DPX-66037	1.0 oz.	6.13	1.52	24.3
DPX-66037	1.5 oz.	6.01	1.50	25.6
Untreated	-	5.70	1.54	22.9

Control of shattercane in imazathapyr tolerant corn. Tonks, D.J., T.J. D'Amato, and P. Westra. Six herbicides were evaluated for control of shattercane (Sorghum bicolor (L.) Moench) in imidazolinone-tolerant corn (Zea Maize L.). Herbicides were applied pre-plant incorporated (PPI), early post-emergence (EPOST), and late post-emergence (LPOST). The experiment was located near Cope, CO and was arranged as a randomized complete block design with three replications, plot size was 10 by 90 feet. Imidazolinone-tolerant corn 'Pioneer 3377-R' was planted on May 5, 1992 after PPI treatments were made. Terbufos was also applied at the time of planting. PPI treatments were applied using a CO_2 powered backpack sprayer delivering 13 gpa at 23 psi using 11001LP tips. EPOST treatments were applied to corn on June 5, 1992 when the corn was approximately 4 inches tall and shattercane was 1-3 inches in height. LPOST treatments were applied in June 6. All post herbicides were applied using 11002LP tips delivering 19 gpa at 22 psi. Corn was 12-14 inches tall and shattercane was 12-14 inches in height.

Several of the herbicide treatments caused corn injury based on stunting, chlorosis, and reduced corn yield. pendimethalin/cyanazine combination was the most damaging to the corn and significantly impacted yield. Injury symptoms also were apparent in some imazathapyr treated plots but were not consistent across all treatments.

Shattercane control was rated as good to excellent by all treatments with the exception the of Pendimethalin/cyanazine combination. Shattercane control from treatments with imazethapyr ranged from 73 to 93%. Shattercane was controlled by nicosulfuron at the 94% level. Timing of herbicide application did not have an effect on shattercane control or corn injury. Results from this experiment indicate that imazathapyr, especially with other herbicides such as atrazine, cyanazine, and EPTC is highly effective for control of shattercane. Nicosulfuron is also highly effective for shattercane control. Uncontrolled shattercane significantly decreased corn yield. (Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80523.)

Control of shattercane in imidazolinone tolerant corn[1].

Treatment	Rate	Application Timing	Corn Injury 6-18-92	Corn Injury 7-14-92	Shattercane Control 6-18-92	Shattercane Control 7-14-92	Corn Yield
	(lb ai/a)		----(%)----		------(%)------		(bu/a)
CHECK			0 a	0 a	0 c	0 d	57 cd
Imazethapyr	0.063	PPI	0 a	17 b	82 a	73 b	112 ab
Imazethapyr Atrazine	0.063 0.50	PPI	0 a	0 d	83 a	83 ab	125 ab
Imazethapyr EPTC	0.063 4.0	PPI	0 a	0 d	90 a	82 ab	120 ab
Imazethapyr Cyanazine	0.063 1.0	PPI	0 a	12 bcd	83 a	88 a	139 a
EPTC Imazethapyr SUN-IT	4.0 0.063	PPI EPOST	0 a	3 cd	92 a	84 ab	134 ab
Imazethapyr Atrazine SUN-IT	0.063 0.50	EPOST	0 a	0 d	90 a	89 a	125 ab
Imazethapyr SUN-IT	0.063	EPOST	0 a	7 bcd	90 a	93 a	132 ab
Imazethapyr Cyanazine SUN-IT	0.063 1.0	EPOST	0 a	13 bc	83 a	91 a	88 bcd
Imazethapyr Bromoxynil SUN-IT	0.063 0.25	EPOST	0 a	0 d	90 a	73 b	103 ab
Pendimethalin Cyanazine	1.0 1.0	EPOST	0 a	50 a	33 b	20 c	48 d
Nicosulfuron SUN-IT	0.032	LPOST	--[2]	16 b	--	94 a	101 abc

[1]Means within a column followed by the same letter are not statistically different (P=0.05).
[2]Treatment with nicosulfuron was applied June 6, 1992 and evaluations were not made until July 14.

Southwestern cupgrass control in corn. Campbell, M. L. and R. C. Leavitt. Southwestern cupgrass has recently become a problem in field crops in the Central Valley of California, and control with preemergent herbicides has been unsatisfactory. This study was done near Modesto comparing the efficacy of two postemergence herbicides with and without surfactant.

Trial design was a randomized complete block with four replications. Each plot was eight feet by 25 feet. All applications were made at 28 gal/a water using a CO_2 backpack sprayer equipped with 8003 flat fan teejet nozzles at 30 psi.

The first application was sprayed over the top of ten inch high (5-6 leaves) to cupgrass one to seven inches high on June 5, 1992. Although the corn and weeds were turgid in the morning, they were visibly stressed for water when the application went on at about noon (85°F). A second application of nicoslufuron alone and in combination with two adjuvents was made on June 19 when the corn was two feet tall and the cupgrass was about eight inches across by five inches tall. The temperature at this application was 68°F, with adequate moisture for the crop and weeds.

Nicosulfuron without surfactant applied under water stressed conditions stunted the cupgrass somewhat but did not provide effective control. All nicosulfuron treatments applied later to well-watered larger weeds provided excellent control of the cupgrass, including nicosulfuron without surfactant. Addition of ajuvents visibly improved weed control over the nicosulfuron alone but rating differences are not statistically significant. None of the metribuzen treatments had any discernable effect on either the corn or the weeds at the first application and this material was not included in the second series of applications because several other trials had already confirmed a lack of efficacy. There was no evidence of injury to the corn from any of the treatments in this study. (University of California Cooperative Extension, Stanislaus County, 733 County Center 3, Modesto, CA, 95355)

Postemergence southwestern cupgrass control in corn
in the Central Valley of California

Herbicide	Rate (lb/a ai)	Application date	% control	LSD .05
nicosulfuron + surfactant[1]	.0125	June 19[3]	99	a
nicosulfuron + scoil[2]	.0125	June 19[3]	98	a
nicosulfuron only	.0125	June 19[3]	91	a
nicosulfuron only	.0125	June 5[4]	38	b
nicosulfuron + metribuzin	.0125 + .070	June 5[4]	38	b
metribuzin	.070	June 5[4]	0	c
metribuzin	.106	June 5[4]	0	c
metribuzin	.141	June 5[4]	0	c

[1]surfactant "Activator 85" added at 0.4% v/v.

[2]scoil (methylated soybean oil) added at 0.4% v/v.

[3]cupgrass 8 in. diameter, well-watered

[4]cupgrass large seedlings, water stressed

Control of puncturevine and citron melon in corn with nicosulfuron in central California. Campbell, M.L. and R.C. Leavitt. Puncturevine and citron melon are problem broadleaf weeds in corn production in California. Two replicated experiments and one non-replicated experiment were conducted in central California to determine the efficacy of nicosulfuron for control of these two weeds.

In the first experiment, nicosulfuron was compared to dicamba, bromoxynil, 2,4-D amine, and tank mixes of nicosulfuron with dicamba and nicosulfuron with bromoxynil. All treatments were applied with a CO_2 back pack sprayer at 2.1 kg/cm2 pressure, 271 liters/ha, and using 8003 nozzles on July 1, 1992. Corn was 0.5 meter tall. Puncturevine was 0.3 to 0.8 meters in diameter with flowers and a few small seeds. Citron melon was all sizes from seedling to 0.3 meter runners. Treatments were replicated 4 times; plots were 8.5 by 6.1 meters in size.

In the second experiment, nicosulfuron was applied using a tractor mounted sprayer to an almost solid stand of large puncturevine and citron melon on July 3, 1992. Treatments were applied at 2.1 kg/cm2 pressure at 187 liters/ha, using 8003 vs teejet nozzles. At the time of treatment, puncturevine covered 98% of the ground surface, and citron melon 2%. Treatments were replicated 8 times; plots were 61.0 by 4.6 meters in size.

In the non-replicated experiment, nicosulfuron was applied to a 2.0 hectare block of corn on June 12, 1992. Application was by a Spray-Coupe at 2.1 kg/cm2 pressure at 94 liters/ha using 8004 nozzles. Weed sizes were similar to those in the first experiment.

Nicosulfuron application rate was at 0.014 kg ai/ha in every experiment with "Activator 85" surfactant added at 0.25% v/v. Evaluation was by visual rating. All three experiments were planted to oats in the late fall after corn harvest, and a visual evaluation made for any crop phytotoxicity.

In the first (back pack applied) experiment, nicosulfuron plus surfactant controlled puncturevine 92% and citron melon 75%. The best control of puncturevine was provided by dicamba plus surfactant (98%) and by nicosulfuron plus dicamba plus surfactant (96%). See table for complete ratings.

In the second (tractor) experiment, nicosulfuron plus surfactant stunted puncturevine 96% and citron melon by 85%. In the third (Spray-Coupe) experiment, nicosulfuron plus surfactant stunted puncturevine and citron melon 98% and 90%. (The tractor and Spray-Coupe applied experiments were rated by percent stunt rather than percent control because of the large size of the weeds at the time of application).

The oats planted in the fall after corn harvest in all three experiments showed no sign of phytotoxicity from any treatment.

Control of puncturevine and citron melon in corn in central California

Herbicide	Rate (kg ai/ha)	% weed control Puncturevine	Citron melon	% injury to corn
Dicamba	0.56	98	73	0
Nicosulfuron +dicamba	0.014 +0.56	96	56	0
Nicosulfuron	0.014	92	75	0
Nicosulfuron +bromoxynil	0.014 +0.42	89	--	0
Bromoxynil	0.42	79	40	0
2,4-D	0.53	77	--	0
Check		0	0	0

Surfactant "Activator 85" added to all nicosulfuron treatments at 0.25% v/v

Grass Weed Control In Spring Canola. Ball, D.A. An experiment was established in spring canola at the Hansell Bros. farm, Hermiston, OR, to evaluate postemergence (POST) herbicides for grass weed control. A RCB design was set up with 10 ft x 30 ft plots and 4 replicates. Spring canola var "Helios" was seeded on March 10, 1992 at 5 lb/a with a Brillion seeder and again on March 23, 1992 because of poor initial emergence at 5 lb/a. Early postemergence (EPOST) herbicide treatments were applied on April 21, 1992 in H_2O at 16 gpa at 32 psi. Canola plants were at the 2.5-4.5 leaf stage (3 in high) at time of treatment. Weed species present were volunteer wheat (5-7 leaf, 2-3 tillers), green foxtail (3 leaf), ryegrass spp. and downy brome (scattered and heading). Crop injury and weed control were assessed at 7, 17 and 27 days after treatment.

Application Details:

EPOST	Date: April 21, 1992
Air temp: 51F	Sky: partly cloudy
Wind: SW at 8 mph	Soil temp: 0-in 60F, 1-in 56F, 2-in 56F
Relative humidity: 74%	Soil moisture: moist to 10-in
Organic matter: 1.3%	Soil pH: 7.6
Soil type: Loamy sand	
Sand: 78.2% Silt: 18.8%	Clay: 3.0%

No injury from the herbicides applied (fluazifop-p-butyl, sethoxydim) was evident at any time after spraying. All herbicides gave good control of both wheat and downy brome. In general, fluazifop-p-butyl treatments gave slightly better control than sethoxydim treatments after 17 days. There was little difference between the two herbicides after 27 days. Sethoxydim at 0.19 lb/a gave significantly less control than other treatments at 27 days. The results of this experiment indicate that both fluazifop-p-butyl and sethoxydim provided acceptable grass weed control without crop injury in spring seeded canola crop. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Grass Weed Control In Canola

Compound Tested	Rate (lb ai/a)	17 DAT % Vol. Wheat Control	17 DAT % BROTE Control	27 DAT % Vol. Wheat Control	27 DAT % Brote Control
sethoxydim OC	0.19 0.125	79	79	93	84
sethoxydim OC	0.28 0.125	81	89	90	98
sethoxydim Dash	0.19 0.125	84	71	83	99
sethoxydim Dash	0.28 0.125	86	46	63	96
fluazifop-p-butyl OC	0.187 0.125	86	100	100	99
fluazifop-p-butyl OC	0.25 0.125	93	100	100	100
control		0	0	0	0
LSD (0.05)		8	40	23	7

BROTE = Downy Brome
DAT = Days after treatment

Evaluation of postemergence herbicides and herbicide additive combinations for weed control in canola. Brennan, J.S. and D.C. Thill. Grass and broadleaf weeds can reduce canola seed yield. Trifluralin, the only herbicide registered for weed control in canola, does not control many grass and broadleaf weeds. Field experiments were conducted near Craigmont and Tensed, Idaho to evaluate postemergence grass and broadleaf herbicides for weed control in canola and evaluate the effectiveness of several additives on increasing herbicide efficacy.

Plots were 10 by 30 feet and treatments were arranged as 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 March 29, 1992 at Craigmont and on April 15, 1992 at Tensed. Herbicides were applied May 7 and May 19 at Craigmont and Tensed, respectively, with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Crop injury was evaluated visually on May 26 at Craigmont and May 27 and June 3 at Tensed. Weed control was evaluated visually on May 26 and June 18 at Craigmont and on June 3 and June 25 at Tensed. Canola seed was direct combine harvested at Craigmont on August 17 and Tensed on August 18 from a 120.5 ft^2 area. Frost on May 11 at Craigmont reduced canola stand, and seed yield was reduced by drought conditions throughout the growing season at both locations.

Table 1. Herbicide application data

Location	Craigmont	Tensed
Application date	May 7	May 19
Growth stage:		
canola	2 to 4 leaf	2 to 6 leaf
wild oat (AVEFA)	1 to 3 leaf	------
mayweed chamomile (ANTCO)	cot[1] to 4 leaf	2 to 6 leaf
field pennycress (THLAR)	cot to 5 leaf	2 to 8 leaf
common lambsquarters (CHEAL)	2 to 3 leaf	------
henbit (LAMAM)	------	2 to 4 leaf
quackgrass (ELYRE)	------	3 to 5 leaf
Air temperature (F)	81	70
Soil temperature (F), @ 2 in.	74	73
Relative humidity (%)	33	54
Wind (mph) - direction	5 - N	3 - N
Clouds (%)	30	5
Soil pH	5.7	5.6
OM (%)	5.1	3.3
CEC (meq/100g soil)	30.4	17.0
texture	silt loam	silt loam

[1]cotyledon

Wild oat (AVEFA) control was 95% or greater with sethoxydim and quizalofop alone and when tank mixed with ethametsulfuron and clopyralid (Table 2). Quackgrass (ELYRE) control was no greater than 78% with sethoxydim and was greater than 90% with quizalofop and additives did not effect control. Common lambsquarters (CHEAL) and field pennycress (THLAR) were not controlled at Craigmont. Field pennycress control was no greater than 80% at Tensed. Henbit (LAMAM) control ranged from 42 to 93% with ethametsulfuron. Clopyralid was effective on mayweed chamomile only. Mayweed chamomile control ranged from 75 to 99% with clopyralid and was not controlled by ethametsulfuron at either site. Treatments containing Sun It II and combinations of Sun It II + R-11, Sun It II + 32-0-0 or R-11 + 32-0-0 generally increased the phytotoxicity of the herbicide treatments more than other additives. No herbicide injury was noted at either location. Canola seed yield at Craigmont was greater when a grass and broadleaf herbicide were applied compared to these herbicides applied alone. Seed yield from herbicide treated canola were not different from the untreated check at Tensed. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Weed control in canola with postemergence herbicides

		Craigmont						Tensed					
Treatment	Rate	Canola injury	AVEFA	CHEAL	ANTCO	THLAR	Canola yield	Canola Injury	ANTCO	LAMAM	THLAR	ELYRE	Canola yield
	lb ai/a	---%--	-------% control-------				lb/a	---%--	------% control--------				lb/a
check		--	--	--	--	--	5	--	--	--	--	--	667
sethoxydim + MorAct[1]	0.19 2 pt	0	99	0	0	0	32	0	0	0	0	51	572
sethoxydim + MorAct	0.28 2 pt	0	99	0	0	0	23	0	0	0	0	55	670
sethoxydim + Sun-It II/DASH[2]	0.19 2 pt	0	99	0	0	0	47	0	0	0	0	56	659
sethoxydim + Sun-It II/DASH	0.28 2 pt	0	99	0	0	0	43	0	0	0	0	55	505
quizalofop + Sun-It II	0.063 2 pt	0	99	0	0	0	48	0	0	0	0	91	624
quizalofop + Sun-It II	0.088 2 pt	0	98	0	0	0	27	0	0	0	0	95	606
clopyralid	0.094	0	0	0	97	0	12	0	75	0	0	0	606
clopyralid	0.188	0	0	0	99	0	6	0	92	5	0	0	548
ethamt[3] + clopyralid + R-11[4]	0.018 0.094 0.25%	0	0	0	99	0	5	0	75	64	33	0	504
ethamt + R-11	0.018 0.25%	0	0	0	0	0	4	0	0	43	8	0	624
ethamt + R-11	0.027 0.25%	0	0	0	0	0	12	0	8	68	56	0	583
ethamt + Sun It II	0.018 0.25%	0	0	0	0	0	5	0	0	88	46	0	579
ethamt + 32-0-0[5]	0.018 0.25%	0	0	0	0	0	10	0	0	42	20	0	642
ethamt + R-11 32-0-0	0.018 0.25% 0.25%	0	0	0	0	0	4	0	0	77	45	0	632
ethamt + Sun It II 32-0-0	0.027 2 pt 0.25%	0	0	0	0	8	4	0	0	91	47	0	536
sethoxydim + ethamt + Sun-It II + R-11	0.28 0.018 1 pt 0.25%	0	99	0	0	44	89	0	13	89	63	48	773
sethoxydim + ethamt + R-11 + 32-0-0	0.28 0.018 0.25% 2 qt	0	97	0	0	16	59	0	8	88	49	39	582
sethoxydim + ethamt + Sun It II + 32-0-0	0.28 0.018 2 pt 2 qt	0	99	0	0	26	67	0	8	88	43	55	506
sethoxydim + ethamt + clopyralid + R-11 + Sun-It II	0.28 0.018 0.094 0.25% 2 pt	0	99	0	97	23	111	0	38	79	60	78	613

continued

Table 2. Continued

Treatment	Rate	Craigmont Canola injury	Craigmont AVEFA	Craigmont CHEAL	Craigmont ANTCO	Craigmont THLAR	Craigmont Canola yield	Tensed Canola Injury	Tensed ANTCO	Tensed LAMAM	Tensed THLAR	Tensed ELYRE	Tensed Canola yield
	lb ai/a	---%--	-------% control-------				-lb/a	---%--	-------% control-------				lb/a
sethoxydim +	0.28												
ethamt +	0.018												
clopyralid +	0.094												
Sun-It II +	2 pt												
32-0-0	2 qt	0	99	0	99	31	85	0	10	89	27	63	542
quizalofop +	0.088												
ethamt +	0.018												
R-11	0.25%	0	99	0	0	3	40	0	0	89	33	90	657
quizalofop +	0.088												
ethamt +	0.018												
Sun It II	2 pt	0	98	0	0	19	38	0	0	90	63	95	597
quizalofop +	0.088												
ethamt +	0.018												
32-0-0	2 qt	0	99	0	0	5	25	0	10	90	27	95	392
quizalofop +	0.088												
ethamt +	0.018												
Sun-It II +	1 pt												
R-11	0.25%	0	98	0	0	13	64	0	0	68	80	95	591
quizalofop +	0.088												
ethamt +	0.018												
R-11 +	0.25%												
32-0-0	2 qt	0	99	0	0	16	32	0	0	87	20	90	661
quizalofop +	0.088												
ethamt +	0.018												
Sun It II +	2 pt												
32-0-0	2 qt	0	99	0	0	19	45	0	0	93	58	96	721
quizalofop +	0.088												
ethamt +	0.018												
clopyralid +	0.094												
R-11 +	0.25%												
Sun-It II +	2 pt	0	98	0	99	29	87	0	90	90	68	95	759
quizalofop +	0.088												
ethamt +	0.018												
clopyralid +	0.094												
Sun-It II +	2 pt												
32-0-0	2 qt	0	95	0	98	34	114	0	97	91	78	94	574
density plants/ft^2			21	1	23	26	5		9	6	1	1	14
LSD (0.05)		0	21	0	18	16	43	0	16	27	24	16	239

[1]MorAct is a petroleum oil concentrate from Wilbur Ellis Co.
[2]Sethoxydim treatments were applied with Sun It II, a methylated crop seed oil from AGSCO, at Craigmont and DASH, a proprietary blend of four adjuvants from BASF at Tensed.
[3]ethamt = ethametsulfuron.
[4]R-11 is a nonionic surfactant from Wilbur Ellis Co. applied on a % v/v basis.
[5]32-0-0 is an aqueous solution of urea and ammonium-nitrate.

Evaluation of preplant incorporated, preemergence, and postemergence herbicides for weed control in canola. Brennan, J.S. and D.C. Thill. Canola acreage is rapidly growing in the Pacific Northwest. Trifluralin is the only herbicide registered for weed control in canola. This herbicide does not adequately control all weed species in canola. An experiment was established near Craigmont, Idaho to evaluate the preplant incorporated (PPI) herbicides (ethalfluralin, pendimethalin, triallate, trifluralin, and a combination of triallate and trifluralin); preemergence (PRE) herbicide (pendimethalin); and triallate, and trifluralin (PPI) followed by postemergence (POST) applications of ethametsulfuron and sethoxydim for weed control in canola.

The predominate weed species present were wild oat (AVEFA), field pennycress (THLAR), mayweed chamomile (ANTCO), and common lambsquarters (CHEAL). Postemergence treatments were applied to 2 to 5 leaf canola, 2 to 5 leaf wild oat, 3 to 8 leaf field pennycress, 2 to 4 leaf mayweed chamomile, and 3 to 5 leaf common lambsquarters on May 13 (Table 1).

Preplant incorporated and preemergence treatments were applied on March 24 and April 5 at 20 gal/a. Postemergence treatments were applied on May 13 at 10 gal/a. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer at 40 psi and 3 mph (Table 1). Plots were 10 by 30 ft. Treatments were arranged in a randomized complete block design with four replications. Preplant incorporated herbicides were incorporated twice with a field cultivator. Canola was seeded 1 in. deep with a double disk drill at 6.0 lb/a, on March 29, 1992. Crop injury was evaluated visually on May 26 and weed control was evaluated visually May 26 and June 18. Canola seed was direct combine harvested on August 17 from 121.5 ft^2 area.

Table 1. Herbicide application data.

Application date	March 24	April 5	May 13
Air temperature (F)	65	33	57
Soil temperature at 2 in. (F)	56	38	53
Relative humidity (%)		56	34
Wind velocity/direction (mph)	4-S	5-N	3-S
Cloud cover (%)	0	20	100
Soil pH	5.7		
organic matter (%)	5.1		
CEC (meq/100g soil)	30.4		
texture	silt loam		

Trifluralin, ethalfluralin, and pendimethalin applied alone (PPI) controlled common lambsquarters 79% or greater, but did not control wild oat, or field pennycress (Table 2). Pendimethalin (PRE) controlled common lambsquarters 56 to 68%. Wild oat control ranged from 45 to 81% with triallate alone or mixed with trifluralin. Field pennycress, and common lambsquarters were not controlled effectively by triallate plus trifluralin treatments. Trifluralin (PPI) plus sethoxydim or ethametsulfuron (POST) controlled common lambsquarters 86 and 88%. Sethoxydim effectively controlled wild oat in all tank mixes. Field pennycress control was variable with sethoxydim plus ethametsulfuron (POST). This variability may be attributed to additives used and frost prior to herbicide application. Mayweed chamomile was not controlled regardless of herbicide used. No herbicide injured canola, but frost on May 11 and subsequent drought conditions greatly reduced canola seed yield. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Weed control in canola with preplant incorporated, preemergence, and postemergence herbicides

Treatment	Rate	Canola injury	AVEFA	THLAR	ANTCO	CHEAL	Canola yield
	lb ai/a	---%--	--------% Control---------				lb/a
check	---	---	---	---	---	---	17
trifluralin (PPI)[1]	0.5	0	0	0	0	84	14
trifluralin (PPI)	0.75	0	0	0	0	91	5
ethalfluralin (PPI)	0.5	0	0	0	0	79	18
ethalfluralin (PPI)	0.75	0	0	0	0	93	21
pendimethalin (PPI)	0.75	0	0	0	0	83	16
pendimethalin (PPI)	1.0	0	0	0	0	80	12
pendimethalin (PRE)	0.75	0	0	0	0	68	7
pendimethalin (PRE)	1.0	0	0	0	0	56	5
trif[2] + tria (PPI)	0.30+1.0	0	45	0	0	53	11
trif + tria (PPI)	0.38+1.25	0	81	0	0	43	18
triallate (PPI)	1.25	0	59	0	0	26	12
triallate (PPI) ethamt[2] + R-11[3] (POST)	1.25 0.018+0.2	0	77	0	0	13	26
trifluralin (PPI) sethoxydim + Sun It II[4] (POST)	0.5 0.28 + 2 pt	0	99	0	0	86	26
trifluralin (PPI) ethamt + R-11 (POST)	0.5 0.018+0.2%	0	0	0	0	88	20
trifluralin (PPI) ethamt + seth Sun-It II + R-11 (POST)	0.5 0.018+0.28 2 pt+0.2%	0	98	95	0	49	23
ethametsulfuron + seth[2] + Sun-It II + R-11 (POST)	0.018 0.28+2 pt 0.2%	0	98	30	0	10	27
density (plants/ft^2)			5	3	11	2	4
LSD (0.05)		---	20	14	---	35	12

[1]preplant incorporated (PPI), preemergence (PRE), postemergence (POST)
[2]trif = trifluralin, tria = triallate, ethamt = ethametsulfuron, seth = sethoxydim.
[3]R-11 is a nonionic surfactant applied on a % v/v.
[4]Sun-It II is a methylated crop seed oil.

Evaluation of canola varieties and herbicides on weed control in irrigated and nonirrigated canola. Brennan, J.S. and D.C. Thill. Field experiments were conducted near Rathdrum, Greencreek, and Tensed, Idaho to evaluate the effect of canola varieties and herbicides on weed control in canola under irrigated and nonirrigated environments. Rathdrum was the irrigated site and Greencreek and Tensed were the nonirrigated sites. Plots were 10 by 20 feet and treatments were arranged in a randomized complete block split plot design, with canola varieties as main plots and herbicides as subplots. Treatments were replicated four times. Canola varieties were seeded 0.5 in. deep with a double disk cone seeder on April 23, 1992 at Rathdrum, April 15, 1992 at Tensed, and 1 in. deep on April 8, 1992 at Greencreek. Canola was seeded at 7 lb/a at all locations. Carbofuran was applied with the seed at 0.35 lb ai/a as 'Furadan CR10' for flea beetle control. Rathdrum was first irrigated on May 23 and subsequently irrigated every eight days with 2 in. of irrigation water through July 19.

Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Crop injury was evaluated visually on June 8, May 29, and June 3, at Rathdrum, Greencreek, and Tensed, respectively. Weed control was evaluated visually June 9 and June 25 at Rathdrum, May 29 and June 9 at Greencreek, and June 25 at Tensed. Canola seed was direct combine harvested from a 76.5 ft^2 area at Rathdrum and Tensed on August 31 and 18, respectively. Canola was not harvested at Greencreek due to severe hail damage.

Table 1. Herbicide application data

Location	Rathdrum	Greencreek	Tensed
Application date	May 27	May 7	May 19
Growth stage:			
canola	3 to 5 leaf	1 to 4 leaf	2 to 6 leaf
field pennycress (THLAR)	4 to 8 leaf	2 to 8 leaf	2 to 8 leaf
henbit (LAMAM)	2 to 4 leaf	Cot to 4 leaf	---
tumble mustard (SSYAL)	4 to 6 leaf	---	---
c. lambsquarters (CHEAL)	4 to 6 leaf	---	
wild oat (AVEFA)	2 to 4 leaf	---	---
mayweed chamomile (ANTCO)	---	cot to 4 leaf	2 to 6 leaf
volunteer wheat (TRIAE)	---	1 to 3 leaf	---
prostrate kotweed (POLAV)	---	---	2 to 8 leaf
Penn. smartweed (POLPY)	3 to 4 leaf	---	---
Air temperature (F)	75	82	73
Soil temperature (F) @ 2 in.	70	86	72
Relative humidity (%)	58	35	44
Wind (mph) - direction	5 - W	5 - N	5 - N
Cloud cover (%)	45	0	30
Soil data:			
pH	6.1	5.8	5.0
organic matter (%)	5.6	4.5	3.4
CEC (meq/100g soil)	34.4	29.5	18.0
texture	silt loam	silt loam	silt loam

[1]cotyledon

No treatment interactions were significant; therefore, only main effects are reported (Tables 2 and 3). Field pennycress control at Rathdrum was greater when IMC01 was seeded compared to IMC144, but was not different from the other varieties (Table 2). Seed yield was lower from IMC01 at Tensed and was less from IMC144 at Rathdrum compared to the other varieties. Mayweed chamomile, field pennycress, and common lambsquarters control generally was greater with sethoxydim + ethametsulfuron + clopyralid than ethametsulfuron + clopyralid (Table 3). Canola seed yield was highest with handweed treatments at Rathdrum. Canola seed yield was not different at Tensed regardless of treatment. No canola injury was noted from weed control treatments at all sites (data not reported). (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Weed response to canola varieties averaged over herbicide treatments

	Tensed		Greencreek				Rathdrum					
Variety	ANTCO	Canola yield	TRIAE	THLAR	LAMAM	ANTCO	THLAR	CHEAL	POLPY	SSYAL	AVEFA	Canola yield
	-%[1]--	lb/a	-----------------------			-% control-	-------------------------					lb/a
IMC01	46	171	59	45	59	59	49	50	57	59	59	304
IMC129	49	315	59	42	59	59	48	45	57	59	59	319
IMC144	52	341	59	39	58	59	45	47	57	59	59	196
Legend[2]	42	362	59	45	64	64	46	45	57	59	59	300
Westar[2]	47	204	59	44	59	59	48	46	57	59	59	299
density (plants/ft^2)	5	5	1	10	3	4	7	10	19	1	2	4
LSD (0.05)	10	170	NS	9	7	7	3	5	2	NS	7	129

[1]% control
[2]Legend and Westar are registered canola varieties included for comparison.

Table 3. Evaluation of postemergence herbicides averaged over canola varieties

Treatment	Rate	Tensed		Greencreek				Rathdrum					
		ANTCO	Canola yield	TRIAE	THLAR	LAMAM	ANTCO	THLAR	CHEAL	POLPY	SSYAL	AVEFA	Canola yield
	lb ai/a	-%[4]--	lb/a	-----------------% control-----------------------									lb/a
check		--	281	--	--	--	--	--	--	--	--	--	160
Handweed[1]		85	271	94	94	94	94	99	99	99	99	99	616
sethoxydim + Sun-It II[2]	0.28 1 pt	5	289	99	4	5	5	0	0	0	0	99	180
ethametsulfuron + clopyralid + R-11[4]	0.018 0.094 0.2%	64	237	5	39	99	99	63	61	92	99	0	214
sethoxydim + ethametsulfuron + clopyralid + Sun-It II + R-11	0.28 0.018 0.094 1 pt 0.2%	82	316	99	71	98	99	76	73	93	99	94	250
density (plants/ft^2)		5	5	1	10	3	4	7	10	19	1	2	4
LSD (0.05)		12	81	10	12	12	12	4	3	1	NS	6	47

[1]Handweeded plus a postemergence treatment of sethoxydim + ethametsulfuron + clopyralid + Sun-It II + R-11 with the same rates as in this table
[2]Sun-It II is a methylated seed oil.
[3]R-11 is a nonionic surfactant applied on a % v/v basis.
[4]% control

Hairy nightshade control with metham. Vargas, Ron. A fine sandy loam field, known to be infested with hairy nightshade was divided into plots, that were 4, 38 inch rows wide by 1300 ft. long and replicated three times in a randomized complete block design. Metham was applied to preirrigated, preformed beds in an 8 inch band on top of the bed. A soil cap was applied over the top of the treated area to seal the soil, preventing volitalization losses. Twelve days after application, on April 15, 1992, Maxxa cotton was planted.

An evaluation of hairy nightshade control on May 8, 1992 indicated 100 percent control with all treatments. No cotton phytotoxicity was evident. Seed cotton yields on October 26, 1992 indicated 267 to 365 pounds more seed cotton with the metham treated plots compared to the control.

Hairy Nightshade Control

Herbicide	Rate	Nightshade Seedling Per 8" by 12" band 5/8	Seed Cotton Yield 10/26
	(gal/a)		(lb/ac)
metham	100	0	3405
metham	75	0	3503
metham	50	0	3478
control	--	8	3138

Preplant incorporated nightshade control in cotton. Vargas, Ron. A fine sandy loam field, known to be infested with both hairy and black nightshade was divided into plots 20 by 30 feet, with 20 ft. buffer zones between plots, and replicated three times in a randomized complete block design. The herbicides were applied on February 6, 1992 with an ATV calibrated to deliver 16 gallons of solution per acre. One day after application, the herbicides were incorporated with an offset disc. The field was listed, preirrigated and planted to Maxxa cotton on April 10, 1992.

An evaluation on September 9, 1992, just after cotton defoliation indicated acceptable to excellent control with all treatments. Trifluralin by itself provided 83 percent control. In general, Mon 13211 by itself provided better control with increasing rates. Control increased at the lower rates with the addition of trifluralin. No cotton injury was noted throughout the duration of the study.

Hairy Nightshade Control

Herbicide	Rate	Control 9/28/92 - 231 DAT
	(lb ai/A)	--------%--------
trifluralin	0.75	83
Mon 13211	0.125	73
Mon 13211	0.25	80
Mon 13211	0.30	90
Mon 13211	0.38	100
Mon 13211	0.50	96
Mon 13211 + trifluralin	0.25 + 0.25	90
Mon 13211 + trifluralin	0.125+ 0.50	86
Mon 13211 + trifluralin	0.25 + 0.50	93
Mon 13211 + trifluralin	0.30 + 0.50	100
Mon 13211 + trifluralin	0.38 + 0.50	96
Mon 13211 + trifluralin	0.50 + 0.50	83
Mon 13211 + trifluralin	0.125+ 0.75	93
Mon 13211 + trifluralin	0.38 + 0.75	76
Mon 13211 + prometryn	0.25 + 2.0	96
Mon 13211 + cyanazine	0.25 + 2.0	100
Control	-	0

<u>Black nightshade control in cotton</u>. Vargas, Ron. A uniform stand of Maxxa cotton, heavily infested with black nightshade, was divided into plots of 2, 38 in. rows that were 15 ft. long, and replicated three times in a randomized complete block design. DPX-PE350 was applied May 2, 1992, early post-emergence (EP) over the top of cotton at the cotyledon to two leaf stage when the black nightshade was in the cotyledon to two leaf stage. A second treatment was a split application, applied at EP and again at mid-postemergence (MP) on May 15, 1992, as an over the top application on 4 to 6 leaf cotton when the black nightshade was 1 to 2 in. tall with 2 to 6 leaves.

Evaluations throughout the growing season indicated excellent control with all treatments, with best control being obtained with the early single and sequential treatments. Single mid post treatments only provided 93 to 96 percent control of black nightshade, except the 2 oz ai/a rate which provided 100 percent control. Evaluations begining 7 DAT showed yellowing and stunted growth of the nightshade. At 14 DAT all treatments were exhibiting 63 to 70 percent control. At 21 days after the early treatment, control had increased considerably with the sequential treatment of DPX-PE350 at 0.75 oz ai/a followed by 1.2 lb ai/a of cyanazine providing 100 percent control. At 91 DAT, all treatments were providing from 93 to 100 percent control of black nightshade.

Cotton phytotoxicity and injury symptoms were insignificant. All treatments exhibited slight interveinal chlorosis and leaf crinkling when evaluated seven days after treatment. Injury symptoms subsided with the most injury evident at 28 DAT from the 1.5 and 2.0 oz ai/a rate. Injury symptoms were non-existent 50 DAT.

Black Nightshade Control and Cotton Phytotoxicity

Herbicide	Rate EP	MP	Control 14DAT	21DAT	91DAT	Cotton Phyto Scale 0 - 10 7DAT	21DAT	28DAT
	(oz ai/a)		--------%-------					
DPX-PE350	0.75		66	76	100	1.6	.3	.6
DPX-PE350	0.75	0.75	66	80	100	1.3	.6	.6
DPX-PE350		0.75	0	66	93	0	1.0	1.0
DPX-PE350	1.00		66	76	100	1.3	.3	0
DPX-PE350		1.00	0	66	93	0	1.6	1.0
DPX-PE350	1.50		66	83	100	1.6	.3	.3
DPX-PE350		1.50	0	60	96	0	2.0	1.0
DPX-PE350	1.50	1.50	63	76	100	1.6	1.3	.6
DPX-PE350	2.00		66	76	100	2.0	.6	0
DPX-PE350		2.00	0	70	100	0	2.0	1.0
DPX-PE350 + Bladex	0.75	1.2 lb	70	100	100	1.6	1.6	2.0
Control			0	0	0	0	0	0

EP - Early Post MP - Mid Post

Postemergent tall morningglory control in cotton. Wright, S. D. The objective of this study was to evaluate several herbicides at varying rates, herbicide combinations, and combinations with liquid nitrogen UN-32 for control of tall morningglory as a layby treatment in cotton.

Research plots were established on June 11, 1992, near Pixley, California. The experimental design was a randomized complete block with three replications. Individual plots were 6.5 by 30 ft in size. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 20 gal/a at 28 psi. Tall morningglory population was moderate to heavy throughout the experimental area (5-30 plants/plot area) and plants were in the 2-3 leaf stage. Cotton was 16 inches tall with 10 main-stem nodes.

Most herbicide treatments gave good tall morningglory control. Control diminished slightly by 32 days after treatment. The addition of UN-32 nitrogen fertilizer to Caparol slightly enhanced weed control at 32 days after treatment.

All treatments showed some cotton injury to the bottom leaves when evaluated at 18 DAT. For most treatments, phytotoxicity symptoms were minor.

(Univ. of Calif. Cooperative Extension, County Civic Center, Visalia, CA 93291-4584)

Results

Summary of Tall Morningglory Control and Cotton Injury
(0-10 rating: 0 = no injury, 10 = dead)

	Treatments	Rate (lbs ai/a)	T. Morningglory Control 18 DAT	T. Morningglory Control 32 DAT	Cotton Injury 18 DAT
1.	Lactofen	.2	9.4	6.0	1.3
2.	UN-32	6 gal	7.2	1.3	1.0
3.	Oxyfluorfen	0.25	9.8	8.0	1.2
4.	Oxyfluorfen	0.50	8.7	8.3	1.5
5.	Oxyfluorfen + UN-32	0.25 + 6 gal	8.2	8.0	1.3
6.	Cyanazine	1.00	9.1	7.7	0.8
7.	Cyanazine + UN-32	1.00 + 3 gal	8.3	9.3	1.2
8.	Cyanazine + UN-32	1.00 + 6 gal	8.2	8.0	0.7
9.	Prometryn	0.65	8.5	5.5	0.5
10.	Prometryn + UN-32	0.65 + 3 gal	8.3	9.0	0.7
11.	Prometryn + UN-32	0.65 + 6 gal	7.7	8.7	0.7
12.	DPX-PE350	0.5 oz	6.7	7.2	0.2
13.	DPX-PE350 + UN-32	0.5 oz + 3 gal	7.7	6.7	0.7
14.	DPX-PE350 + UN-32	0.5 oz + 6 gal	8.8	7.0	0.5
15.	Oxyfluorfen + Cyanazine	0.25 + 1.00	8.9	7.0	0.8
16.	Oxyfluorfen + Prometryn	0.25 + 0.65	7.7	7.2	1.2
17.	DPX-PE350	1.00 oz	8.9	7.6	0.8
18.	UTC		0.0	0.0	0.0

.25% v/v AG-98 included with all treatments.

Johnsongrass control in cotton. Wright, S. D. The objective of this study was to evaluate different herbicides in combination with DPX-PE350 herbicide to see if this combination would effect control of johnsongrass and cotton injury. Treatments were applied over the top of cotton.

Research plots were established on May 29, 1992, near Tipton, California. A second application of the grass herbicides was applied on June 17, 1992. Evaluations are expressed as days after the first application. The experimental design was a randomized complete block with three replications. Individual plots were 6.5 by 30 feet in size. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 20 gal/a at 28 psi. Johnsongrass population was moderate throughout the experimental area and plants were 6 to 24 inches tall. Cotton was 4 to 6 inches tall.

Fluazifop-p, sethoxydim, and clethodim gave excellent control of johnsongrass with two applications. The addition of DPX-PE350 to these herbicides did not affect weed control or cotton injury.

(Univ. of Calif. Cooperative Extension, County Civic Center, Visalia, CA 93291-4584)

Results

Summary of Johnsongrass Control and Cotton Injury
(0-10 rating: 0 = no injury, 10 = dead)

			Johnsongrass Control			Cotton Injury
	Treatments	Rate (oz ai/a)	7 DAT	30 DAT	45 DAT	7 DAT
1.	DPX-PE350	1.0	5.0	0.0	0.0	0
2.	DPX-PE350	1.5	1.0	1.7	1.7	0
3.	Fluazifop-p	.38 lb	6.7	9.5	10.0	0
4.	DPX-PE350 + fluazifop-p	1.0 + .38 lb	5.3	9.1	9.7	0
5.	DPX-PE350 + fluazifop-p	1.5 + .38 lb	6.0	9.3	9.8	0
6.	Sethoxydim	.38 lb	6.0	8.2	9.2	0
7.	Clethodim	.095 lb	7.3	9.9	10.0	0
8.	DPX-PE350 + sethoxydim	1.0 + .38 lb	5.0	8.0	9.0	0
9.	DPX-PE350 + clethodim	1.5 + .38 lb	7.3	10.0	10.0	0
10.	UTC		0	0	0	0

Postemergent nightshade control in cotton. Wright, S. D. The objective of this study was to evaluate DPX-PE350 and MSMA herbicides at different rates to control black nightshade and to observe cotton injury. Treatments were applied over the top of small cotton and nightshade.

Research plots were established on April 29, 1992, near Pixley, California. The experimental design was a randomized complete block with three replications. Individual plots were 6.5 by 25 feet in size. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 20 gal/a at 28 psi. Cotton was in the cotyledon to two-leaf stage. Black nightshade was 1 to 3 inches in diameter with a heavy population.

All treatments with DPX-PE350 gave good control of black nightshade. An early cultivation followed the DPX-PE350 herbicide application covering injured nightshade plants resulting in excellent control. Initially all treatments gave slight injury to small cotton; however, at 14 days after treatment symptoms were barely noticeable. At 26 days after treatment all symptoms were gone. The addition of MSMA to DPX-PE350 did not significantly affect nightshade control or cotton injury.

(Univ. of Calif. Cooperative Extension, County Civic Center, Visalia, CA 93291-4584)

Results

Summary of Cotton and Black Nightshade Injury
(0-10 rating: 0 = no injury, 10 = kill)

	Treatments	Rate (oz ai/a)	Nightshade Control 9 DAT	14 DAT	26 DAT	44 DAT	Cotton Injury 9 DAT	14 DAT	26 DAT
1.	DPX-PE350	1.0	8.5	8.8	9.7	9.7	1.3	0.0	0
2.	DPX-PE350	1.5	8.2	8.5	9.0	9.3	2.0	0.3	0
3.	DPX-PE350	2.0	8.5	8.8	10.0	10.0	2.2	0.7	0
4.	MSMA	1.5 lb	1.0	0	1.0	1.3	1.0	0.0	0
5.	DPX-PE350 + MSMA	1.0 + 1.5	8.5	8.7	9.3	10.0	2.0	0.0	0
6.	DPX-PE350 + MSMA	1.5 + 1.5	8.3	8.5	9.0	10.0	1.8	0.3	0
7.	DPX-PE350 + MSMA	2.0 + 1.5	7.8	6.0	10.0	10.0	2.3	0.7	0
8.	UTC		0	0	0	0	0.0	0.7	0

Postemergent purple nutsedge control in cotton with EPTC. Wright, S. D., and L. C. Hearn. EPTC 7E and 10G were applied in irrigated cotton to evaluate control of purple nutsedge. The treatment list included sequential applications of EPTC 7E at 2.0/2.0 lbs, 3.0/3.0 lbs, and EPTC 10G at 2.0/2.0 lbs. ai/a. For comparison, sequential applications of EPTC 7E + MSMA (2+2/2+2 lbs ai/a) and MSMA 6EC alone at 2.0/2.0 lbs ai/a were applied. The first application was made when the cotton was 4-8 inches tall (5/27), and the second application was made when the cotton was 8-12 inches tall (6/19).

At 14 DAT2, all EPTC treatments provided 87-92% nutsedge control, with no differences among treatments, while MSMA gave only 30% control. The best control was observed at 28 DAT2 with EPTC treatments providing 93-97% control. At 56 DAT2, EPTC 7E applied at 3.0 lbs and the EPTC + MSMA treatments showed the best control (80-82%), followed by EPTC 7E 2.0 lb rate (62%), and EPTC 10G (27% control).

At 14 DAT2, nutsedge populations averaged 2-6 nutsedge plants/sq ft in all EPTC treatments, while MSMA and untreated plots averaged 25 and 30 plants/sq ft, respectively. At 56 DAT2, all EPTC 7E treatments averaged 2-5 plants/sq ft, while EPTC 10G, MSMA, and the untreated averaged 10, 13, and 16 plants/sq ft, respectively.

Crop phyto was observed in EPTC treatments and increased from 10-17% at 14 DAT1 to 32 and 25% phyto in the EPTC 7E (3.0 lbs) and EPTC + MSMA treatments, respectively, at 28 DAT1. Subsequently, crop phyto declined to 0% in all treatments at 28 DAT2. No significant differences in crop height were observed among all treatments at any evaluation.

The highest yields were harvested from the MSMA treatment, EPTC 3.0 lbs/a, and the untreated. These were followed by the EPTC at 2.0 lbs, EPTC 10G, and EPTC + MSMA at 2.0 lbs + 2.0 lbs. Only the EPTC + MSMA treatment was statistically different from the untreated check. In conclusion, this trial indicates that EPTC did not significantly affect the yield of cotton as compared to the untreated check except when applied with MSMA.

(Univ. of Calif. Cooperative Extension, County Civic Center, Visalia, CA 93291-4584, and ICI Americas, Visalia, CA 93277)

Table 1
Summary of Purple Nutsedge Control and Cotton Injury

Trt. No.	Treatment name	Rate lb/ai/a	Growth stage	Appl. code	Purple nutsedge height in 6/10/92 14DAT1	Purple nutsedge number soft 6/10/92 14DAT1	Cotton phyto % 6/10/92 14DAT1	Cotton height in 6/10/92 14DAT1	Cotton height in 6/17/92 21DAT1	Cotton phyto % 6/17/92 21DAT1	Purple nutsedge control % 6/17/92 21DAT1	Purple nutsedge height in 7/1/92 14DAT2	Purple nutsedge number soft 7/1/92 14DAT2	Purple nutsedge control % 7/1/92 14DAT2	Cotton height in 7/1/92 14DAT2	Cotton phyto % 7/1/92 14DAT2
1	EPTC	2.0	Post	A	5.2	7.8	13.3	16.0	19.3	15.0	40.0	5.4	6.2	86.7	30.9	8.8
1	EPTC	2.0	Post	B												
2	EPTC	3.0	Post	A	4.8	15.7	16.7	18.8	21.3	31.7	76.7	4.0	2.3	90.0	32.2	14.6
2	EPTC	3.0	Post	B												
3	EPTC	2.0	Post	A	4.8	10.2	13.3	14.8	19.8	25.0	60.0	4.3	1.6	91.7	32.7	13.3
3	MSMA	2.0	Post	A												
3	EPTC	2.0	Post	B												
3	MSMA	2.9	Post	B												
4	EPTC	2.0	Post	A	4.8	13.3	10.0	14.9	18.3	11.0	50.0	4.9	3.2	90.0	32.3	15.0
4	EPTC	2.0	Post	B												
5	MSMA	2.0	Post	A	4.8	7.6	3.3	15.7	22.3	0.0	16.7	5.5	25.2	21.7	30.1	0.0
5	MSMA	2.0	Post	B												
6	Untreated check				5.3	21.6	0.0	15.3	22.3	0.0	0.0	8.5	30.4	0.0	31.0	0.0
	LSD (.05)				0.9	16.3	16.2	5.1	5.1	16.2	47.2	1.9	17.5	22.1	4.8	11.2
	CV				9.4	70.7	94.0	17.8	13.8	64.8	63.9	18.7	83.9	19.2	8.5	71.2

Table 2
Summary of Purple Nutsedge Control and Cotton Injury

Trt. No.	Treatment name	Rate lb/ai/a	Growth state	Appl. code	Purple nutsedge number soft 7/15/92 28DAT2	Purple nutsedge control % 7/15/92 28DAT2	Cotton height in 7/15/92 28DAT2	Cotton phyto % 7/15/92 28DAT2	Purple nutsedge number soft 8/12/92 56DAT2	Purple nutsedge control % 8/12/92 56DAT2	Cotton height in 8/12/92 56DAT2	Seed cotton yield lbs/a 10/8/92 113DAT2
1	EPTC	2.0	Post	A	1.7	93.3	39.1	0.0	4.7	61.7	40.4	3632
1	EPTC	2.0	Post	B								
2	EPTC	3.0	Post	A	0.1	97.7	39.2	0.0	2.5	81.7	43.5	3826
2	EPTC	3.0	Post	B								
3	EPTC	2.0	Post	A	0.4	97.0	38.1	0.0	1.7	80.0	42.3	3104
3	MSMA	2.0	Post	A								
3	EPTC	2.0	Post	B								
3	MSMA	2.0	Post	B								
4	EPTC	2.0	Post	A	3.8	93.3	38.8	0.0	10.5	26.7	41.8	3517
4	EPTC	2.0	Post	B								
5	MSMA	2.0	Post	A	20.6	33.3	36.6	0.0	13.3	13.3	42.3	4121
5	MSMA	2.0	Post	B								
6	Untreated check				14.0	26.7	40.8	0.0	15.6	0.0	42.3	3964
	LSD (.05)				16.9	53.1	9.6	0.0	9.8	32.4	7.4	691
	CV				110.4	39.7	13.7	0.0	67.4	40.5	9.6	10.3

Goatsrue seed expiration from several locales over a nine year period. Evans, J.O. and M.R. Larson. In the United States, goatsrue is found only within a 38,000 acre area of northern Utah and is included on the Utah and Federal Noxious Weed Lists. It is an unpalatable, undesirable weed and research has shown that it is highly toxic to livestock. An eradication program has been in effect since 1981 and is scheduled to continue until the late 1990's when goatsrue elimination is expected to be complete. All perennial plants have been eliminated and new seed production has been prevented for 4 to 10 years, depending upon location. Seedlings continue to emerge every year from soil seed-reserves but each new crop is promptly eliminated.

In October, four replications of soil samples from 60 locations (sites) are collected for evaluation. The purpose was to determine goatsrue seed reserves in the soil and ascertain whether or not the seed supply is depleting.

The sampling sites were chosen from areas originally infested with goatsrue that have been sampled annually. Habitats included: pastures, wetlands, ditchbanks, ditchbottoms, canalbanks, canalbottoms, and fencelines. The fencelines boarder croplands such as corn, alfalfa, and small grain. A three inch inside diameter soil probe was inserted into the ground to a depth of five inches and the resulting 35 in^3 sample carefully placed in a plastic bag. The four samples at each site were taken approximately 1 ft apart in a straight line. The samples were transferred to a laboratory where each sample was washed through a 16 mesh screen. The remaining objects were, very coarse sand, gravel, organic matter, and seed from various plants including goatsrue. The goatsrue seeds were collected and counted, separately for each of the four samples per site. Seed numbers from the different habitats were averaged.

Seed reserves have declined in the soil annually and will continue until total eradication is realized in approximately 1996. (Plant Science Department, Utah State University, Logan, UT 84322-4820).

Number of goatsrue seed in soil collected from several habitats where additional seed production was prevented

	Sample year				
Habitat	1983	1985	1987	1989	1991
	---------number of seed in 140 in^3---------				
Pasture	46	11	16	3	2
Wetlands	34	40	2	13	3
Ditchbank	60	8	8	6	10
Ditchbottom	96	34	58	17	2
Canalbank	136	34	25	16	7
Canalbottom	59	28	33	81	47
Fencelines	67	8	5	0	3
Average	71	23	21	20	11

Quackgrass control in cropland with various spring-applied herbicides. Maruska, Dean W., Rodney G. Lym, and Calvin G. Messersmith. Many selective and nonselective herbicides are available for quackgrass control in cropland. The objective of this experiment was to evaluate all herbicides registered in North Dakota for postemergence quackgrass control.

The experiment was established at the North Dakota State University experiment station in Fargo using a well established stand of quackgrass. The soil was a Fargo silty clay with 3.5% organic matter and pH 8.0. There were two quackgrass treatment dates, spring or late-spring applied May 15 or June 2, 1992, respectively (Table). Sequential applications for fluazifop-P plus fenoxaprop and clethodim were applied 2 weeks after the initial application date as the manufacturer suggested. Bromoxynil plus 2,4-D plus X-77 and L-77 surfactant (0.75 lb/A + 0.25 lb/A + 0.25% + 0.25%) were applied May 21, 1992 to reduce broadleaf weed competition.

Herbicide treatments were applied with a tractor-mounted sprayer delivering 17 gpa at 35 psi. Plots were 10 by 30 feet. Treatments were replicated four times in a randomized complete block design. Control was visually evaluated 8 or 6 weeks after treatment (WAT) for the spring- and late- spring-applied treatments, respectively, and were based on percent stand reduction compared to the control. Quackgrass was harvested on July 20 to 23.

The spring-applied treatments consistently provided better quackgrass control than the late-spring-applied treatments (Table). Glyphosate provided the best control, averaging 95%, regardless of application rate, date, or adjuvant. Glyphosate treatments also reduced the quackgrass biomass an average of 98%.

Clethodim provided variable control (Table). Clethodim spring-applied at 3 or 4 oz/A plus ammonium sulfate, an adjuvant, provided 59 and 70% control, respectively. However, control with clethodim averaged only 38% over all other application rates, dates, and adjuvants. Nicosulfuron at 0.4 and 0.5 oz/A spring-applied provided 54 and 65% control, respectively, while the late-spring-applied treatments averaged 47% control. Nicosulfuron provided an average 66% reduction in quackgrass biomass.

Primisulfuron provided control averaging 38% across application dates and reduced the quackgrass biomass by 57% (Table). Control with quizalofop varied as the spring-applied treatment averaged 50% control while the late spring-applied treatment averaged 23% control. Fluazifop-P averaged only 16% visible control, but the biomass was reduced by an average of 43%. Fluazifop-P plus fenoxaprop provided an average of 23% control and reduced biomass by 47%. Sethoxydim only provided 26% and 17% visible control for the spring- and late-spring-applied treatments, respectively, and an average biomass reduction of 35%.

In summary, glyphosate provided excellent control but cannot always be used because it is nonselective. Nicosulfuron, clethodim, and primisulfuron provided fair to good control and are selective in corn, soybean, and corn, respectively. Quizalofop, fluazifop-P, fluazifop-P plus fenoxaprop, and sethoxydim did not provide satisfactory control. Control with all herbicides was better with the spring than the late-spring application date. (Published with approval of the Agric. Exp. Stn., North Dakota State University, Fargo 58105).

Table. Quackgrass control with various herbicides in North Dakota cropland (Maruska, Lym, and Messersmith).

Application date and treatment[a]	Rate	Evaluation: Control 8/6 WAT[b]	Yield	Biomass reduction
	- oz/A -	- % -	lb/A	— % —
Spring (May 15, 1992)				
Nicosulfuron + Scoil	0.4 + 2%	54	270	66
Nicoculfuron + Scoil	0.5 + 2%	65	200	75
Primisulfuron + Scoil	0.4 + 2%	35	420	47
Primisulfuron + Scoil	0.6 + 2%	37	310	61
Fluazifop-P + Scoil	3 + 1%	16	360	55
Sethoxydim + Scoil	8 + 1%	26	520	34
Quizalofop + Scoil	1 + 1%	50	300	62
Fluazifop-P + fenoxaprop + Scoil[c]	2 + 0.7 + 1%	22	470	40
Glyphosate + X-77	24 + 0.5%	79	70	91
Glyphosate + X-77	36 + 0.5%	96	10	99
Glyphosate + X-77 + AMS	24 + 0.5% + 16	94	20	98
Glyphosate + X-77 + AMS	36 + 0.5% + 16	98	10	99
Clethodim + Scoil[c]	3 + 1%	37	490	38
Clethodim + Scoil[c]	4 + 1%	43	190	76
Clethodim + Scoil + AMS[c]	3 + 1% + 16	59	250	68
Clethodim + Scoil + AMS[c]	4 + 1% + 16	70	190	76
Control	0	0	790	0
Late Spring (June 2, 1992)				
Nicosulfuron + Scoil	0.4 + 2%	47	310	60
Nicosulfuron + Scoil	0.5 + 2%	47	310	61
Primisulfuron + Scoil	0.4 + 2%	43	260	68
Primisulfuron + Scoil	0.6 + 2%	36	380	51
Fluazifop-P + Scoil	3 + 1%	16	540	31
Sethoxydim + Scoil	8 + 1%	17	510	35
Quizalofop + Scoil	1 + 1%	23	430	46
Fluazifop-P + fenoxaprop + Scoil[c]	2 + 0.7 + 1%	23	360	54
Glyphosate + X-77	24 + 0.5%	96	20	98
Glyphosate + X-77	36 + 0.5%	99	5	100
Glyphosate + X-77 + AMS	24 + 0.5% + 16	99	5	100
Glyphosate + X-77 + AMS	36 + 0.5% + 16	99	5	100
Clethodim + Scoil[c]	3 + 1%	40	370	54
Clethodim + Scoil[c]	4 + 1%	31	390	51
Clethodim + Scoil + AMS[c]	3 + 1% + 16	38	330	59
Clethodim + Scoil + AMS[c]	4 + 1% + 16	36	270	66
Control	0		790	0
LSD (0.05)		13	180	

[a]AMS, diammonium sulfate.
[b]Weeks after treatment, 8 and 6 WAT for spring and late-spring treatments, respectively.
[c]Sequential application made 2 WAT as manufacturer suggested.

Prairie cupgrass control in fallow. Northam, F.E. and P.W. Stahlman. Prairie cupgrass (*Eriochloa contracta* Hitchc. ERBCO) is a native annual that germinates from late-spring through mid-summer and is found mostly in moist ditches, waste areas, and along roadsides. In recent years, it began encroaching into cropland in west-central Kansas. The increase of prairie cupgrass seems to be associated with the increase of conservation tillage farming practices. Prairie cupgrass is especially successful in production systems that have a summer fallow period because the species is not susceptible to atrazine or glyphosate which are widely used for weed control in fallow in Kansas.

Several herbicide treatments for control of prairie cupgrass in fallow were tested near Hays, KS, in a wheat field that had been chemically fallowed with glyphosate since June 1991. The experiment was a randomized complete block design with three replications. Plots were 3.7 m by 9.8 m with a running untreated check in each range of plots. Soil was a Crete silty clay loam with 2.0% organic matter content and pH 6.0. Herbicides were applied preemergence in water with a tractor-mounted, compressed-air sprayer equipped with XR80015 flat fan nozzles delivering 109 L/ha at 175 kPa on 17 April 1992. The summer growing season was unusually wet (>51 cm rainfall from 1 May to 15 Sep.) with frequent rainfall during June and July. This provided more opportunities for prairie cupgrass emergence than normally occurs in west-central Kansas.

Prairie cupgrass control was visually estimated on 8 September (143 DAT). Ten treatments reduced prairie cupgrass biomass by 75 to 97% (see table), but they were not significantly different from each other. Because of the variability among treatment replications, and from a practical standpoint, only those treatments providing 93% or better control were considered acceptable. Those treatments included UCC-C4243 at 0.13 kg ai/ha plus either cyanazine at 2.8 kg/ha, BAS 514H at 0.43 kg/ha, or imazethapyr at 0.13 kg/ha; pendimethalin alone at 2.2 kg/ha; and pendimethalin plus imazethapyr at 2.0 + 0.15 kg/ha. Singular applications of cyanazine at 2.8 kg/ha and imazethapyr at 0.13 kg/ha, and a tank mixture of UCC-C4243 plus imazethapyr at 0.10 + 0.13 kg/ha controlled prairie cupgrass 50% or less. (Ft. Hays Branch, Kansas Agric. Exp. Sta., Hays, KS 67601).

Prairie cupgrass control in fallow in Kansas

Herbicide	Rate	Control
	kg ai/ha	%
UCC-C4243 + cyanazine	0.13 + 2.8	97
UCC-C4243 + BAS 514H	0.13 + 0.43	96
Imazethapyr + pendimethalin	0.15 + 2.0	96
Pendimethalin	2.2	95
UCC-C4243 + imazethapyr	0.13 + 0.13	93
BAS 514H	0.43	90
UCC-C4243 + pendimethalin	0.13 + 2.0	88
UCC-C4243	0.13	88
UCC-C4243 + BAS 514H	0.10 + 0.43	82
UCC-C4243	0.10	75
UCC-C4243 + imazethapyr	0.10 + 0.13	50
Imazethapyr	0.13	30
Cyanazine	2.8	0
Untreated	- -	0
LSD (0.05)		25

Weed control in fallow with two glyphosate formulations and various surfactants. Thompson, C.R. and D.C. Thill. Two nonionic surfactants tank mixed with varied rates of two different glyphosate formulations were evaluated for control of weeds and volunteer crops. Studies were established at two sites. The sites were located south of Lewiston in the Tammany area and east of Moscow, ID. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 38 psi and 3 mph (Table 1). Treatments were applied to 6 to 10 in. downy and ripgut brome (*Bromus* sp.) and 2 to 5 in. bur chervil (ANRCA) at Lewiston on April 24, 1992 (Table 2). Treatments were applied to jointing winter wheat, 5 to 10 in. peas, 3 in. mayweed chamomile (ANTCO), and 6 to 15 in., flowering field pennycress (THLAR) at Moscow on May 1, 1992 (Table 3). Control was evaluated visually 7, 14, and 28 days after treatment (DAT). Treatments were arranged in a randomized complete block and were replicated four times.

Table 1. Application and soil analysis data

	Moscow	Lewiston
Temperature (F)	54	48
Soil temperature at 2 in. (F)	64	46
Relative humidity (%)	66	72
Wind speed (mph - direction)	2-W	2-N
Soil pH	6.1	5.6
OM (%)	2.8	4.1
CEC (meq/100g soil)	16.3	26.0
Texture	silt loam	silt loam

The addition of a nonionic surfactant tended to enhance control of brome, bur chervil, volunteer peas, and mayweed chamomile with glyphosate 7 to 8 DAT (Tables 2 and 3). Evaluations 28 DAT indicates that all glyphosate rates provided greater than 92% control of weed and volunteer crop species except volunteer peas. *Bromus* sp. treated with PR glyphosate, 'Protocol', at 0.5 lb ai/a alone produced a seed head 7 DAT, however, seed viability was not determined. All other treatments prevented seed head production. Peas were controlled 90% or greater with 0.5 lb ai/a RO glyphosate, 'Roundup', alone or tank mixed with nonionic surfactant and PR glyphosate at 0.5 lb/a tank mixed with 'Induce' (Table 3). The addition of 0.5% v/v 'Induce' to 0.25 lb/a RO glyphosate or to all rates of PR glyphosate controlled more peas than the addition of 0.5% v/v 'Kinetic'. Significant differences between surfactants were not observed on other weed and crop species. (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Weed control in fallow with glyphosate formulations and various surfactants, Lewiston, Idaho

Treatment	Rate	*Bromus sp.*[1] A	B	C	ANRCA[1] A	B	C
	lb ai/a	(% control[2])					
glyphosate	RO[3] 0.25	29	72	98	18	65	99
glyphosate	RO 0.25						
Kinetic[4]	0.06 %	53	93	100	23	48	98
glyphosate	RO 0.25						
Kinetic	0.125 %	46	94	99	22	56	99
glyphosate	RO 0.25						
Kinetic	0.25 %	58	92	100	25	32	99
glyphosate	RO 0.25						
Induce[4]	0.5 %	61	97	100	25	75	99
glyphosate	RO 0.5	73	97	100	30	83	99
glyphosate	RO 0.5						
Kinetic	0.06 %	81	99	100	33	92	100
glyphosate	RO 0.5						
Kinetic	0.12 %	71	99	100	30	91	100
glyphosate	RO 0.5						
Kinetic	0.25 %	69	98	100	28	83	100
glyphosate	RO 0.5						
Induce	0.5 %	75	99	100	30	88	100
glyphosate	PR[3] 0.25	13	68	92	17	63	95
glyphosate	PR 0.25						
Kinetic	0.06 %	18	77	96	8	63	100
glyphosate	PR 0.25						
Kinetic	0.125 %	20	75	96	12	55	100
glyphosate	PR 0.25						
Kinetic	0.25 %	23	73	95	17	50	99
glyphosate	PR 0.25						
Induce	0.5 %	42	88	99	20	47	98
glyphosate	PR 0.5	20	74	97	18	55	100
glyphosate	PR 0.5						
Kinetic	0.06 %	50	93	99	22	67	99
glyphosate	PR 0.5						
Kinetic	0.125 %	53	95	100	27	58	99
glyphosate	PR 0.5						
Kinetic	0.25 %	41	94	99	18	92	100
glyphosate	PR 0.5						
Kinetic	0.5 %	50	96	100	20	73	100
glyphosate	PR 0.5						
Induce	0.5 %	53	98	100	28	75	100
$LSD_{(0.05)}$		14	13	2	11	27	3

[1] evaluations were made A=May 1, B=May 8, and C=May 22 correspond to 7, 14, and 28 days after treatment
[2] visual evaluation of percent control
[3] glyphosate formulations RO = Roundup, PR = Protocol (contains no surfactant in the commercial formulation);
[4] Kinetic = nonionic surfactant with 99% proprietary blend of polyalkyleneoxide modified polydimethylsiloxane; Induce = nonionic surfactant with 90% proprietary blend of alkyl aryl polyoxylkane ethers, free fatty acids, and isopropyl alcohol; surfactants applied at % v/v

Table 3. Weed control in fallow with glyphosate and various surfactants, Moscow, Idaho

Treatment	Rate	Wheat[1] A	Wheat[1] B	Wheat[1] C	THLAR[1] A	THLAR[1] B	THLAR[1] C	Peas[1] A	Peas[1] B	Peas[1] C	ANTCO[1] A	ANTCO[1] B	ANTCO[1] C
	lb ai/a	(% control[2])											
glyphosate	RO[3] 0.25	35	85	94	57	91	98	40	58	61	47	92	90
glyphosate	RO 0.25												
Kinetic[4]	0.06 %	30	87	98	54	93	99	46	64	77	50	94	95
glyphosate	RO 0.25												
Kinetic	0.125 %	30	86	96	49	95	99	48	61	74	49	94	95
glyphosate	RO 0.25												
Kinetic	0.25 %	30	87	96	57	95	98	48	67	75	52	95	95
glyphosate	RO 0.25												
Induce[4]	0.5 %	44	89	97	64	95	99	50	71	81	57	94	97
glyphosate	RO 0.5	61	98	99	76	97	99	54	75	91	63	98	97
glyphosate	RO 0.5												
Kinetic	0.06 %	58	98	100	74	97	100	55	82	97	56	98	98
glyphosate	RO 0.5												
Kinetic	0.125 %	62	97	100	76	97	100	59	79	96	66	97	98
glyphosate	RO 0.5												
Kinetic	0.25 %	58	97	100	74	97	100	58	79	95	61	96	98
glyphosate	RO 0.5												
Induce	0.5 %	58	98	100	77	98	100	63	85	98	65	98	98
glyphosate	PR[3] 0.25	15	82	92	40	89	96	35	52	50	41	91	93
glyphosate	PR 0.25												
Kinetic	0.06 %	21	84	94	44	90	98	37	52	62	44	90	93
glyphosate	PR 0.25												
Kinetic	0.125 %	21	79	92	52	90	98	38	52	62	49	88	93
glyphosate	PR 0.25												
Kinetic	0.25 %	25	85	95	57	94	98	45	61	71	51	93	95
glyphosate	PR 0.25												
Induce	0.5 %	28	88	97	61	94	99	50	69	82	55	93	94
glyphosate	PR 0.5	44	92	97	71	93	99	48	58	66	59	93	96
glyphosate	PR 0.5												
Kinetic	0.06 %	51	96	99	75	96	99	53	76	87	62	95	97
glyphosate	PR 0.5												
Kinetic	0.125 %	48	94	99	70	95	99	52	69	78	60	96	97
glyphosate	PR 0.5												
Kinetic	0.25 %	48	96	99	68	97	99	48	71	79	56	97	97
glyphosate	PR 0.5												
Kinetic	0.5 %	56	95	99	74	96	99	53	74	89	64	97	96
glyphosate	PR 0.5												
Induce	0.5 %	56	97	100	74	96	100	57	82	97	65	97	98
LSD $_{(0.05)}$		10	4	3	17	2	1	14	8	9	14	3	3

[1] evaluations were made A=May 8, B=May 15, and C=May 29 corresponded to 7, 14, and 28 days after treatment

[2] visual evaluation of control

[3] glyphosate formulations RO = Roundup, Pr = Protocol (contains no surfactant in the commercial formulation);

[4] Kinetic = nonionic surfactant with 99% proprietary blend of polyalkyleneoxide modified polydimethylsiloxane; Induce = nonionic surfactant with 90% proprietary blend of alkyl aryl polyoxylkane ethers, free fatty acids, and isopropyl alcohol; surfactants applied at % v/v

<u>Metribuzin Tolerance in Tall Fescue Seed</u>. Ball, D.A. & M. Stoltz. A study was established south of Hermiston, OR in Morrow County to evaluate fall postemergence (EPOST) herbicide treatments for downy brome (BROTE) control and crop tolerance in tall fescue grown for seed. The experimental area was located in an established stand of tall fescue var "Bar None" planted in fall 1988. The prior residue treatment consisted of baling straw, irrigating for regrowth (Sept 17), sheep grazing (October), and 2nd irrigation (Oct 15). EPOST treatments were made on November 15, 1991 with a hand-held CO_2 sprayer delivering 17 gpa at 30 psi. Plots were 8 ft x 40 ft in size, in an RCB arrangement, with 3 replications.

EPOST Application details:	Date: November 15, 1991
Air temp: 42F	Sky: cloudy w/ high fog
Wind: N at 0-1 mph	Soil temp: 0-in 42F, 1-in 40F, 2-in 40F
Relative humidity: 77%	Soil moisture: moist, good condition
Organic matter: 0.8%	Soil pH: 7.2
Soil type: Loamy sand; 76% sand, 21.6% silt, 2.4% clay	

Results indicate that treatments containing metribuzin provided very good control of downy brome at the two highest rates tested. Addition of oxyfluorfen improved downy brome control, and increased initial crop injury, but symptoms disappeared in later evaluations. No evidence of fescue seed head thinning was observed except possibly from the oxyfluorfen + terbacil treatment. Winter conditions were extremely mild at the experimental site, which may have contributed to the negligible crop injury symptoms at the March 27, 1992 evaluation time. The experimental site had a healthy, uniform crop of tall fescue, and moderate, uniform infestation of downy brome which contributed to excellent experimental conditions. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Metribuzin Tolerance in Tall Fescue

D. A. Ball, and M. Stoltz

Compound	Rate (lb ai/a)	% Crop Injury Jan 13	% Crop Injury Mar 27	% BROTE Control Nov 23	% BROTE Control Jan 13	% BROTE Control Mar 27
metribuzin	0.25	0	0	0	50	63
metribuzin	0.5625	2	0	2	73	78
metribuzin	0.75	3	0	2	83	89
metribuzin	1.125	13	3	0	93	100
oxyfluorfen metribuzin	0.25 0.5625	25	0	5	98	92
oxyfluorfen metribuzin COC	0.25 0.5625 0.25	3	0	5	98	93
terbacil	0.40	0	0	5	60	83
oxyfluorfen terbacil	0.25 0.40	15	10	7	84	99
diuron metribuzin	1.00 0.25	0	0	5	68	95
oxyfluorfen diuron metribuzin	0.25 1.00 0.25	22	2	10	97	98
atrazine	0.50	0	2	2	78	98
control		0	0	0	0	0
LSD (0.05)		5	2	ns	25	14

Notes: On 11/23/91 (8 DAT) Downy Brome (BROTE) was just beginning to emerge, and no visible injury was evident in any plot.

Weed Control in Red Lentils. Ball, D.A. A study was established at the Pendleton Experiment Station to evaluate postplant incorporated (POPI) and preemergence (PRE) herbicides for weed control in dryland red lentils. A seedbed was prepared by chiseling, skew treading 2 times, and field cultivating. Red lentils, var "Crimson" were planted March 25, 1992 at 40 lb/a, in 7-in rows, at a 2-in seeding depth, into 30% wheat straw residue with a John Deere 8300 double-disk drill. All POPI and PRE applications were made on March 26, 1992 with a hand-held CO_2 sprayer delivering 16 gpa at 25 psi. POPI treatments were incorporated with a flex-tine harrow, 2 passes at 90° to a 1.5-in depth. Plots were rolled on March 26, 1992 after planting. Plots were 10 ft x 25 ft in size, in an RCB arrangement, with 3 replications.

Lentil and weed stand counts were made on May 5, 1992 and later weed counts made on July 1, 1992. Lentil yields were taken with a Hege plot combine on July 7, 1992. Dry growing conditions produced very light weed infestations throughout the growing season.

Application details:

POPI and PRE

Air temp: 57F	Sky: cloudy
Wind: 0-3 mph	Soil temp: surface 0 in. 54F
Relative humidity: 77%	Soil moisture: good to 12-in. +, seedbed trashy
Organic matter: 2.1%	Soil pH: 5.8

Soil type: Walla Walla silt loam; 22% sand, 69.6% silt, 8.4% clay

Treatments containing imazethapyr provided acceptable control of cutleaf nightshade (SOLTR) with no visible crop injury. Ethalfluralin applied POPI provided some lentil stand thinning, but yield was unaffected. Metribuzin applied PRE provided poor cutleaf nightshade control and slight crop injury. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Weed Control In Red Lentils

Compound	Rate (lb ai/a)	Lentil	5/4/92 PANCA	5/4/92 SOLTR	7/1/92 PANCA	7/1/92 SOLTR	7/1/92 SASKR	Lentil Yield (kg/ha)
		no./m^2						
Post-plant incorporated								
imazethapyr	0.047	141	3	5	1	3	0	1038
ethalfluralin	0.75	124	1	18	2	13	0	1023
pendimethalin	0.75	129	0	49	0	20	3	1036
metribuzin	0.25	136	7	57	1	23	5	1041
ethalfluralin imazethapyr	0.56 0.031	127	3	16	2	13	1	1217
ethalfluralin metribuzin	0.56 0.25	135	0	21	0	32	3	1127
pendimethalin imazethapyr	0.50 0.031	135	3	20	0	4	4	950
pendimethalin metribuzin	0.50 0.25	126	6	39	1	13	4	915
imazethapyr metribuzin	0.031 0.25	150	7	12	1	3	3	948
imazethapyr metribuzin	0.047 0.25	139	3	17	1	3	5	924
Pre-emergence								
imazethapyr	0.047	145	1	8	1	0	2	1093
metribuzin	0.25	145	5	39	4	20	1	706
imazethapyr metribuzin	0.031 0.25	173	1	9	1	2	2	1112
imazethapyr metribuzin	0.047 0.25	145	1	1	0	1	1	1163
pendimethalin	0.75	142	1	48	0	27	2	1004
pendimethalin imazethapyr	0.50 0.031	162	0	10	0	1	1	1056
pendimethalin metribuzin	0.50 0.25	147	2	31	1	15	7	1030
control		152	8	49	5	20	1	1133
LSD (0.05)		30	6	26	3	15	6	275

PANCA - Witchgrass, SOLTR - Cutleaf Nightshade, SASKR - Russian Thistle

Small bugloss control in lentils. Boerboom, C.M. and M.E. Thorne. Small bugloss (*Anchusa arvensis* (L.) Bieb.), an annual broadleaf weed and a member of the Boraginaceae family, has infested parts of the lentil growing areas of Eastern Washington. Because growers report that small bugloss is very difficult to control in lentils, a site near Garfield, WA with a heavy infestation was selected to evaluate several herbicides for small bugloss control.

The experimental design was a randomized complete block with four replications and 10 by 30 ft plots. 'Brewer' lentils were seeded on March 28, 1992 in 7 in. rows with a double-disc drill at a rate of 80 lb/a. Treatments were applied with a 10 ft hand-held spray boom, 8001 flat-fan nozzles, and pressurized with CO_2 at 35 psi, delivering a total volume of 10 gal/a. Post-plant incorporated (PoPI) treatments were applied on March 28 and incorporated twice with a five bar flex-tine harrow in opposite directions. Preemergence (PRE) treatments were applied on April 1, early post-emergence (EPOST) treatments were applied on April 28, and the late post-emergence (LPOST) treatment was applied on May 3. At both post-emergence treatment dates; lentils had three pairs of leaves and small bugloss was at the cotyledon to two-leaf stage with an average density of 120 plants/ft^2. A light rain shower occurred during application of early post-emergence treatments which turned into a heavy shower after completion.

Based on visual control ratings, which were made on May 21, none of the herbicide treatments gave satisfactory small bugloss control. Stand counts and fresh weights taken on June 1 showed that imazethapyr reduced the small bugloss stand and pendimethalin reduced plant size. This may suggest that a combination of pendimethalin plus imazethapyr may improve control, but this has not been tested. Metribuzin and cyanazine were not effective in controlling small bugloss. Bentazon was included to determine the efficacy if used for small bugloss control in dry peas. Small bugloss competition drastically reduced lentil yields compared to grower averages of 1000 to 1500 lb/a. (Department of Crop and Soil Sciences, Washington State University, Pullman, WA 99164-6420)

Table 1. Application data

Date	March 29	April 1	April 28	May 3
Treatments	PoPI	PRE	EPOST	LPOST
Air temperature (F)	62	70	54	77
Soil temperature (F)	60	65	54	85
Relative humidity (%)	42	56	88	42
Wind (mph)/direction	2/W	4/NW	2/S	0/0
Delivery rate (gal/a)	10	10	10	10
Crop		'Brewer' lentils		

Table 2. Small bugloss control and crop data

Treatment	Rate	Time	Small bugloss Control	Small bugloss Fresh weight	Small bugloss Density	Lentil Injury	Lentil Yield
	(lb ai/a)		(%)	(g/plt)	(plts/ft^2)	(%)	(lb/a)
Check			0	20	124	0	249
metribuzin	0.25	PRE	10	25	83	0	341
metribuzin	0.38	PRE	10	24	82	0	277
metribuzin metribuzin	0.19 0.19	PRE EPOST	71	24	49	5	416
metribuzin metribuzin	0.25 0.25	PRE EPOST	58	25	41	5	285
imazethapyr	0.047	PoPI	58	55	15	0	445
imazethapyr bentazon	0.047 0.75	PoPI LPOST	75	29	33	99	41
imazethapyr metribuzin	0.047 0.19	PoPI PRE	68	49	19	0	679
imazethapyr metribuzin	0.047 0.25	PoPI PRE	65	53	18	0	643
imazethapyr metribuzin	0.047 0.19	PoPI EPOST	64	31	19	0	490
pendimethalin	0.75	PRE	65	15	33	3	432
pendimethalin metribuzin	0.75 0.25	PRE PRE	68	15	34	0	580
cyanazine	2.0	PRE	58	22	60	0	440
LSD (0.05)			10	20	38	2	224

Weed Control and Crop Tolerance in White Lupine. Ball, D.A. An experiment was established at the Sherman Experiment Station, Moro, OR to examine preplant incorporated (PPI), preemergence (PRE), and postemergence (POST) herbicide treatment for weed control and crop tolerance to herbicide injury in white lupine (*Lupinus albus*). White lupine var "Ultra" were seeded at 5-7 seeds per foot of row, on April 1, 1992, to a depth of 2.5-in with a Great Plains no-till drill on 10-in row spacings. The experiment was a RCB of 22 herbicide treatments, on 8 ft x 30 ft plots with 4 replications. PPI and PRE treatments were applied with a hand-held boom in H_2O at 17 gpa and 25 psi. PPI treatments were incorporated with a spike-tooth harrow to 1-in depth followed by a Calkins field cultivator at a 3-in depth the same direction. Postemergence (POST) treatments were applied on May 15, 1992 to 7-8 leaf lupines, russian thistle at the 4-leaf stage and 5-leaf prostrate knotweed plants, with a hand-held boom in 17 gpa and 31 psi with 0.125% v/v R-11® surfactant. Weed populations in the plots were light and variable. Plots were assessed for crop injury, russian thistle (SASKR) and prostrate knotweed (POLAV) control on June 11, 1992. Plants were harvested for yield evaluation on July 29, 1992.

Application Details:

PPI	Date: April 1, 1992
Air temp: 76F	Sky: clear
Wind: N at 4 mph	Soil temp: surface 0 in 71F, 1 in 70F, 2 in 68F
Relative humidity: 27%	Soil moisture: dry to 1-in then good moisture
Organic matter: 1.5%	Soil pH: 6.0
Soil Type: Walla Walla silt loam; Sand: 78.2% Silt: 18.8% Clay: 3.0%	
PRE	Date: April 1, 1992
Air temp: 71F	Sky: clear
Wind: E at 3-5 mph	Soil temp: surface 0-in 71F, 1-in 70F, 2-in 68F
Relative humidity: 33%	Soil moisture: dry to 1-in then good moisture
POST	Date: May 15, 1992
Air temp: 65F	Sky: clear, sunny
Wind: W at 8-9 mph	Soil temp: surface 0 in. 65F, 1 in. 65F, 2 in. 65F
Relative humidity: 46%	Soil moisture: dry to 2-in. then good moisture

Herbicide injury in lupines was evident as stand thinning from UBI-C4243 and blossom thinning and leaf necrosis/epinasty from MCPA treatments. UBI-C4243 caused significantly more injury when applied as a preemergence treatment compared to the preplant incorporated treatment. All treatments except MCPA and MCPB provided good control of russian thistle and cutleaf nightshade. UBI-C4243 applied PRE and MCPA applied POST significantly reduced lupine yield due to stand reduction (UBI-C4243) and blossom thinning reducing pod set (MCPA). Yield was not increased by weed control due to light and variable weed infestations. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Weed Control and Crop Tolerance in White Lupine

Compound Tested	Rate lb ai/a	% Crop Injury	% SASKR Control	%POLAV Control	Yield kg/ha
PPI					
imazethapyr	0.047	0	100	100	652
imazethapyr	0.063	1	100	100	596
trifluralin	0.75	0	93	95	652
ethalfluralin	0.75	1	94	99	622
pendimethalin	0.75	0	88	93	622
metolachlor	2.0	0	59	96	611
ethalfluralin + metolachlor	0.75+2.0	0	96	96	634
ethalfluralin + imazethapyr	0.75+0.047	0	100	100	614
pendimethalin + imazethapyr	0.75+0.047	0	99	100	682
UBI-C4243	0.12	10	100	100	528
PRE					
imazethapyr	0.047	0	100	100	647
imazethapyr	0.063	0	100	100	654
pendimethalin	0.75	0	83	96	709
pendimethalin/imazethapyr	0.75/0.047	3	100	100	640
UBI-C4243	0.12	24	100	100	317
PPI/POST					
trifluralin/MCPA	0.75/0.25	64	78	95	124
trifluralin/MCPB	0.75/0.33	10	74	100	612
ethalfluralin/MCPB	0.75/0.33	6	76	98	553
imazethapyr	0.063	3	69	99	652
POST					
MCPA	0.25	56	51	100	148
MCPB	0.33	4	53	97	553
control		0	0	0	601

MCPA - formulated as the sodium salt, Chiptox®
MCPB - formulated as the sodium salt, Thistrol®

Weed Control in Irrigated Green Peas. Ball, D.A. & G. Clough. A study was established at the Hermiston Agricultural Research and Extension Center to evaluate preplant incorporated (PPI), preemergence (PRE), and postemergence (POST) herbicides for weed control in irrigated green peas for processing. All PPI and PRE were made on March 24, 1992 with a hand held CO_2 sprayer delivering 16 gpa at 30 psi. PPI treatments were incorporated with a flex-tine harrow, 2 passes at 2-in depth. Peas, var "Bolero" were planted March 24, 1992 at 230 lb/a, 7-in rows, and 2-in. seeding depth. POST treatments were made on April 27, 1992 with the same hand-held equipment. Plots were 10 ft x 30 ft in size, in an RCB arrangement, with 3 replications. Percent visual injury, percent stand reduction, and control of henbit (LAMAM) and green foxtail (SETVI) plants were evaluated on May 8, 1992. Yield was not evaluated due to very heavy weed growth and shattering of the peas.

Application details:

PPI and PRE	Date: March 24, 1992
Air temp: 65F	Sky: clear
Wind: W at 0-5 mph	Soil temp: surface 80F
Relative humidity: 32%	Soil moisture: good to 12 in +
Organic matter: 1.0%	Soil pH: 6.4

Soil type: Adkins fine sandy loam; 68% sand, 28% silt, 3% clay

POST	Date: April 27, 1992
Air temp: 69F	Sky: clear
Wind: S at 3 mph	Soil temp: surface 68F
Relative humidity: 58%	Soil moisture: dry to 2-in, moist 12-in

Pea growth stage: 7-node stage
Weed growth stage: Henbit - heavy infestation 1-in height
Green Foxtail - 4-5 leaf stage

Results indicate that all herbicide treatments except UBI-C4243 and pendimethalin caused crop injury of 10-25%. UBI-C4243, metribuzin, bentazon and combinations caused some stand reduction (2-22%). Pendimethalin and UBI-C4243 gave excellent henbit and green foxtail control whereas metribuzin treatments were only effective in controlling henbit. Other treatments gave poor control of both weed species. Pendimethalin at 0.75 lb ai/a and UBI-C4243 at 0.063 lb ai/a provided the best overall weed control, with minimal damage to the pea crop. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Weed Control in Green Peas

Treatment	Rate lb ai/a	% Stand Red.	% Inj.	% control Henbit	Green Foxtail
PPI					
control	-	0	0	0	0
pendimethalin	0.75	0	1	78	90
UBI-C4243	0.063	5	0	94	90
UBI-C4243	0.125	17	0	92	88
lactofen	0.10	0	10	20	37
PRE					
pendimethalin	0.75	0	0	91	90
UBI-C4243	0.063	3	0	97	88
UBI-C4243	0.125	18	0	99	98
lactofen	0.05	0	10	42	0
lactofen	0.10	0	8	40	0
lactofen	0.20	0	8	68	37
metribuzin	0.25	22	23	100	89
PRE/POST					
metribuzin/MCPA	0.125/0.25	15	23	95	65
metribuzin/bentazon	0.125/0.5	15	20	100	83
metribuzin/bentazon	0.25/0.5	10	35	100	83
POST					
MCPA	0.25	2	23	27	0
MCPB	0.75	0	5	37	0
bentazon	0.50	2	12	55	0
bentazon	0.75	2	8	62	0
bentazon + COC	0.5/0.25%	2	10	50	0
MCPA + bentazon	0.25/0.5	2	13	47	0
MCPB + bentazon	0.75/0.5	0	13	42	0
metribuzin	0.25	5	27	100	70
metribuzin + bentazon	0.125/0.5	2	25	100	52
metribuzin + bentazon	0.25/0.5	8	25	100	72
control	-	0	0	0	0
LSD (0.05)		14.5	13.1	24.2	31.9

All POST treatments received R-11® at 0.125 % v/v = 1 pt/100 gal.

Residual effect of nicosulfuron, primsulfuron and rimsulfuron on potatoes. Evans, J.O., R.W. Mace, R. Rassmusen. Herbicides were applied June 25, 1991 in 10 by 100 ft strips across the rows of field corn, in a RCB design, with three replications. Herbicides were applied with a bicycle sprayer delivering 16 gpa at 40 psi using 8001 flatfan nozzles with 18 inch spacing.

On April 22, 1992 two rows of Norgold russet potatoes were planted perpendicular to the herbicide plots to provide six replications. The seed was placed, with a single row planter, 5 inches deep every 12 inches with 30 inch row spacing. The potatoes were planted in conjunction with alfalfa, wheat, barley, dry beans, and sugarbeets as part of a plant back evaluation. The soil was silt loam with a water table at 1.5 to 2 feet below the surface. The plots received four centimeters of rain and 30 cm of irrigation water prior to harvest on August 4, 1992. The crop was harvested early because of an outbreak of blackleg bacterial disease probably vectored by Psylla, an insect not previously observed in the area. Thus tuber size was correspondingly smaller but the crop was uniform and provided excellent comparisons between treatments. Weeds were controlled by hand every two weeks throughout the season.

All plants within the plot were harvested by hand and evaluated visually and by total tuber weight for herbicide injury and yield. There were no visible tuber deformities or injuries found for any of the treatments. The ANOVA showed no significant difference in yield between any of the treatments. (Utah Agricultural Experiment Station, Logan, Ut. 84322-4820)

Potato yields following corn treated with sulfonylurea herbicides.

Herbicide	Application June 25, 1991 (oz ai/A)	Yield August 4, 1992 (6 rep mean)	Tuber injury
		--Cwt/A--	--%--
Nicosulfuron +X-77 0.25%	0.5	97.6	0
Nicosulfuron +X-77 0.25%	1.0	97.6	0
Nicosulfuron +X-77 0.25%	2.0	84.5	0
Rimsulfuron +X-77 0.25%	0.5	90.4	0
Rimsulfuron +X-77 0.25%	1.0	80.0	0
Primsulfuron +X-77 0.25%	0.5	84.4	0
Untreated		85.3	0

LSD (0.05) 19.2

Preemergence hairy nightshade control in potatoes with DPX-E9636. M.J. VanGessel and P. Westra. Hairy nightshade (Solanum sarrachoides Sendt., SOLSA) is a common annual weed in potato fields in Colorado. There is not a consistent full-season control strategy for hairy nightshade in potatoes or many of the crops in rotation with potatoes. This experiment was designed to evaluate the efficacy and phytotoxicity of DPX-E9636 in a hairy nightshade infested potato field. This study was conducted in the San Luis Valley with loamy sand soil, 1% o.m. and pH 7.6. The experiment was arranged as a randomized block design with three replications; treatments are listed in Table 1. Potato variety 'Centennial' was planted May 12, 1992. Potatoes were planted in rows 86 cm apart and plots were four rows wide and 9 m long. Potatoes were allowed to emerge and then re-hilled ("dragged-off"); herbicide treatments were applied immediately after re-hilling (June 16, 1992). Treatments were applied with flat fan nozzles at 197 L/ha, 175 kPa, and 5 km/hr. Weed control was visually evaluated 4 and 10 weeks after treatment (WAT). At 8 WAT, height and width of potato canopy was measured at four subsamples in each plot. Selected plots were harvested and tubers graded as follows: seeds= <100 gr; strippers= 100 to 200 gr; cartons= 200 to 300 gr; overs= >300 gr; and cull= mis-shapened and cracked tubers.

Hairy nightshade control was similar for all herbicide treatments, except when metribuzin was applied alone (Table 1). A rate response was noticed for DPX-E9636 alone and in combination with metribuzin, although no significant differences were detected. Height by width of potato canopy is a non-destructive measurement of aboveground biomass. Potato biomass was reduced when the highest rate of metribuzin was applied in combination with DPX-E9636 (Table 1). Centennial is a metribuzin-sensitive cultivar. Yield data were not significantly different for harvested treatments (Table 2). (Weed Research Laboratory, Colorado State Univ., Ft. Collins, CO 80523).

Table 1. Treatments, hairy nightshade control, and potato biomass measurements.

Treatment	Rate	SOLSA control 4 WAT	SOLSA control 10 WAT	Potato canopy (ht x wid)
		-------%--------		--cm²--
Check		0.0 c	0.0 c	4490 ab
DPX-E9636	14 g/ha	91.7 a	90.0 a	4587 ab
DPX-E9636	21 g/ha	93.3 a	86.7 a	4658 ab
DPX-E9636	28 g/ha	100 a	96.7 a	4658 ab
DPX-E9636	55 g/ha	100 a	88.3 a	4516 ab
DPX-E9636 metribuzin	14 g/ha 110 g/ha	88.3 a	83.3 a	4593 ab
DPX-E9636 metribuzin	21 g/ha 165 g/ha	93.3 a	86.7 a	4781 ab
DPX-E9636 metribuzin	28 g/ha 220 g/ha	100 a	71.7 a	4374 b
metribuzin	110 g/ha	50 b	33.3 b	4948 a
metribuzin	165 g/ha	40.0 b	25.0 bc	4735 ab
metolachlor metribuzin	1.3 kg/ha 220 g/ha	100 a	96.7 a	4465 ab
LSD (.05) =		20.1	26.3	466
Standard Dev.=		11.8	15.5	271
CV =		15.2	22.4	5.9

Table 2. Total yield and percent of potato grades.

Treatment	Rate	Total wt.	Seed	Stripper	Carton	Over
		-T/ha-	---------------%---------------			
Check		33.6 a	5 a	74 a	20 a	1 a
DPX-E9636	28 g/ha	29.5 a	4 a	75 a	20 a	1 a
DPX-E9636	55 g/ha	25.9 a	4 a	75 a	21 a	0 a
DPX-E9636 metribuzin	21 g/ha 165 g/ha	28.3 a	5 a	78 a	15 a	1 a
DPX-E9636 metribuzin	28 g/ha 220 g/ha	26.6 a	7 a	83 a	10 a	0 a
metolachlor metribuzin	1.3 kg/ha 220 g/ha	29.0 a	6 a	80 a	14 a	0 a
LSD (.05) =		8.4	3.8	8.8	12	1.1
Standard Dev.=		4.6	2.1	4.8	6.4	0.6
CV =		16	42	6	38	100

Herbicide evaluation in sugarbeets. Bell, C. E. Wild beet, (Beta maritima L.) is a major weed in sugarbeets in the Imperial Valley of California. This research project compared various postemergence herbicides, applied alone and in combinations, for control of wild beet and for injury to the crop. The experiment was conducted on a commercial sugarbeet field in the Imperial Valley.

The experiment was a randomized complete block with four replications. The crop was sown in early October, 1991, and herbicide treatments were made when the crop had 4 to 6 true leaves on Oct. 24, 1991. The weather was warm, 12^{o} C, and sunny. Plot size was one bed (75cm wide) by 8 m long. Herbicide applications were made with a CO_2 pressured sprayer at 200 l/ha spray volume and 138 kPa pressure through 8003LP nozzles. The wild beets had 6 to 8 true leaves when treated.

A visual evaluation of wild beet control and crop injury was made on Nov. 4, 1991. Most of the treatments listed in the table below were ineffective for control of wild beet. Crop injury levels were generally acceptable, with the exception of the combination of desmedipham/phenmedipham and endothall. (Cooperative Extension, University of California, Holtville, CA 92250.)

Wild beet control and sugarbeet injury
in the Imperial Valley, CA

Treatment	Rate	Visual Evaluation - 11/4/91 Wild beet control	Sugarbeet injury
	kgai/ha	%	%
endothall	0.84	24	2.0
endothall	1.68	54	2.0
clopyralid	0.14	38	0
clopyralid	0.28	27	1.4
DPX 66037	0.14	62	0.1
DPX 66037	0.28	0	0.1
des/phenmedipham[a]	0.84	0	0.1
des/phenmedipham	1.12	31	7.0
des + endothall	0.84+0.84	54	5.5
des + clopyralid	0.84+0.14	2	0.6
des + DPX 66037	0.84+0.14	50	3.8
des + endothall	0.84+1.40	54	21.0
des + clopyralid	0.84+0.28	27	7.0
des + DPX 66037	0.84+0.28	2	0.1
untreated control		0	0

[a] - des/phenmedipham and des both refer to the commercial formulation of desmedipham plus phenmedipham.

Preplant, premergence and postemergence weed control in sugarbeets. Downward, R. W. and D. W. Morishita. This study was conducted at the Kimberly Research and Extension Center. Weed species evaluated were kochia (KCHSC), redroot pigweed (AMARE) and common lambsquarters (CHEAL). Sugarbeet (variety 'WS-88') was planted April 19 on 22-inch rows at 47,520 seeds/A. Soil type was Portneuf silt loam with a pH of 8.0, 1.5% o.m. and CEC of 15 meq/100 g soil. The experimental design was a randomized complete block with four replications. Preplant incorporated (PPI) treatments were applied broadcast with a bicycle sprayer equipped with 11001 flat fan nozzles. The sprayer was calibrated to deliver 10 gpa. These treatments were incorporated with a roller harrow. Preemergence (PRE) and postemergence (POST) treatments were applied in a 10-inch band at 20 gpa. Additional application data are presented in Table 1. Kochia densities at application were 4 plants/ft^2 at the cotyledon growth stage and 18 plants/ft^2 7 days later. Redroot pigweed and common lambsquarters densities were 2 plants/ft^2. Crop injury and weed control were taken on June 10 and July 14. Two rows of sugarbeets were harvested on October 1 and a sample taken for sugar analysis.

No treatment caused severe injury (Table 2). Cycloate PPI and ethofumesate PRE followed by DPX-66037 plus desmedipham and phenmedipham POST provided good (80 to 100%) kochia control in June. Later in the season kochia control declined. These treatments also provided the best common lambsquarters and redroot pigweed control. Yields were highest with these treatments and the handweeded check. High weed densities along with the lack of any hand-weeding may be attributed to the low sugarbeet yields. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	4/14	5/5	5/8	5/12	5-14
Application timing[1]	PPI & PRE	Cotyl	2 lf	7d ltr	7d ltr
Air temperature (F)	64	--	74	56	80
Soil temperature (F)	56	74	64	48	76
Relative humidity (%)	41	--	--	60	--
Wind speed (mph)	8 to 12	0 to 4	0 to 8	0 to 4	0 to 2

[1]Application timing abbreviations are: PPI = Preplant incorporated, Pre = Preemergence, Cotyl = Cotyledon, 7d ltr = 7 days later.

Table 2. Preplant, preemergence and postemergence control in sugarbeets.

			Crop injury		Weed control[1]							
					KCHSC		CHEAL		AMARE			
Treatment	Rate	Applic. timing	6/10	7/14	6/10	7/14	6/10	7/14	6/10	7/14	Yield	Sugar Content
	(lb ai/A)		(%)								(t/A)	(%)
Check			0	0	0	0	0	0	0	0	1	17.13
Handweed check			0	0	100	100	100	100	100	100	28	17.63
Cycloate	3.0	PPI	0	0	19	5	39	18	63	5	5	17.10
Cycloate/ DPX-66037[2]	2.0/ 0.0156	PPI 1-2 lf	0	15	68	40	70	36	65	39	9	18.01
Cycloate/ DPX-66037 + desmed. & phen.[3]	2.0/ 0.0156 + 0.33	PPI 1-2 lf	3	0	80	61	94	84	98	96	13	17.56
Diethathyl-ethyl	3.0	PPI	0	0	10	0	48	21	89	21	7	17.26
Diethatyl-ethyl/ DPX-66037[2]	2.0/ 0.0156	PPI 1-2 lf	0	0	48	8	73	58	93	65	7	17.46
Diethatyl-ethyl/ DPX-66037 + desmed. & phen.[3]	2.0/ 0.0156 + 0.33	PPI 1-2 lf	0	0	68	33	81	66	100	100	10	17.63
Ethofumesate	1.12	Pre	0	0	23	6	45	33	55	48	5	16.47
Ethofumesate/ DPX-66037[2]	0.75/ 0.0156	Pre 1-2 lf	0	0	59	25	58	25	66	33	9	17.54
Ethofumesate/ DPX-66037 + Desmed. & phen.[3]	0.75/ 0.0156 + 0.33	Pre 1-2 lf	0	0	85	66	90	83	99	100	12	15.29
Check			0	0	0	0	0	0	0	0	5	17.15
DPX-66037[2]	0.0156	1-2 lf	0	0	71	46	66	43	59	33	11	17.65
DPX-66037 + Desmed. & phen.[3]	0.0156 + 0.33	1-2 lf	0	0	89	73	86	78	100	96	16	18.15
Desmed. & phen.[3]/ Desmed. & phen.[3]	0.33/ 0.33	Cotyl 7d ltr	8	0	71	38	81	69	96	86	10	17.75

Table 2 cont.

Treatment	Rate	Applic. timing	Crop injury 6/10	Crop injury 7/14	Weed control[1] KCHSC 6/10	KCHSC 7/14	CHEAL 6/10	CHEAL 7/14	AMARE 6/10	AMARE 7/14	Yield	Sugar Content
	(lb ai/A)		(%)								(t/A)	(%)
Desmed. & phen.[3,4]/ Desmed. & phen.[3]	0.165/ 0.165	Cotyl 7d ltr	5	0	51	14	85	61	88	63	6	17.61
LSD (0.05)			3	NS	18	19	19	32	27	35	5	NS

[1]Weed species evaluated were Kochia (KCHSC), common lambsquarters (CHEAL), and redrooted pigweed (AMARE).
[2]Surfactant added 0.25% v/v.
[3]Desmed. & phen. = desmedipham & phenmedipham.
[4]Crop oil concentrate added at 1.0 qt/A.

Simulated drift of postemergence herbicides on sugarbeets. Downard, R. W. and D. W. Morishita. This study was conducted near Twin Falls, Idaho to evaluate sugarbeet injury and yield from simulated drift of several commonly used small grain cereal herbicides. Treatments were arranged in a randomized complete block design with four replications. Plots were 4 rows wide by 30 feet long. Soil texture was a silt loam with a 7.7 pH, 1.5% o.m. and a CEC of 17 meq/100 g soil. Herbicide treatments were applied in a 10-inch band with a bicycle sprayer equipped with 8001 even fan nozzles on 22-inch spacing. The sprayer was calibrated to deliver 20 gpa at 38 psi. Additional application data are presented in Table 1. All treatments were hand-weeded throughout the year. Crop injury was evaluated on May 18, 26 and June 9. Two rows of sugarbeets were harvested on October 9 and samples taken for sugar analysis.

Eleven days after treatment (May 18), sugarbeet injury ranged from 43 to 100% compared to the untreated check (Table 2). By 34 days after treatment (June 9), sugarbeets treated at the lowest rates were begining to recover from the injury. Sugarbeet yields indicate that herbicide doses at 0.01X the normal application rate are not permanently injurious. Some treatments indicate complete death but have yield data. This is due to the fact that three replications may have been completly killed, but one had plants that survived. 2,4-D at 0.01X and bromoxynil and MCPA at 0.01X had the lowest injury ratings and the highest yields. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	5/7
Air temperature (F)	84
Soil temperature (F)	84
Relative humidity (%)	---
Wind velocity (mph)	0 to 7

Table 2. Crop injury and yield of sugarbeets, near Twin Falls, Idaho.

Treatment	Rate	Crop injury 5/18	Crop injury 5/26	Crop injury 6/9	Yield	Sugar content
	(lb ai/A)	(%)	(%)	(%)	(t/A)	(%)
Untreated		0	0	0	42	16.25
Imazamethabenz .5X[1]	0.235	65	75	76	2	15.75
Imazamethabenz .1X[1]	0.047	65	95	93	18	15.81
Imazamethabenz .01X[1]	0.0047	43	33	26	33	15.79
Thif & trib .5X[1,2]	0.0070	88	99	100	7	15.93
Thif & trib .1X[1,2]	0.0014	76	97	100	10	15.60
Thif & trib ..01X[1,2]	0.0001	44	38	18	34	15.95
Bromoxynil & .5X MCPA	0.375	98	87	81	13	15.60
Bromoxynil & .1X MCPA	0.075	65	49	30	33	15.73
Bromoxynil & .01X MCPA	0.0075	20	15	3	40	15.86
2,4-D .5X	0.5	79	90	98	2	--[3]
2,4-D .1X	0.1	64	59	70	19	15.76
2,4-D .01X	0.01	15	13	10	43	15.42
Thif & trib .5X[1,2] + Bromoxynil & MCPA	0.0070 0.375	100	100	100	4	15.09
Thif & trib .1X[1,2] + Bromoxynil & MCPA	0.0014 0.075	95	99	100	6	15.17
Thif & trib .01X[1,2] + Bromoxynil & MCPA	0.0001 0.075	55	43	40	33	16.28
Thif & trib .5X[1,2] + 2,4-D	0.0070 0.5	81	99	100	2	15.40
Thif & trib .1X[1,2] + 2,4-D	0.0014 0.1	78	97	100	5	16.12
Thif & trib .01X[1,2] + 2,4-D	0.0001 0.01	33	38	25	39	15.41
LSD (0.05)		18	27	27	10	0.64

[1]Surfactant R-11 added at 0.25% v/v.

[2]Thif. & trib. = Thifensulfuron & tribenuron.

[3]Not enough root sample to determine sugar content.

Postemergence broadleaf weed control in sugarbeets with DPX-66037, tank mix combinations. Downard, R. W. and D. W. Morishita. The study was established near Kimberly, Idaho to evaluate postemergence broadleaf weed control and crop tolerance to DPX-66037 and tank mix combinations with desmedipham and phenmedipham. Weed species evaluated were kochia (KCHSC), common lambsquarters (CHEAL) and redroot pigweed (AMARE). Sugarbeet (variety 'WS-88') was planted April 19, on 22-inch rows at 47,520 seeds/A. Treatments were arranged as a randomized complete block design with five replications. Plots were 4 rows by 30 feet. Soil type was a Portneuf silt loam with a pH of 8.0, 1.5% o.m. and a CEC of 15 meq/100 g soil. Herbicides were applied in a 10-inch band with a hand-held sprayer equipped with 8001 even fan nozzles on 22-inch spacing. The sprayer was calibrated to deliver 20 gpa at 38 psi. Additional application data are presented on Table 1. Weed densities for kochia at application ranged from 18 plants/ft^2 at the cotyledon growth stage to 9 plants/ft^2 at the last 7 days later treatment. Crop injury and weed control ratings were taken on June 3 and July 14. Two rows of sugarbeets were harvested September 29 for yield and a sample taken for sugar analysis.

DPX-66037 at 0.0321 lb ai/A plus desmedipham and phenmedipham at 1.0 lb ai/A had the highest crop injury (Table 2). All DPX-66037 plus desmedipham and phenmedipham treatments controlled redroot pigweed and common lambsquarters 83 to 99% 47 to 68 days after the last treatment. Good (84 to 87%) kochia control was seen only at the higher rates of DPX-66037 (0.0156 and 0.0312 lb ai/A) plus desmedipham and phenmedipham (0.50 and 1.0 lb ai/A) at the last evaluation. The highest yielding treatment was the handweeded check followed by DPX-66037 at 0.0156 lb ai/A plus desmedipham and phenmedipham at 0.33 lb ai/A at the cotyledon growth stage. There was not a significant difference in sugar content among treatments. (Department of Plant, Soils, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	5/5	5/8	5/12	5/14	5/27
Application timing[1]	Cotyl	2 lf	7d ltr	7d ltr	7d ltr
Air temperature (F)	79	76	62	80	64
Soil temperature (F)	74	68	56	76	58
Relative humidity (%)	--	49	42	--	--
Wind speed (mph)	0 to 4	0 to 8	0	0 to 2	10 to 15

[1]Application timing abbreviations are: Cotyl = Cotyledon, 7d ltr = 7 days later and 2 lf = 2 leaf.

Table 2. Postemergence broadleaf weed control in sugarbeets with DPX-66037, desmedipham and phenmedipham and tank mix combinations.

Treatment	Rate	Applic. timing	Crop injury		Weed control[1] KCHSC		CHEAL		AMARE		Yield	Sugar Content
			6/3	7/14	6/3	7/14	6/3	7/14	6/3	7/14		
	(lb ai/A)		(%)								(t/A)	(%)
Check			0	0	0	0	0	0	0	0	6	17.27
Handweeded check			0	0	100	100	100	100	100	100	23	18.15
DPX-66037[2]/ DPX-66037[2]	0.0156/ 0.0156	Cotyl 7d ltr	0	0	80	60	65	37	71	44	16	17.32
DPX-66037[2]/ DPX-66037[2]	0.0156/ 0.0156	2 lf 7d ltr	0	0	72	31	42	28	34	20	13	17.32
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0078 + 0.33/ 0.0078 + 0.33	Cotyl 7d ltr	1	0	86	77	87	86	99	94	15	17.58
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0078 + 0.33/ 0.0078 + 0.33	2 lf 7d ltr	0	2	85	67	95	87	100	97	18	16.88
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0156 + 0.33/ 0.0156 + 0.33	Cotyl 7d ltr	2	0	92	64	98	93	100	96	20	17.09
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0156 + 0.33/ 0.0156 + 0.33	2 lf 7d ltr	0	0	86	60	91	83	97	96	15	16.64
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0078 + 0.50/ 0.0078 + 0.50	Cotyl 7d ltr	6	4	93	68	100	94	100	93	14	16.57
DPX-66037 + Desmed. & phen.[3]/ DPX-66037 + Desmed. & phen.[3]	0.0078 + 0.50/ 0.0078 + 0.50	2 lf 7d ltr	0	2	92	77	114	95	98	96	14	17.28

Table 2 cont.

Treatment	Rate	Applic. timing	Crop injury 6/3	Crop injury 7/14	Weed control[1] KCHSC 6/3	KCHSC 7/14	CHEAL 6/3	CHEAL 7/14	AMARE 6/3	AMARE 7/14	Yield	Sugar Content
	(lb ai/A)		(%)								(t/A)	(%)
DPX-66037 +	0.0156 +	Cotyl	6	1	94	87	97	87	100	95	18	17.92
Desmed. & phen.[3]/	0.50/											
DPX-66037 +	0.0156 +	7d ltr										
Desmed. & phen.[3]	0.50											
DPX-66037 +	0.0156 +	2 lf	0	2	91	84	100	96	98	99	15	17.35
Desmed. & phen.[3]/	0.50/											
DPX-66037 +	0.0156 +	7d ltr										
Desmed. & phen.[3]	0.50											
DPX-66037 +	0.0312 +	Cotyl	16	16	99	91	100	93	100	94	10	16.88
Desmed. & phen.[3]/	1.0/											
DPX-66037 +	0.0312 +	7d ltr										
Desmed. & phen.[3]	1.0											
DPX-66037 +	0.0312 +	2 lf	6	7	95	87	100	97	100	97	14	17.09
Desmed. & phen.[3]/	1.0/											
DPX-66037 +	0.0312 +	7d ltr										
Desmed. & phen.[3]	1.0											
Desmed. & phen.[3]/	0.33/	Cotyl	3	0	79	35	100	95	98	93	9	16.51
Desmed. & phen.[3]	0.33	7d ltr										
Desmed. & phen.[3]/	0.33/	Cotyl	2	0	77	58	98	78	95	88	13	17.47
Desmed. & phen.[3]/	0.33/	7d ltr										
Desmed. & phen.[3]	0.33	7d ltr										
DPX-6603 +	0.0156 +	Cotyl	0	0	37	37	50	51	40	57	12	17.27
Clopyrolid/	0.0937/											
DPX-6603 +	0.0156 +	7d ltr										
Clopyrolid	0.0937											
Desmed. & phen.[3] +	0.33 +	Cotyl	2	0	59	28	96	84	100	63	13	17.41
Clopyrolid/	0.0937/											
Desmed. & phen.[3] +	0.33 +	7d ltr										
Clopyrolid	0.0937											
LSD (0.05)			6	4	15	25	18	21	23	22	5	NS

[1]Weed species evaluated were Kochia (KCHSC), common lambsquarters (CHEAL), and redrooted pigweed (AMARE).
[2]Surfactant added 0.25% v/v.
[3]Desmed. & phen. = desmedipham & phenmedipham.

Control of tame oat nursecrop in sugar beets with sethoxydim. Carter, T.W., D.W. Morishita, and R.W. Downard. This experiment was established near Kimberly, Idaho to evaluate control of cultivated oats (AVESA) planted immediately after sugar beets. The study was established in a silt loam soil with 1.95% OM, CEC of 19 meq/100 g soil and pH of 8. A randomized complete block design was used with four replications. Plots were 7.33 (4 rows) by 25 ft. Sugar beet (variety 'WS-88') was planted April 19, 1992. Oats were planted immediately afterwards. Application data are found in Table 1. A hand held sprayer with 8001 even fan nozzles, and 8 inch boom height was used to apply the herbicides in a 10 inch band at a volume equivalent to 10 gpa. Tame oat control and crop injury were evaluated visually three and four times, respectively.

None of the sethoxydim treatments injured the sugarbeets (Table 2). All rates of sethoxydim controlled the oats 91 to 100% at all evaluations with the exception of the 0.125 lb ai/A rate at the first evaluation. The oats appeared to provide some early broadleaf weed control via competition. The oats were also competitive towards the beets, but the beets recovered very well after the sethoxydim was applied. It did not appear the this early competition would affect yield. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303)

Table 1. Herbicide application information.

Application date	5/20/92
Application method	10-inch band
AVESA growth stage	2 to 3 leaf
Air temperature (F)	69
Soil temperature (F)	70
Relative humidity (%)	32
Wind speed (mph)	N-9

Table 2. Sethoxydim formulations for controlling a tame oat nurse crop, near Kimberly, Idaho.

Treatment	Rate	BETVU injury				AVESA control[1]		
		5/29	6/3	6/19	7/16	6/3	6/19	7/16
	(lb ai/A)	%						
Check		0	0	0	0	0	0	0
Sethoxydim[2]	0.375	0	0	0	0	94	100	99
Sethoxydim	0.28	0	5	0	0	95	100	96
Sethoxydim	0.19	0	0	1	0	91	99	98
Sethoxydim[3]	0.25	0	0	3	3	91	100	99
Sethoxydim[3]	0.188	0	1	1	1	93	100	96
Sethoxydim[3]	0.125	0	0	0	3	85	99	93
LSD (0.05)		NS	NS	NS	NS	3	2	5

[1]Cultivated oat (AVESA) control was evaluated visually.
[2]All sethoxydim treatments were applied with Dash at 1 qt/A.
[3]Sethoxydim formulation was applied as Poast Plus.

Comparison of fall and spring applied herbicides for weed control in sugarbeets. Morishita, D. W. and R. W. Downard. Fall and spring applied soil incorporated herbicides are commonly used for weed control in sugarbeets. This study examined weed control and crop injury. The research was conducted at the Research and Extension Center near Kimberly, Idaho. Sugarbeets 'WS-88' were planted April 19, 1992, and grown under sprinkler irrigation. Plots were 4 rows by 25 ft arranged in a randomized complete block design with four replications. Soil type was a Portneuf silt loam with a pH of 7.9, 1.5% o.m. and a CEC of 15 meq/100 g soil. Herbicide treatments were applied with a bicycle or hand-held sprayer at 10 gpa using 11001 flat fan nozzles. Fall treatments were applied November 11, 1991, and spring treatments on April 14, 1992 (Table 1). Fall treatments were incorporated with a roller harrow and spring applications with a Lilliston rolling cultivator. Crop injury and weed control were evaluated June 2.

Fall applications of diethatyl plus ethofumesate and ethofumesate alone injured the crop the most (Table 2). However diethatyl plus ethofumesate applied in the fall had the best overall weed control. Fall applied ethofumesate controlled weeds better than spring applications. All herbicide treatments had yields greater than the untreated check. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, Idaho, 83303.)

Table 1. Application data.

Application date	11/12/91	4/14/92
Air temperature (F)	59	64
Soil temperature (F)	40	56
Relative humidity (%)	--	41
Wind velocity (mph)	5	8 to 12

Table 2. Crop injury, weed control and yield of sugarbeets, near Kimberly, Idaho.

Treatment	Rate	Applic. Timing	Crop injury	Weed Control[1] KCHSC	AMARE	CHEAL	Stand count	Yield	Sugar content
	(lb ai/A)		%				(plants/50 ft)	T/A	%
Check			0	0	0	0	66	7	17.47
Handweeded check			0	100	100	100	57	29	17.84
Diethatyl	4.0	Fall	3	35	40	40	54	25	17.83
Ethofumesate	2.0	Fall	11	39	90	75	51	29	17.66
Diethatyl + ethofumesate	2.0 2.0	Fall	23	81	96	85	58	28	17.50
Cycloate	4.0	Fall	0	35	84	80	58	25	17.90
Cycloate	3.0	Fall	1	19	78	59	56	29	17.63
Diethatyl	4.0	Spring	0	11	73	61	35	23	17.38
Ethofumesate	2.0	Spring	3	26	61	74	51	24	17.03
Diethatyl + ethofumesate	2.0 2.0	Spring	6	31	86	68	54	28	18.16
Cycloate	3.0	Spring	9	16	75	89	55	28	17.39
Cycloate	4.0	Spring	1	35	74	76	47	27	17.48
LSD (0.05)			8	39	30	25	NS	6	NS

[1]Weeds evaluated for control were kochia (KCHSC), redroot pigweed (AMARE), and common lambsquarters (CHEAL). Evaluation date was June 2, 1992.

Potential interaction of organophosphate insecticides with DPX-66037. Morishita, D. W. and R. W. Downard. The study was conducted at the Kimberly Research and Extension Center. Terbufos and aldicarb, two commonly used organophosphate insecticides in sugarbeets were evaluated for their potential interaction with DPX-66037. Insecticides were applied modified in-furrow (MIF) at planting. Sugarbeet 'WS-88' was planted April 20 on 22-inch rows at 43,850 seeds/A. Herbicides were applied in a 10-inch band with a hand-held sprayer calibrated to deliver 20 gpa at 38 psi. Additional application data are presented in Table 1. Crop injury ratings were taken on May 29 and June 9. Sugarbeets were harvested with a two row beet harvester on September 28.

Crop injury ranged from 9 to 18% with all DPX-66037 treatments following insecticide application on the first evaluation (Table 2). By the second evaluation date, crop injury in the same treatments ranged from 3 to 9%. Terbufos alone or followed by DPX-66037 applications resulted in significantly lower stand counts but not yields. Sugarbeet yield was not affected by the injury observed early in the growing season. The handweeded check had the highest sugar content. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	5/20	5/27
Application timing[1]	3 to 4 lf	7 d ltr
Air temperature (F)	67	64
Soil temperature (F)	70	58
Relative humidity (%)	36	---
Wind velocity (mph)	10	12

[1]Application timing abbreviations are as follows: 3 to 4 lf = 3 to 4 leaf, 7d ltr = 7 days later.

Table 2. Potential interaction of organophosphate insecticides with DPX-66037, near Kimberly, Idaho.

Treatment	Rate	Applic. timing	Crop injury 5/29	Crop injury 6/9	Stand count	Yield	Sugar content
	(lb ai/A)		---------- % --------		plants/50 ft	t/A	%
Handweeded check			0	0	72	28	18.13
Terbufos	2.0	MIF	0	10	54	30	16.52
Terbufos	2.0	MIF	15	6	56	24	17.35
DPX-66037[1]	0.0156	Cotyl					
DPX-66037[1]	0.0156	7d ltr					
Terbufos	2.0	MIF	18	9	55	29	17.78
DPX-66037[1]	0.0312	Cotyl					
DPX-66037[1]	0.0312	7d ltr					
Aldicarb	2.0	MIF	0	1	83	31	17.33
Aldicarb	2.0	MIF	14	3	79	30	16.25
DPX-66037[1]	0.0156	Cotyl					
DPX-66037[1]	0.0156	7d ltr					
Aldicarb	2.0	MIF	9	4	73	29	17.56
DPX-66037[1]	0.0312	Cotyl					
DPX-66037[1]	0.0312	7d ltr					
DPX-66037[1]	0.0156	Cotyl	4	1	71	27	17.83
DPX-66037[1]	0.0156	7d ltr					
DPX-66037[1]	0.0312	Cotyl	11	6	66	30	17.15
DPX-66037[1]	0.0312	7d ltr					
LSD (0.05)			7	7	17	NS	1.12

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

Comparison of broadleaf weed control with ethofumesate formulations. Morishita, D. W. and R. W. Downard. This study was conducted near Twin Falls, Idaho to compare common lambsquarters (CHEAL) and redroot pigweed (AMARE) control in sugarbeets with different ethofumesate formulations. Soil texture was a sandy loam with pH of 7.3, 1.3% o.m. and a CEC of 12 meq/100 g soil. Treatments were arranged in a randomized complete block design with four replications. Plots were 4 rows wide by 30 feet long. Herbicides treatments were applied in a 10-inch band with a hand-held sprayer equipped with 8001 even fan nozzles on 22-inch spacing. The sprayer was calibrated to deliver 20 gpa at 30 psi. Additional application information is presented in Table 1. The herbicide treatments were applied at the cotyledon growth stage and again seven days later. Due to inclement weather and irrigation the 7 day later treatment was applied 16 days after cotyledon stage applications. Crop injury and weed control ratings were taken June 10.

Crop injury ranged from 0 to 9% across all treatments (Table 2). Common lambsquarters and redroot pigweed control was 89 to 100% with all herbicide treatments. All ethofumesate formulations performed equally well. (Department of Plant, Soil, and Entomological Sciences, University of Idaho 83303).

Table 1. Application data.

Application timing[1]	Cotyl	7d ltr
Application date	5/4	6/1
Air temperature (F)	73	71
Soil temperature (F)	61	60
Relative humidity (%)	44	36
Wind velocity (mph)	0	6-16

[1]Application timing abbreviations are as follows: Cotyl = Cotyledon, 7d ltr = 7 days later

Table 2. Comparison of broadleaf weed control, ethofumesate formulations.

Treatment	Rate	Applic. timing	Crop injury	Weed Control[1] CHEAL	AMARE
	(lb ai/A)		----------	%	----------
Check			0	0	0
Desmed. & phen.[2]	0.19	Cotyl	3	93	96
Desmed. & phen.[2]	0.19	7d ltr			
Desmed. & phen.[2]	0.30	Cotyl	1	100	98
Desmed. & phen.[2]	0.30	7d ltr			
NA 307	0.28	Cotyl	9	95	91
NA 307	0.28	7d ltr			
NA 307	0.45	Cotyl	4	96	93
NA 307	0.45	7d ltr			
NA 308	0.28	Cotyl	1	96	98
NA 308	0.28	7d ltr			
NA 308	0.45	Cotyl	4	96	98
NA 308	0.45	7d ltr			
Desmed. & phen.[2]	0.19	Cotyl	5	89	91
Ethofumesate	0.10				
Desmed. & phen.[2]	0.19	7d ltr			
Ethofumesate	0.10				
Desmed. & phen.[2]	0.30	Cotyl	6	95	93
Ethofumesate	0.15				
Desmed. & phen.[2]	0.30	7d ltr			
Ethofumesate	0.15				
LSD (0.05)			NS	7	10

[1]Weed species evaluated were common lambsquarters (CHEAL) and redroot pigweed (AMARE).

[2]Desmed. & phen. = desmedipham & phenmedipham.

Evaluation of combinations of phenmedipham-desmedipham with ethofumesate and endothall for weed control and yield of sugarbeets. Norris, R. F., F. R. Kegel, J. A. Roncoroni, and E. J. Roncoroni. The treatments listed in Table 1 were applied postemergence to sugarbeets planted February 10, 1992, in Holt, San Joaquin County, California. The treatment field layout was a split-plot randomized complete block design with 5 replications. Main plots were herbicide treatments, with subplots of handweeding versus no handweeding. Main plots were 50 ft long by 15 ft wide (6 beds on 30 inch centers). Handweeded or not handweeded subplots were 25 ft long.

Herbicides were applied 12 inches wide to each bed top using a CO^2 backpack sprayer set at 30 psi with 8002E nozzles delivering 30 gal/A. At the initial application the beets were in the cotyledon stage with the first leaf showing. At the second application the beets were in the full first (2) leaf stage. Prostrate knotweed plants were small and had 1 to 3 leaves at the time of the initial application. Standard cultivation was done throughout the entire trial. Handweeding was done to the top of the beds as required by treatment. A large percentage of the barnyardgrass germinated after hand weeding.

The sugarbeets and weeds were harvested on October 5, 1992. Number and weight of sugarbeets were obtained from a total of 6 m (3 m from each of the middle two rows) per plot. Weed yield and numbers were taken from a total of 2 m (1 m from each of the middle two rows). Analysis was made on total beet weight and number. Weed control was based on the number of common knotweed, barnyardgrass, and the dry weight of total weeds [prostrate knotweed, barnyardgrass, smartweed, lambsquarters, yellow nutsedge, and other minor weeds]. Split plot ANOVA of the effect of herbicides, weeding, and the interaction between the two for each of these factors appear in Table 2.

All weed control treatments provided adequate control of prostrate knotweed; there were only minor differences between treatments.

Barnyardgrass was difficult to control in this experiment because it germinated and grew late in the growing season after treatments had been applied. Hand weeding suppressed barnyardgrass invasion; this was attributed to increased sugarbeet growth with associated increase in competitive ability. Early application of ethofumesate in combination with handweeding provided 80 to 90% control of the barnyardgrass.

Analysis of total weed biomass showed that hand weeding reduced weed growth by about 60%. Treatments that included ethofumesate at the first treatment resulted in about 90% weed suppression, and hand weeding provided no further benefit.

Numbers of sugarbeets were significantly reduced by lack of weed control, but there were only minor differences between all other treatments. Similarly the sugarbeet yield was reduced by lack of weed control in relation to all other treatments. Handweeding resulted in yields that were not statistically different than those obtained with herbicides. Early vigor reductions visually estimated to be approximately 10 to 20% did not result in decreased yield at harvest. (Section of Botany, University of California, Davis).

Table 1. Weed counts, weed biomass and sugarbeet yields in relation to herbicide treatments and handweeding.

Treatment		Applications (lb a.1./a)		Beet wt (kg/8 m²)			Beet number/12 m of row		
		2/25/92	3/10/92	weeded	nonwd	mean	weeded	nonwd	mean
1	Untreated check			19.9	7.1	13.5	52.8	37.4	45.1
2	(phenmedipham + desmedipham) + endothall	(0.5)	(0.5) + 0.75	23.6	20.6	22.1	57.6	52.0	54.8
3	(phenmedipham + desmedipham) + endothall	(0.65)	(0.65) + 0.75	21.8	23.3	22.6	52.8	51.6	52.2
4	(phenmedipham + desmedipham) + ethofumesate	(0.5) + 1.5	(0.5)	21.6	23.4	22.5	54.2	53.2	53.7
5	(phenmedipham + desmedipham) + ethofumesate	(0.65) + 1.5	(0.65)	22.8	22.0	22.4	56.6	51.4	54.0
6	(phenmedipham + desmedipham) + endothall + ethofumesate		(0.65) + 0.75 + 1.5	20.1	19.2	19.6	54.2	49.2	51.7
	mean			21.7	19.3		54.7	49.1	
$LSD_{0.05}$ for handweeded vs. nonweeded; for between treatments; for interaction effects of weeding and treatments.				2.1; 6.0; 5.2			2.9; n/s; 7.2		

Table 1. continued.

Treatment	Weed biomass (g d.w./1.5 m²)			Knotweed number/ 2 m of row			Barnyardgrass number/2 m of row		
	weeded	non/wd	mean	weeded	non/wd	mean	weeded	non/wd	mean
1	73.4	213.4	143.4	3.2	24.6	13.9	8.0	8.2	8.1
2	79.7	52.0	65.8	4.4	3.0	3.7	5.6	9.0	7.3
3	73.7	109.7	91.7	5.0	5.8	5.4	8.0	7.0	7.5
4	26.1	23.5	24.8	0.2	0.8	0.5	1.0	4.4	2.7
5	19.1	22.4	20.8	1.4	0.8	1.1	1.8	5.8	3.8
6	71.0	47.8	59.4	5.2	2.6	3.9	3.2	3.2	3.2
Mean	57.2	78.1		3.2	6.2		4.6	6.3	
$LSD_{0.05}$ for handweeded vs. nonweeded; for between treatments; for interacting effects of weeding and treatments.	24.7; 70.4; 60.5			1 3; 4.8; 3.2			1.8; 3.3; 4.3		

Postemergence weed control in sugarbeets with desmedipham plus phenmedipham and ethofumesate. VanGessel, M.J. and P. Westra. Postemergence (POST) control of annual weeds with desmedipham plus phenmedipham (Betamix) is inconsistent for control of many common weeds in sugarbeet fields. Two studies were conducted in 1992, one north of Fort Collins (Kerbs Farm) and the second at the CSU Bay Farm to examine POST weed control with Betamix and ethofumesate. The soils were both clay loams, with a pH of 8.0 and 1.5% o.m. at Kerbs Farm; and 1.0% o.m. with pH 7.9 at the Bay Farm. Variety at Kerbs Farm was 'Mono-Hy 1605' planted April 15, and 'Monohikari' was planted at the Bay Farm on June 4. The plots at Kerbs Farm were 3 m by 6 m and at the Bay Farm were 3 m by 8 m. Treatments are listed in the accompanying table. Treatments were arranged as randomized block design with 3 replications. Early treatments (first split) were applied at the 2 to 4 leaf beet stage, and the second split was applied seven days later. Herbicides were applied with flat fan nozzles at 197 L ha^{-1}, 175 kPa, and 5 km hr^{-1}. Weed control and sugarbeet injury were visually rated 1, 2, and 4 weeks after treatment (WAT). There was no interaction between weed control ratings and WAT, thus only the 2 WAT rating will be reported. No sugarbeet injury was observed.

At the Kerbs Farm, only redroot pigweed (Amaranthus retroflexus L., AMARE) was present. Split applications of NA307 at 0.5 and 0.6 kg ha^{-1}, NA308 at 0.6 kg ha^{-1}, and Betamix plus ethofumesate at 0.4 and 0.2 kg ha^{-1}, respectively, provide similar pigweed control (85 to 90%). A rate response was observed with Betamix, NA307, NA308, and Betamix plus ethofumesate. Split application of Betamix alone and treatments only applied at the second split did not provide adequate pigweed control.

Redroot pigweed, kochia (Kochia scoparia (L.) Schrad., KCHSC), and common lambsquarters (Chenopodium album L., CHEAL) were present at the Bay Farm. Greater than 75% control of pigweed was achieved with split applications of NA307, NA308, and Betamix plus ethofumesate at the highest rate. Kochia control was best with a split application of NA307 at 0.6 kg ha^{-1} and single application of NA308 at 1.3 kg ha^{-1} (60% control). Lambsquarters control was similar for NA307 with a split application at 0.6 kg ha^{-1} and single application of NA307 at 1.3 kg ha^{-1} (>70% control). A rate response was observed for control of pigweed, kochia, and lambsquarters with split applications of NA307, NA308, and Betamix plus ethofumesate. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table. Postemergence weed control treatments in sugarbeets. Ratings taken 2 weeks after treatment at both locations.

Treatment	Rate	Growth stage	Control: Kerbs AMARE	Control: Bay Farm AMARE	Control: Bay Farm KCHSC	Control: Bay Farm CHEAL
	kg ha⁻¹		--------	%	--------	--------
CHECK			0 f	0 h	0 f	0 h
Betamix Betamix	0.2 0.2	2-4 lvs +7 days	27 e	23 g	5 ef	10 gh
Betamix Betamix	0.3 0.3	2-4 lvs +7 days	43 d	42 efg	35 a-e	43 b-f
Betamix Betamix	0.4 0.4	2-4 lvs +7 days	57 cd	40 efg	12 ef	18 fgh
Beta/Nor NA307 Beta/Nor NA307	0.3 0.3	2-4 lvs +7 days	53 cd	48 def	23 c-f	30 d-g
Beta/Nor NA307 Beta/Nor NA307	0.5 0.5	2-4 lvs +7 days	85 a	60 a-e	23 c-f	40 c-f
Beta/Nor NA307 Beta/Nor NA307	0.6 0.6	2-4 lvs +7 days	85 a	82 a	67 a	72 ab
Beta/Nor NA308 Beta/Nor NA308	0.3 0.3	2-4 lvs +7 days	57 cd	20 gh	18 def	18 fgh
Beta/Nor NA308 Beta/Nor NA308	0.5 0.5	2-4 lvs +7 days	75 ab	53 c-f	23 c-f	33 c-g
Beta/Nor NA308 Beta/Nor NA308	0.6 0.6	2-4 lvs +7 days	90 a	77 ab	50 a-d	62 abc
Betamix Betamix Ethofumesate Ethofumesate	0.2 0.2 0.1 0.1	2-4 lvs +7 days 2-4 lvs +7 days	65 bc	47 def	7 ef	23 e-h
Betamix Betamix Ethofumesate Ethofumesate	0.3 0.3 0.15 0.15	2-4 lvs +7 days 2-4 lvs +7 days	83 a	55 b-f	30 b-f	27 d-h
Betamix Betamix Ethofumesate Ethofumesate	0.4 0.4 0.2 0.2	2-4 lvs +7 days 2-4 lvs +7 days	77 ab	78 a	37 a-e	50 a-e
Betamix	0.8	@ 2nd split	50 cd	37 fg	30 b-f	33 c-g
Beta/Nor NA307	1.3	@ 2nd split	63 bc	67 a-d	48 a-d	75 a
Beta/Nor NA308	1.3	@ 2nd split	65 bc	72 abc	58 ab	53 a-d
Betamix Ethofumesate	0.8 0.4	@ 2nd split @ 2nd split	53 cd	65 a-d	53 abc	62 abc
LSD (0.05) =			15	20	28	26
Standard Dev.=			9	12	17	15
CV =			16	24	56	40

Tolerance of spring wheat varieties recropped following sulfonylurea herbicides. Boerboom, C.M. and M.E. Thorne. Sulfonylurea herbicides may be applied in the fall to winter wheat, which occasionally freezes out and is recropped to spring wheat. A study was conducted to determine if the residual from fall applied sulfonylurea herbicides would injure recropped spring wheat and if differences in tolerance exist among spring wheat varieties.

The study was conducted near Odessa, WA in the 1990-91 growing season and near Winona, WA in the 1991-92 growing season. The Odessa site received supplemental irrigation and the Winona site was non-irrigated and in a wheat-fallow region. Each study site was seeded to winter wheat in early fall. The four main plot treatments consisted of a nontreated control and three sulfonylurea herbicides, which were applied on October 24, at Odessa and November 4, at Winona. Application rates were 0.25 oz ai/a of chlorsulfuron, 0.38 oz ai/a of chlorsulfuron + metsulfuron (Finesse), and 0.43 oz ai/a triasulfuron. In December of each year, each trial was sprayed with 0.38 lb ae/a glyphosate plus 0.25% non-ionic surfactant to simulate winter kill. In March, spring wheat varieties were randomized and seeded across each main plot. In the spring, 0.75 lb ae/a 2,4-D amine plus 0.19 lb ai/a bromoxynil were applied for broadleaf weed control at the Odessa site and 0.38 lb ai/a bromoxynil was applied at the Winona site.

Chlorsulfuron + metsulfuron significantly reduced wheat yields and heights when averaged across varieties at the Odessa site. This treatment specifically reduced the yields of Penewawa, Wadual, and Wakanz compared to the highest yielding herbicide treatment for each respective variety. Chlorsulfuron + metsulfuron also reduced the heights of several of the varieties. At the Winona site, there were no significant differences in wheat yields and because crop injury was not apparent, plant heights were not measured.

In this study, carryover injury from chlorsulfuron + metsulfuron only occurred at the irrigated Odessa site and not at the dryland site. The differences in these results may have resulted from the differences in soil moisture (irrigated vs dryland) or other stresses such as the below average spring rainfall and the one hard spring frost that the Winona site received in 1992. (Department of Crop and Soil Sciences, Washington State University, Pullman, WA 99164-6420)

Table 1. 1991 Spring wheat yield - Odessa

Treatment	Varieties							Average
	906R	Owens	Penawawa	WS-1	Wadual	Wakanz	Wampum	
	(bu/a)							
nontreated	103	112	107	107	108	118	90	106
chlorsulfuron	107	109	115	101	107	120	91	107
chlorsulfuron + metsulfuron	99	107	99	98	86	104	78	96
triasulfuron	110	101	126	105	100	120	81	106
LSD (0.05)	14	14	14	14	14	14	14	5

Table 2. 1991 Spring wheat height - Odessa

Treatment	Varieties							Average
	906R	Owens	Penawawa	WS-1	Wadual	Wakanz	Wampum	
	(in.)							
nontreated	41	47	42	42	45	40	46	43
chlorsulfuron	40	45	42	43	44	41	46	43
chlorsulfuron + metsulfuron	39	42	38	40	38	39	43	40
triasulfuron	41	45	40	41	44	41	44	42
LSD (0.05)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.2

Table 3. 1992 Spring wheat yield - Winona

Treatment	Varieties										Average
	906R	Edwall	Owens	Penawawa	Spillman	WA7677	WS-1	Wadual	Wakanz	Wampum	
	(bu/a)										
nontreated	27.5	26.4	29.3	27.7	27.5	31.9	33.2	28.6	26.7	23.8	28.3
chlorsulfuron	26.4	27.8	30.8	26.2	28.1	33.8	28.4	28.6	26.8	26.6	28.4
chlorsulfuron + metsulfuron	26.5	27.5	29.3	27.3	29.5	33.5	31.6	30.1	26.4	26.5	28.8
triasulfuron	28.1	27.8	30.0	27.5	30.8	34.3	28.8	31.3	26.6	27.0	29.1
LSD (0.05)											ns

Competition in mixed stands of wheat and sulfonylurea resistant and susceptible Kochia scoparia. P. J. Christoffoleti and P. Westra. Three replacement series experiments, at fixed densities of 100, 200, and 400 plants/m^2 for each of the combinations (wheat x resistant kochia biotype, wheat x susceptible kochia biotype, and resistant x susceptible kochia biotype) were used to assess the competitive ability of wheat, resistant, and susceptible kochia biotype. Three different approaches to data analysis were used to describe the competitive interactions between wheat and the two kochia biotypes. Wheat was the dominant competitor, and an average of one wheat plant reduced resistant kochia yield per plant equal to the effect of 4.8 resistant kochia or 5.4 susceptible kochia plants. Intraspecific competition was more important than interspecific competition for wheat, whereas the reverse was true for the resistant and susceptible kochia biotypes. The results of niche differentiation index (NDI) indicate that wheat and either resistant or susceptible kochia biotypes are only partly limited by the same resources; they partly avoid each other. The resistant and susceptible biotypes; however, are limited by the same resources; they do not avoid each other. (Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80525.)

Competitive ability of sulfonylurea resistant and susceptible Kochia scoparia. P. J. Christoffoleti and P. Westra. Two years of field experiments were carried out to study the degree of intrabiotype competition, interbiotype competition, and niche differentiation. The data used for the analysis were the final biomass data of populations varying in biotype composition and total density of two kochia biotypes, one resistant and one susceptible. Addition series experiments were used as experimental design, and the calculation of the competition effects was made by the reciprocal yield model. Prediction of shift in the kochia biomass production from density dependent to density independent relationship was made. The above ground biomass data from two years of field experimentation showed that the two kochia biotypes had the same competitive ability, independent of the variation in density and proportion of the biotypes. Interbiotype competition was more important than intrabiotype competition for the susceptible biotype; however, the inverse was true for the resistant biotype. The product of the coefficients for intrabiotype competition did not significantly exceed the product of the coefficient for interbiotype competition, indicating that the two biotypes were competing for the same resources. When the seed yield of the two experiments was analyzed by means of the relation between per-plant biomass and harvest index, it was observed that the resistant biotype had a higher seed yield than the susceptible one; however, the resistant seeds were heavier. (Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80525.)

Growth analysis of sulfonylurea resistant and susceptible Kochia scoparia. P. J. Christoffoleti and P. Westra. Greenhouse experiments were conducted to compare the growth analysis of sulfonylurea resistant and susceptible kochia (Kochia scoparia L. Schard). Aboveground, leaf and stem dry weight, and leaf area per plant were measured weekly 14 times starting at 14 days after planting. Data were analyzed with Richards function for shoot dry weight per plant, exponential polynomial function for leaf area per plant, and splines function for leaf area ratio, specific leaf area, leaf weight ratio, stem weight ratio, and leaf:stem ratio. Derived quantities, such as absolute and relative growth rate, and net assimilation rate, were calculated from these functions. Even though small differences can be observed in the growth analysis of sulfonylurea resistant and susceptible kochia, it was concluded from the analysis of these results that both resistant and susceptible kochia present the same performance in growth and development of individual plants under non-competitive conditions. The final shoot dry weight and leaf area seemed to be little affected by the biochemical differences of the resistant and susceptible kochia; however, the partitioning of the resources was more concentrated to the leaves in the resistant kochia. If competitive ability of the resistant and susceptible kochia are different, it is not the consequence of the differential growth, development, or ontogeny of the kochia biotypes. (Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80525.)

Control of ALS resistant and susceptible kochia biotypes with clomazone. Tonks, D.J. and P. Westra. A field study was initiated in the spring of 1992 to evaluate the effectiveness of clomazone applied pre-emergence on ALS resistant and susceptible kochia (Kochia scoparia [L.] Schrad). Kochia biotypes used were collected from: Reeder, N.D. (S); Wiggins, CO (S); Wiggins, CO (R); San Luis Valley, CO (S); San Luis Valley, CO (R); Arriba, CO (R); Ault, CO (S); Havre, MT (R) (R = resistant and S = susceptible) and were from original collections to maximize growth differences due to adaptation to their respective environments. These kochia biotypes previously demonstrated different germination rates. This research was located at the Colorado State University Bay Farm Research Center in Fort Collins, CO (clay loam, pH 7.9, 1.0% O.M.). Each biotype was planted in 12 meter rows with a distance of 30 cm between individual rows and were seeded at 30 cm increments along the rows. The experimental layout was a split-plot design with kochia biotypes being the main plots and herbicide rates being the sub-plots with three replications.

Command was applied perpendicular to the rows immediately after planting at 0.28, 0.55 and 0.84 kg ai/ha using a CO_2 powered backpack sprayer delivering 80 L/ha at 200 kPa and 11002 LP tips. Air and soil temperature was 9° C and 5° C respectively and relative humidity was 54%. The experimental area was irrigated with an overhead sprinkler to facilitate seed germination and herbicide activity and was watered as necessary to maintain vigorous growth. Visual evaluations were made 45 and 90 days after planting (DAP).

Results determined that the kochia biotypes were equally controlled by clomazone. This indicates that there is no cross resistance or negative cross resistance between sulfonylurea herbicides and clomazone. Kochia plants showed initial injury but overcame injury in treatments at 0.28 and 0.55 kg ai/ha indicating these rates are not adequate for control. (Department of Plant Pathology and Weed Science, Colorado State University, Fort Collins, CO 80523.)

Control of kochia resistant and susceptible kochia biotypes with command[1].

Herbicide Treatment	Rate (kg ai/ha)	----% Control---- 45 DAP	90 DAP
Command	0.28	13 c	17 c
Command	0.55	35 b	23 b
Command	0.84	68 a	57 a
Untreated		0 d	0 d

[1]Treatments within a column followed by the same letter are not significantly different (Waller/Duncan k-ratio test, P=0.05).

Wild oat and broadleaf weed control in spring wheat with UCC-C4243. Downard, R. W. and D. W. Morishita. A study was established near Kimberly, Idaho to evaluate wild oat and broadleaf weed control. Weed species evaluated were common lambsquarters (CHEAL), redroot pigweed (AMARE), volunteer rape (BRACA) and wild oat (AVEFA). Spring wheat 'Penewawa' was planted March 26 at 60 lb/A. The soil type was a Portneuf silt loam with a pH of 8.0, 1.55% o.m. and CEC of 14 meq/100 g soil. Preplant herbicides were applied with a bicycle sprayer at 20 gpa and 40 psi. Preemergence and postemergence herbicides were applied at 10 gpa and 38 psi. Additional application information is presented in Table 1. On May 14 the field was sprayed for Russian wheat aphid with disulfoton. Crop injury and weed control evaluations were taken on June 9 and August 7. Wheat was harvested on August 7 with a small-plot combine.

Crop injury was minimal (0 to 9%) with all treatments (Table 2). Redroot pigweed control was 90 to 98% with all treatments except, triallate followed by UCC-4243 at 0.0625 lb ai/A and triallate followed by bromoxynil and MCPA. Common lambsquarters control was 80 to 100% with UCC-4243 EC or WP alone, UCC-4243 at 0.0625 lb ai/A followed by diclofop and triallate followed by bromoxynil and MCPA. Triallate treatments applied PPI followed by the UCC-4243 EC formulation controlled wild oat best and were the highest yielding treatments. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83303).

Table 1. Application Data

Application date	3/30	4/3	5/27
Application timing[1]	PPI	Pre	Post
Air temperature (F)	65	73	64
Soil temperature (F)	56	62	58
Relative humidity (%)	62	28	--
Wind velocity (mph)	8	4	12 to 15

[1]Application timing abbreviations are as follows: PPI = preplant incorporated, Pre = premergence, and Post = postemergence.

Table 2. Crop injury, wild oat and broadleaf weed control in spring wheat.

Treatment	Formulation	Rate	Applic. timing	Crop Injury	Weed Control[1] CHEAL 6/9	CHEAL 8/7	AMARE 6/9	BRACA 6/9	BRACA 8/7	AVEFA 6/9	Yield
		(lb ai/A)		%							(bu/A)
Check				0	0	0	0	0	0	0	50
UCC-C4243	WP	0.0625	Pre	3	70	80	93	40	25	19	61
UCC-C4243	EC	0.625	Pre	0	68	83	98	23	25	33	67
Triallate		1.0	PPI	8	66	66	93	64	0	84	76
UCC-C4243	EC	0.046	Pre								
Triallate		1.0	PPI	8	64	66	74	19	0	88	76
UCC-C4243	EC	0.0625	Pre								
UCC-C4243	WP	0.0625	Pre	5	65	66	99	40	25	66	69
Triallate		1.0	PPI								
UCC-C4243[2]	EC	0.046	Pre	5	63	78	96	19	0	79	75
diclofop		0.75	E post								
UCC-C4243[2]	EC	0.625	Pre	8	85	85	90	34	0	44	70
diclofop		0.75	E post								
Triallate		1.0	PPI	9	83	100	31	68	95	36	68
bromoxynil & MCPA		0.75	E post								
LSD (0.05)				NS	37	36	27	NS	44	41	14

[1]Weed species evaluated were common lambsquarters (CHEAL), redroot pigweed (AMARE), volunteer rape (BRACA) and wild oat (AVEFA).

[2]Crop oil concentrate added at 1 qt/A.

Broadleaf weed control in spring wheat. Downard, R. W. and D. W. Morishita. A study was established near Kimberly, Idaho, to evaluate broadleaf weed control using several different herbicides and tank mix combinations. Weed species evaluated were common lambsquarters (CHEAL) and volunteer rape (BRACA). The experimental design was a randomized complete block with four replications. Spring wheat 'Penawawa' was planted March 26 at 60 lb/A. The soil type was Portneuf silt loam with a pH of 8.0, 1.55% o.m. and CEC of 14 meq/100 g soil. Herbicides were applied with a hand-held sprayer calibrated to deliver 10 gpa and 38 psi. Wheat was treated with disulfoton May 14 for Russian wheat aphid. Additional application data are presented in Table 1. Crop injury and weed control were evaluated June 8 and August 7. Wheat was harvested on August 7 with a small plot combine.

2,4-D plus metribuzin had the highest crop injury and next to lowest yields (Table 2). Common lambsquarters control in June was good to excellent (81 to 100%) with all treatments except late postemergence treatments of UCC-C4243 wettable powder. In August, all herbicide treatments controlled 83 to 100% common lambsquarters except 2,4-D at 1.0 lb ai/A. Season long control of volunteer rape was 88 to 100% with all treatments except 2,4-D at 1.0 lb ai/A, dicamba + 2,4-D, MCPA or metribuzin, and UCC-C4243. The highest yielding treatments were 2,4-D at 0.75 lb ai/A and dicamba at 0.125 lb ai/A plus 2,4-D at 0.375 lb ai/A. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	4/3	5/5	5/27
Application timing[1]	Pre	E Post	L Post
Air temperature (F)	72	67	64
Soil temperature (F)	62	56	58
Relative humidity (%)	28	50	--
Wind velocity (mph)	4	3	12 to 15

[1]Application timing abbreviations are as follows: Pre = premergence, E Post = early postemergence, and L Post = late postemergence.

Table 2. Crop injury and broadleaf weed control in spring grain, near Kimberly, Idaho.

				Weed Control[1]				
		Applic.	Crop	CHEAL		BRACA		
Treatment	Rate	timing	injury	6/8	8/7	6/8	8/7	Yield
	(lb ai/A)		%					(bu/A)
Check			0	0	0	0	0	63
EXP30973A	0.25	E Post	4	100	100	97	100	52
Bromoxynil	0.25	E Post	0	90	100	93	95	61
Bromoxynil & MCPA	0.75	E Post	3	98	100	100	100	52
Bromoxynil & MCPA[2] + Thifen. & Triben.[3]	0.375 0.0156	E Post	0	100	100	100	100	51
Bromoxynil & MCPA[2] + Thifen. & Triben.[3]	0.50 0.0156	E Post	5	100	99	100	99	61
2,4-D Amine	0.75	L Post	6	76	100	44	100	70
2,4-D Amine	1.0	L Post	6	60	75	26	75	64
Thifen. & Triben.[2,3] + 2,4-D Amine	0.0156 0.25	L Post	9	79	99	58	100	58
Dicamba SGF + 2,4-D Amine	0.125 0.375	<5 lf	9	93	95	70	68	69
Dicamba SGF + MCPA	0.125 0.125	<5 lf	1	96	100	87	75	63
Dicamba SGF[2] + Thifen. & Triben[3]	0.125 0.0156	<5 lf	0	98	100	98	100	65
Dicamba + 2,4-D	0.125 0.375	<5 lf	4	96	100	77	100	63
2,4-D[4]	1.0	L Post	8	83	100	40	100	60
Metribuzin	0.14	<4 lf	15	85	84	99	88	38
2,4-D + Metribuzin	0.25 0.14	<4 lf	23	100	95	100	100	39
Dicamba + Metribuzin	0.125 0.14	<4 lf	16	100	100	100	74	55
UCC-C4243 WP	0.0625	Pre	5	75	83	43	25	48
UCC-C4243 EC	0.0625	Pre	1	81	85	50	36	61
LSD (0.05)			8	17	21	32	40	18

[1]Weed species evaluated were common lambsquarters (CHEAL) and volunteer rape (BRACA).

[2]Nonionic surfactant R-11 added at 0.25% v/v.

[3]Thifen. & Triben = Thifensulfuron & Tribenuron

[4]Cayuse added at 0.50% v/v.

UCC-C4243 applied preemergence and postemergence for weed control in spring wheat. Thompson, C.R. and D.C. Thill. A study was established in 'Sprite' spring wheat 1 mile north of Viola, ID to evaluate wheat response and weed control efficacy with UCC-C4243 applied to wheat at various stages of development. The cooperator applied and harrow incorporated triallate at 1.25 lb ai/a to the experimental area and seeded wheat 1.5 in. deep on March 26 and 27, respectively. All treatments were applied with a CO_2 backpack sprayer calibrated to deliver 10 gal/a for postemergence treatments and 20 gal/a for preemergence treatments (Table 1). Preemergence (PRE) treatments were applied to the soil surface on March 30. Spike treatments were applied to 0.5 to 1 in. wheat with the first leaf still rolled on April 10. Approximately 50 to 75% of the wheat had emerged at the time of treatment. No weeds were present. The 1 leaf treatments were applied to 2.5 to 3 in. wheat with 1 to 1.2 leaves and to cotyledon field pennycress (THLAR) and common lambsquarters (CHEAL) on April 14. The 3 leaf treatments were applied to 3 to 3.5 leaf wheat, 0.25 to 2.5 in. field pennycress and common lambsquarters, and to 0.5 to 1 in. mayweed chamomile (ANTCO) on April 28. Weed densities were determined by counting plant number of each species within 1 ft^2 quadrants placed in two locations within each untreated control plot. The thifensulfuron-tribenuron + bromoxynil at 0.008 + 0.187 lb ai/a treatments were applied with R-11 at 0.25% v/v to 4 to 4.5 leaf wheat, 1 to 4 in. field pennycress and common lambsquarters, and to 1 to 2 in. mayweed chamomile on May 6. Wheat injury and weed control were evaluated visually on July 2. Wheat from a 4.5 by 27 ft area of each plot was harvested for grain yield on August 1. The experiment had four replicates and was designed as a split-plot with the UCC-C4243 treatments as the main plots with or without (+T or -T) thifensulfuron-tribenuron + bromoxynil + R-11 as the subplots.

Table 1. Application and soil analysis data

Wheat leaf stage	PRE	Spike	1	3	4
Temperature (F)	52	48	65	76	79
Soil temperature at 2 in. (F)	44	43	66	70	72
Relative humidity (%)	55	89	63	54	49
Wind speed (mph - direction)	3-W	0--	2-N	2-W	4-S
Soil pH			5.7		
OM (%)			3.1		
CEC (meq/100g soil)			18.3		
Texture			loam		

UCC-C4243 did not reduce grain yield, test weight, or injure spring wheat regardless of the application rate or time (Table 2). UCC-C4243 applied to wheat in the spike stage desiccated the wheat tissues, however, wheat appeared to recover (observation only). The UCC-C4243 wettable powder formulation appears to have good safety when applied postemergence to spring wheat. Thifensulfuron-tribenuron+bromoxynil delayed the mid-June wheat heading 1 to 2 days (observation) and caused slight injury; however, wheat yield and test weight were not affected.

UCC-C4243 controlled mayweed chamomile, common lambsquarters, and field pennycress 85% or more regardless of rate or application time. UCC-C4243 at 0.015 lb ai/a applied at the 3 leaf stage of wheat controlled mayweed chamomile and common lambsquarters less than other treatments. UCC-C4243 at 0.015 lb/a controlled less Italian ryegrass (LOLMU) than UCC-C4243 at 0.03 or 0.063 lb/a. (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Spring wheat response to UCC-C4243 and thifensulfuron-tribenuron

Main plot treatment[1]	Rate	App.[2] time	Yield -T[3]	Yield +T[3]	Yield Mean	Test weight -T[3]	Test weight +T[3]	Test weight Mean	Injury -T[3]	Injury +T[3]	Injury Mean
	lb ai/a		---	(bu/a)	---	--	(lb/bu)	--	-----	(%)	-----
control			78	80	79	63	63	63	--	--	--
C4243	0.063	PRE	76	71	74	63	63	63	0	3	1
C4243	0.015	Spike	82	81	82	62	62	62	1	3	2
C4243	0.030	Spike	79	80	79	62	63	63	2	4	3
C4243	0.063	Spike	81	78	80	63	63	63	1	5	3
C4243[4]	0.063	Spike	85	88	86	63	63	63	1	4	3
C4243	0.015	1 leaf	86	84	85	63	63	63	0	4	2
C4243	0.030	1 leaf	79	79	79	63	62	63	0	4	2
C4243	0.063	1 leaf	88	91	90	63	63	63	2	4	3
C4243	0.015	3 leaf	90	86	88	63	63	63	0	3	1
C4243	0.030	3 leaf	86	85	85	63	63	63	0	4	2
C4243	0.063	3 leaf	85	85	85	63	63	63	1	4	2
	mean		83	82		63	63		1	4	
	C4243 $LSD_{(0.05)}$			NS			NS			NS	
	T $LSD_{(0.05)}$			NS			NS			1	
	C4243*T $LSD_{(0.05)}$			NS			NS			NS	

[1] C4243 = UCC-C4243 50% WP formulation
[2] App. = Application
[3] T = thifensulfuron-tribenuron+bromoxynil (+) = applied (-) = not applied
[4] EC formulation of UCC-C4243 (0.83 lb ai/gal)

Table 3. Weed species response to UCC-C4243 and thifensulfuron-tribenuron

Main plot trt[1]	Rate	App.[2] time	ANTCO -T[3]	ANTCO +T[3]	ANTCO Mean	CHEAL -T[3]	CHEAL +T[3]	CHEAL Mean	THLAR -T[3]	THLAR +T[3]	THLAR Mean	LOLMU -T[3]	LOLMU +T[3]	LOLMU Mean
	lb ai/a		-------	-------	-------	-------	(% control)	-------	-------	-------	-------	-------	-------	-------
C4243	0.063	PRE	98	100	99	98	100	99	99	100	99	74	76	75
C4243	0.015	Spike	92	99	95	91	99	95	97	99	98	44	51	48
C4243	0.030	Spike	95	99	97	95	99	97	98	99	99	68	70	69
C4243	0.063	Spike	99	99	99	99	99	99	99	99	99	75	79	77
C4243[4]	0.063	Spike	98	99	99	99	99	99	99	99	99	78	85	81
C4243	0.015	1 leaf	90	99	95	91	99	95	95	99	97	56	63	59
C4243	0.030	1 leaf	99	99	99	99	99	99	99	99	99	75	74	74
C4243	0.063	1 leaf	99	99	99	99	99	99	99	99	99	84	82	83
C4243	0.015	3 leaf	85	99	92	89	99	94	96	99	98	55	60	58
C4243	0.030	3 leaf	94	99	97	96	99	98	99	99	99	65	75	70
C4243	0.063	3 leaf	99	99	99	99	99	99	99	99	99	74	69	71
	mean		95	99		96	99		98	99		68	71	
	C4243 $LSD_{(0.05)}$			4			3			1			16	
	T $LSD_{(0.05)}$			2			1			1			2	
	C4243*T $LSD_{(0.05)}$			5			5			2			6	
Weed density (plants/ft^2)				4			6			1			<1	

[1] trt = treatment; C4243 = UCC-C4243 50% WP formulation
[2] App. = Application
[3] T = thifensulfuron-tribenuron+bromoxynil (+) = applied (-) = not applied
[4] EC formulation of UCC-C4243 (0.83 lb ai/gal)

MON 13280 evaluated for weed control in spring wheat. Thompson, C.R. and D.C. Thill. An experiment was established 3 miles northeast of Potlatch, ID, to determine the influence of MON 13280 on 'Penawawa' spring wheat and various weed species. The preplant preemergence surface treatments (PPES) were applied to the soil surface and spring wheat was planted 0.25 to 0.5 in. deep on March 28, 1992 (Table 1). Postplant preemergence surface treatments (POPES) were applied to the soil surface on March 30. Preemergence treatments were applied in 20 gal/a water carrier. The postemergence treatment (POST) was applied in 10 gal/a to 3.5 to 4.5 leaf wheat and wild oat, 1 to 2 in. mayweed chamomile (ANTCO), 1 to 3 in. common lambsquarters (CHEAL), and to 1 to 4 in. field pennycress (THLAR). Wheat stand reduction and weed control were evaluated on July 2. Wheat was not harvested because of severe stand reductions with all MON 13280 treatments.

Table 1. Application and soil analysis data

Application date	3/28	3/30	5/6
Application stage	PPES	POPES	POST
Temperature (F)	48	68	82
Soil temperature at 2 in. (F)	42	55	81
Relative humidity (%)	55	50	55
Wind speed (mph - direction)	2-NW	3-SE	1-SW
Soil pH		5.6	
OM (%)		2.7	
CEC (meq/100g soil)		20.2	
Texture		silt loam	

MON 13280 reduced wheat stand 82 to 98% compared to untreated wheat (Table 2). Wheat stand reduction may have been enhanced because of the 0.25 to 0.5 inch seeding depth. Wheat stand was much better in a small area of the trial where seed was placed in the soil 1 to 2 in. deep (observation only). MON 13280 did not control wild oat or provide adequate control of mayweed chamomile, common lambsquarters or field pennycress regardless of the rate applied or the timing of application. (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Spring wheat and weed species response to MON 13280

Treatment	Rate	Application time	Wheat stand reduction	Control AVEFA	ANTCO	CHEAL	THLAR
	lb ai/a		(%)				
MON 13280	0.125	PPES	90	0	19	51	23
MON 13280	0.25	PPES	93	8	43	53	45
MON 13280	0.5	PPES	98	20	60	66	61
MON 13280	0.125	POPES	82	0	26	49	43
MON 13280	0.25	POPES	91	0	26	33	34
MON 13280	0.5	POPES	98	25	68	78	66
thifensulfuron-tribenuron[1]+	0.008	POST					
bromoxynil+	0.187	POST					
R-11[2]	0.25% v/v	POST	0	0	99	99	99
LSD (0.05)			10	19	23	26	25
Plants / ft^2				6	7	4	6

[1] commercially formulated mixture
[2] nonionic surfactant

Wild Oat Control in Winter Wheat. Ball, D.A. An experiment was established on a commercial winter wheat field south-east of Adams, OR to evaluate postemergence herbicide treatments for control of wild oats (AVEFA). Plots were 10 ft x 30 ft in a RCB arrangement, replicated three times. Treatments were applied early postemergence (EPOST) to winter wheat in the 6-leaf stage and wild oats in the 4-5 leaf stage on March 6, 1992, or as a late postemergence (LPOST) treatment to 7-leaf winter wheat and 7-leaf wild oats on March 20, 1992. Applications were made with a hand-held boom delivering 15 gpa H_2O at 25 psi.

Application Details:

EPOST	Date: March 6, 1992
Air Temp: 55F	Sky: partly cloudy
Wind: E at 1-3 mph	Soil temp: 0 in. 60F, 1 in. 60F, 2 in. 54F
Relative humidity: 55%	Soil moisture: moist at surface
Organic matter: 3.7%	Soil pH: 6.3
Soil type: Athena silt loam	
Sand: 16% Silt: 76% Clay: 8%	

LPOST	Date: March 20, 1992
Air Temp: 61F	Sky: clear
Wind: NE at 5 mph	Soil temp: 0 in. 55F, 1 in. 62F, 2 in. 57F
Relative humidity: 46%	Soil moisture: moist to 12 in.
Soil type: Athena silt loam	

Visual wild oat control was evaluated on April 16, 1992 and on June 8, 1992. Yields were taken on July 10, 1992. Wild oat control from treatments with imazamethabenz was improved at delayed applications timing. All treatments provided improved yields compared to an untreated control. Later evaluation timing generally resulted in an increase in visual control estimates. Diclofop provided the best wild oat control of the materials tested but not significantly better than difenzoquat or imazamethabenz applied late. The development of wild oat resistance to diclofop in areas surrounding eastern Oregon should be of major consideration when choosing a wild oats control program. Rotating other wild oat controls with diclofop will delay resistance development. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Wild Oat Control in Winter Wheat

Compound	Rate (lb ai/a)	%AVEFA Control April 16	%AVEFA Control June 8	Yield kg/ha
Early postemergence				
diclofop	1.00	80	94	107
difenzoquat	1.00	78	90	97
imazamethabenz	0.47	65	53	88
imazamethabenz difenzoquat	0.23 0.50	71	72	99
imazamethabenz difenzoquat	0.12 0.50	80	66	90
imazamethabenz difenzoquat	0.31 0.25	71	72	88
Late postemergence				
difenzoquat	1.00	70	83	92
imazamethabenz	0.47	63	92	101
imazamethabenz difenzoquat	0.23 0.50	67	85	100
imazamethabenz difenzoquat	0.12 0.50	45	73	97
imazamethabenz difenzoquat	0.31 0.25	62	85	99
control		0	0	56
LSD (0.05)		17.6	11.1	16.3

AVEFA = Wild oats

Influence of Replanting Regime on Control of Downy Brome in Winter Wheat. Ball, D.A. and E. Jacobsen. A study was conducted at the Sherman Experiment Station, Moro, OR to evaluate options available when poor winter wheat stands and heavy downy brome infestations occur simultaneously. Winter wheat var "Stephens" was planted on September 23, 1991 into a trashy seed bed with variable moisture conditions. Seeds were placed at approximately 4.5-in depth with a John Deere HZ split packer-wheel drill. Crop emergence was slow and variable due to poor soil moisture, and trashy seedbed conditions. The field had a history of high levels of downy brome which, combined with poor stand establishment, resulted in an extreme downy brome infestation during the winter and early spring.

An experiment was arranged as a RCB with 12 ft x 125 ft plots, replicated 4 times. Treatments consisted of glyphosate application, with and without field cultivating to remove winter wheat followed by replanting with spring wheat. These options were compared with metribuzin + metsulfuron + chlorsulfuron applied postemergence with no replanting of wheat, and an untreated, unreplanted control. Metribuzin + metsulfuron + chlorsulfuron (2.25+0.3 oz ai/a) was applied with a trailer-mounted sprayer in 10 gpa water at 28 psi to wheat at the 2-leaf stage and downy brome at the 1-2 leaf stage. Glyphosate at 0.375 lb ai/a was applied on February 12, 1992 with a trailer-mounted sprayer delivering 10 gpa at 30 psi. Plots were chisel plowed within four hours of the glyphosate treatment and planted with spring wheat var "Penawawa" at 70 lb/a. Evaluations of wheat stand and percent control of downy brome were made on May 15, 1992. Plots were harvested for yield on July 27, 1992.

Results indicate that replanting spring wheat provided fair to good control of downy brome, but caused a significant yield reduction compared to leaving the downy brome infested winter wheat crop. Treatment of the winter wheat with metribuzin + metsulfuron + chlorsulfuron provided moderate suppression of downy brome with a substantial yield enhancement over the untreated control. Of the treatments used to establish spring wheat, glyphosate plus cultivation immediately before planting provided excellent downy brome control with an acceptable wheat yield. Cultivation alone did not adequately control downy brome before replanting. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Replanting for Control of Severe Downy Brome Infestations.

Treatment	% BROTE Control	Yield bu/a	Crop
no treatment	0	24 bc	Winter Wheat
glyphosate + replant	79	21 cd	Spring Wheat
cultivate + replant	31	13 d	Spring Wheat
glyphosate + cultivate + replant	96	28 ab	Spring Wheat
metribuzin + chlorsulfuron + metsulfuron (POST)	46	34 a	Winter Wheat

Yield values followed by the same letter are not significantly different at the 0.05% probability level as determined by Fisher's protected LSD.

chlorsulfuron + metsulfuron applied as Finesse®

Downy Brome Control in Winter Wheat. Ball, D.A. and S.A. Reinertsen. Two studies were established to evaluate various herbicide combinations for control of downy brome (BROTE) in winter wheat. Studies were located north of Mission, OR (OR) and north of Walla Walla, WA (WA). **Mission Location:** Preplant incorporated (PPI) treatments were applied September 24, 1991 in 20 gpa water at 30 psi and incorporated 1 time with a flex-tine harrow. Winter wheat var "Stephens" was seeded September 24, 1991 at 1.5-in depth into dry soil with a John Deere 8300 double-disk drill. Early postemergence (EPOST) treatments, with no surfactant were applied December 13, 1991 to 2-leaf wheat and 0.5-leaf downy brome. Late postemergence (LPOST) treatments were applied March 9, 1992 to 1-4 tiller wheat and 2-leaf to 4-tiller downy brome with M-90 surfactant at 0.25 % v/v. The wheat stand was of variable uniformity due to shallow seeding. Downy brome infestation was light and variable throughout the plot area. Plots were evaluated for percent downy brome control and crop injury on April 17, 1992. No visible crop injury was observed on this date. Yield was evaluated on July 2, 1992. Results indicate that several PPI/LPOST sequential treatments provided excellent season-long control of downy brome at this site. Mild winter conditions improved control of several tested materials and possibly contributed to the lack of crop injury symptoms. Light and variable populations of downy brome, and scattered wild oats infestation prevented significant yield reductions from being detected. **Walla Walla Location:** PPI treatments were applied September 12, 1991 in 20 gpa water at 24 psi and incorporated 2 times with a flex-tine harrow. Winter wheat var "Stephens" was seeded on September 27, 1991 at 1.5-in depth into a dry seedbed with a double-disk drill. EPOST treatments with M-90 surfactant at 0.25 % v/v were applied February 3, 1992 to 3-4 leaf wheat and 2-5 leaf downy brome. LPOST treatments with M-90 surfactant at 0.125 % v/v were applied February 26, 1992 to 6-10 leaf wheat with 2-in secondary roots and 3-leaf to 5-tiller downy brome. Wheat stand was uniform and vigorous throughout the plot area. Downy brome infestation was heavy and uniform throughout the plot area. Plots were evaluated for percent downy brome control and crop injury on April 17, 1992. Minor visible injury was present from some treatments. Good crop stand and heavy, uniform downy brome infestation allowed for excellent experimental conditions. Results indicate that several PPI/LPOST sequential treatments provided excellent season-long control of downy brome at this site. Mild winter conditions improved control of several tested materials and possibly contributed to the lack of crop injury symptoms. Results are presented for each site separately and as averaged for both locations. (Columbia Basin Agricultural Research Center, Oregon State University, Pendleton, OR 97801).

Downy Brome Control in Winter Wheat

Treatment	Rate (lb ai/a)	Time	% BROTE Control			Yield (kg/ha)		
			OR	WA	Avg	OR	WA	Avg
diclofop	0.75	PPI	98	80	89	4970	4030	4500
diclofop	1.00	PPI	95	80	87	5240	4100	4670
triallate	1.5	PPI	86	50	68	5640	3430	4535
control			0	0	0	5240	2890	4065
diclofop triallate	0.75 1.50	PPI PPI	89	87	88	5240	4230	4735
diclofop chlorsulfuron + metsulfuron	0.75 0.018	PPI PPI	94	74	84	5640	3900	4770
diclofop triasulfuron	0.75 0.018	PPI PPI	93	72	83	5580	4370	4975
UBI-C4243	0.094	PPI	75	48	62	5510	3700	4605
UBI-C4243	0.125	PPI	86	76	81	5850	4100	4975
diclofop UBI-C4243	1.00 0.094	PPI PPI	95	83	89	5380	4100	4740
diclofop UBI-C4243	1.00 0.125	PPI PPI	91	90	91	5780	4030	4905
diclofop metribuzin	0.75 0.28	PPI LPOST	99	99	99	5440	4500	4970
triallate metribuzin	1.50 0.28	PPI LPOST	87	97	92	5380	4230	4805
chlorsulfuron + metsulfuron	0.018	EPOST	69	9	39	5380	3160	4270
triasulfuron	0.018	EPOST	67	5	36	5510	3220	4365
metribuzin	0.14	EPOST	66	53	59	5580	4230	4905
chlorsulfuron + metsulfuron metribuzin	0.018 0.14	EPOST EPOST	86	74	80	5710	4370	5040
triasulfuron + metribuzin	0.018 0.14	EPOST EPOST	79	65	72	5710	4300	5005
control			0	0	0	5580	2900	4240
metribuzin	0.28	LPOST	80	73	77	5510	4030	4770
metribuzin	0.38	LPOST	83	80	81	5710	3960	4835
metribuzin + bromoxynil	0.28 0.25	LPOST	67	69	68	5240	4170	4705
metribuzin bromoxynil + MCPA	0.28 0.25	LPOST LPOST	71	70	71	5440	4170	4805
metribuzin + MCPA	0.28 0.25	LPOST LPOST	57	63	60	5510	3830	4670
LSD (0.05)			13	13	13	ns	550	-

OR - Mission, OR site
WA - Walla Walla, WA site
BROTE - Downy Brome
MCPA applied as the low volatile ester formulation

Preemergence weed control in wheat. Bell, C. E. Several winter annual weeds cause crop yield loss in cereal grains in the Lower Colorado River Desert areas of California and Arizona. This research was conducted at the University of California Desert Research and Extension Center in Holtville, CA. The purpose of the trials was to compare trifluralin and pendimethalin for weed control when applied preemergence.

The trial was conducted on durum wheat (cv Yavaros) planted on January 24, 1992 on flat ground between raised borders and flood irrigated. Trial design was a randomized complete block with four replications. Plot size was 3 m by 3 m. Treatments consisted of each herbicide applied at three rates (.56, .84, and 1.12 kgai/ha) and in both a liquid and a granular formulation. All treatments were applied on January 27, 1992. Liquid treatments were applied at a 150 l/ha carrier volume at 138 kPa pressure through 8003LP flat fan nozzles. Granules were applied with a small jar with holes punched in the lid, salt shaker style.

Data collection included biomass samples taken on May 21, 1992 and crop yield on June 1, 1992. The biomass sample was .25 m^2 from each plot. Weeds were separated by species from the wheat, dried at 50^o C for three days, and weighed. These data are presented in the table below, with wild oats, the most prevalent weed, listed separately and the other species lumped together. These species included littleseed canarygrass, wild beet, nettleleaf goosefoot, annual sowthistle, little mallow, and silversheath knotweed. The sample was taken after crop anthesis, but before maturity. Yield was collected mechanically with a small plot harvester from a 4 m^2 area in the middle of each plot.

Analysis of variance, mean separation (LSD), and single degree of freedom class comparisons were performed on these data. For the wheat biomass, the herbicide treatments did not adversely affect crop growth ($P > 0.05$), when compared to the untreated control. The class comparison indicated that the granular treatments tended to affect wheat biomass compared to liquid treatments. Wild oat biomass appears to be higher in the treated plots as compared to the untreated. It also appears that the pendimethalin 4E treatments may have reduced wild oat biomass compared to the other herbicide treatments.

The other weeds in the trial were affected by the herbicide treatments, compared to the untreated ($P < 0.01$). The pendimethalin 4E treatments lowered this weed biomass better than the other herbicide treatments ($P < 0.01$), and the liquid treatments had lower weed biomass than the granular treatments ($P < 0.01$). Wheat yield was affected in a similar manner; pendimethalin treatments had higher yields than trifluralin ($P < 0.09$), the liquid was better than the granules ($P = 0.01$), and, in particular, the pendimethalin

4E treatment yields were greater than the other herbicide treatments ($P < 0.01$). (Cooperative Extension, University of California, Holtville, CA 92250).

<u>Russian thistle control in winter wheat and spring barley</u>. Boerboom, C.M and M.E. Thorne. Sulfonylurea resistant Russian thistle is wide spread throughout central Washington. In an effort to find low cost treatments to control these resistant Russian thistle, studies were conducted near Prosser and Washtucna, WA to evaluate low rates of bromoxynil combined with 2,4-D in winter wheat and spring barley.

The experimental design was a randomized complete block with 10 by 30 ft plots and four replications. All treatments were applied with a CO_2 backpack sprayer using 8001 flat-fan nozzles and 35 psi, delivering 10 gal/a. Each site was prepared and seeded by the cooperating grower.

At the Prosser site, treatments were applied when the 'Weston' hard red winter wheat had 7 leaves, 4 tillers, and was 8 to 11 in. tall; Russian thistle density averaged 4 plants/ft^2 and were 1 to 3 in. tall. Flixweed was also present at a density of 3 plants/ft^2 and 2 to 6 in. tall.

At Washtucna, 'Meltan' spring barley was seeded at 50 lb/a on March 16. The treatments were applied when the barley had 6 to 7 leaves, 2 tillers, and was 6 to 8 in. tall. Russian thistle density increased across the replications, ranging from 5 to 60 plants/ft^2 and averaging 23 plants/ft^2. Plants were 1 to 3 in. tall.

Table 1. Application data

Site	Prosser	Washtucna
Application date	April 10	May 7
Air temperature (F)	51	87
Soil temperature (F)	55	92
Relative humidity (%)	41	80
Wind (mph)/direction	0/0	3-7/W
Delivery rate (gal/a)	10	10
Crop	'Weston' hard red winter wheat	'Meltan' spring barley

Visual weed control ratings at Prosser were made 21 and 47 days after treatment (DAT); at Washtucna, 25 and 35 DAT. Crop injury was not observed at Prosser and the effects of moisture stress at Washtucna masked any injury that may have occurred.

Crop yields were low at both sites because of the dry spring. Competition from uncontrolled flixweed significantly reduced wheat yields at Prosser. At Washtucna, treatments that included 2,4-D ester often had lower barley yields than other treatments or the nontreated controls. Many combinations of bromoxynil plus either ester or amine formulations of 2,4-D controlled Russian thistle. Tribenuron plus 2,4-D was also effective. MCPA alone did not control Russian thistle. (Department of Crop and Soil Sciences, Washington State University, Pullman, WA 99164-6420)

Table 2. Weed control and crop yield - Prosser

Treatment	Rate[2]	Weed control				
		Russian thistle		Flixweed		Wheat
		5/1	5/27	5/1	5/27	yield
	(lb/a)	(%)				(bu/a)
bromoxynil + 2,4-D ester	0.13 0.5	91	96	90	100	15.6
bromoxynil + 2,4-D ester	0.19 0.38	91	97	91	100	15.3
bromoxynil + 2,4-D ester	0.19 0.5	91	96	95	100	16.1
bromoxynil + 2,4-D ester	0.25 0.5	85	96	94	100	18.3
bromoxynil + 2,4-D amine	0.13 0.5	71	89	74	88	15.2
nontreated		0	0	0	0	8.0
bromoxynil + 2,4-D amine	0.19 0.38	80	94	84	94	14.2
bromoxynil + 2,4-D amine	0.19 0.5	93	96	86	98	17.1
bromoxynil + MCPA ester + 2,4-D ester	0.13 + 0.13 0.25	90	78	81	99	16.4
bromoxynil + MCPA ester + 2,4-D ester	0.13 + 0.13 0.38	81	74	83	94	15.0
bromoxynil + MCPA ester + 2,4-D ester	0.19 + 0.19 0.25	82	97	86	99	15.3
tribenuron[1] + 2,4-D ester	0.016 0.5	69	96	95	100	15.4
tribenuron + 2,4-D ester	0.008 0.5	76	84	96	100	16.1
nontreated		0	0	0	0	10.1
bromoxynil + MCPA ester	0.38 + 0.38	97	97	94	100	15.3
bromoxynil	0.38	85	100	69	61	15.0
2,4-D ester	1.0	40	89	90	100	14.3
2,4-D ester	0.5	53	74	88	100	16.0
MCPA ester	0.5	21	28	76	100	15.2
dicamba + 2,4-D ester	0.063 0.5	45	95	81	100	13.9
LSD (0.05)		15	17	10	8	3.9

[1]Non-ionic surfactant included at 0.125%, v/v.
[2]Rates of bromoxynil and tribenuron expressed as lb ai/a; all others expressed as lb ae/a.

Table 3. Weed control and crop yield - Washtucna

Treatment	Rate[2]	Russian thistle control 5/27	Russian thistle control 6/11	Barley yield
	(lb/a)	----------(%)----------		(lb/a)
bromoxynil +	0.13	90	92	627
2,4-D ester	0.5			
bromoxynil +	0.19	91	90	583
2,4-D ester	0.38			
bromoxynil +	0.19	96	98	504
2,4-D ester	0.5			
bromoxynil +	0.25	98	97	569
2,4-D ester	0.5			
bromoxynil +	0.13	85	91	595
2,4-D amine	0.5			
nontreated		0	0	687
bromoxynil +	0.19	84	90	707
2,4-D amine	0.38			
bromoxynil +	0.19	85	87	601
2,4-D amine	0.5			
bromoxynil + MCPA ester +	0.13 + 0.13	86	90	697
2,4-D ester	0.25			
bromoxynil + MCPA ester +	0.13 + 0.13	86	89	627
2,4-D ester	0.38			
bromoxynil + MCPA ester +	0.19 + 0.19	86	84	539
2,4-D ester	0.25			
tribenuron[1] +	0.016	97	100	540
2,4-D ester	0.5			
tribenuron +	0.008	95	99	607
2,4-D ester	0.5			
nontreated		0	0	719
bromoxynil + MCPA ester	0.38 + 0.38	93	85	673
bromoxynil	0.38	94	92	682
2,4-D ester	1.0	78	94	473
2,4-D ester	0.5	75	84	528
MCPA ester	0.5	0	28	770
dicamba +	0.063	65	85	503
2,4-D ester	0.5			
LSD (0.05)		10	11	103

[1]Non-ionic surfactant included at 0.125%, v/v.
[2]Rates of bromoxynil and tribenuron expressed as lb ai/a; all others expressed as lb ae/a.

Wheat injury and jointed goatgrass control from clomazone. D'Amato, T.J. and P.W. Westra. This trial was designed to assess: the potential safening effect of phorate on wheat (Triticum aestivum L.), from clomazone phytotoxicity; the relative tolerance of 4 winter wheat varieties to clomazone injury; and the efficacy of clomazone for control of jointed goatgrass (Aegilops cylindrica).

Clomazone was applied at 3 rates and 2 timings over a field infested with jointed goatgrass. Four wheat varieties; 'Tam107', 'Sandy', 'Lamar', and 'Scout 66' were drilled through the study site. A 14 foot wide hoe drill was used with half the granular insecticide applicators applying phorate (20 G formulation) at a rate of 1.2 ounces of product per 1000 row feet, and half the applicators disconnected and applying no insecticide. The clomazone was applied preplant or preemergence to the wheat. No jointed goatgrass was emerged at the time of applications. The study was a randomized complete block design with 3 replications. Plots were 20 feet wide and 60 feet long. The drill rows were 12 inches wide and perpendicular to the plots, thus the 4 wheat varieties were contained within each plot. The clomazone was applied through 11001LP, flat fan nozzles at a rate of 12 gallons per acre.

An October 2, 1991 evaluation (see table, first 4 columns) showed 100% wheat emergence for all varieties in all plots. The preplant treatments of clomazone caused more overall bleaching of the wheat than the preemergent treatments. No jointed goatgrass had emerged by this time. On April 22, 1992 the plots were rated for jointed goatgrass control (fifth data column), none of the treatments provided acceptable control. At this time wheat injury was severe across all treated plots. No differences between injury severity or symptomology was observed between herbicide rates, application method, wheat variety, or the presence or absence of phorate. The wheat injury symptoms were 75% bleaching and 50% stunting relative to the untreated check plots. (Weed Research Laboratory, Colorado State University, Ft. Collins, CO 80523)

Data from wheat injury and jointed goatgrass control study.

			-% bleaching of wheat varieties- 10-2-91				% control 4-22-92
Treatment	Rate (lbs ai/a)	Appl. stage	Scout 66	Lamar	Sandy	Tam 107	AEGCY
Check			0.0 c	0.0 b	0.0 b	0.0 c	0.0 d
Clomazone	.125	PP	0.7 bc	1.3 ab	2.0 b	5.7 ab	43.3 bc
Clomazone	.25	PP	2.0 ab	3.0 a	3.0 ab	8.3 a	40.0 bc
Clomazone	.50	PP	3.0 a	3.0 a	5.7 a	10.0 a	51.7 ab
Clomazone	.125	PRE	0.0 c	0.0 b	0.0 b	0.7 c	28.3 c
Clomazone	.25	PRE	0.7 bc	0.7 ab	0.7 b	1.3 bc	26.7 c
Clomazone	.50	PRE	2.0 ab	1.3 ab	1.3 b	3.0 bc	63.3 a

Wild oat control in cereal grains with imazamethabenz formulations combined with difenzoquat and various broadleaf herbicides. Grasham, C.G., C.R. Thompson, and D.C. Thill. Wild oat (AVEFA) and broadleaf weed control with a liquid concentrate (LC) and a soluble granular (SG) imazamethabenz formulation combined with spray adjuvants and various herbicide tank mixes were evaluated in winter wheat, spring wheat and spring barley near Potlatch, Idaho. Plots were 10 by 30 feet and arranged in a randomized complete block design with four blocks. Difenzoquat treatments were applied to 4 to 5 leaf crop. All other applications were applied to 2 to 3 leaf crop. Herbicide treatments were applied with a pressurized CO_2 backpack sprayer calibrated to deliver 10 gal/a at 38 psi and 3 mph. Field pennycress (THLAR) and wild buckwheat (POLCO) control and barley injury were evaluated May 21 and wild oat (AVEFA), common lambsquarters (CHEAL), and mayweed chamomile (ANTCO) control were evaluated July 10 for barley. Winter and spring wheat injury were evaluated on July 10. Wild oat, and *Amsinckia* species (AMSIN) (composite of coast fiddleneck and palouse tarweed) control were evaluated in winter wheat, and wild oat control was evaluated in spring wheat on July 10. Clopyralid was broadcast applied to the winter wheat site on March 3 for Canada thistle control. Winter wheat was harvested with a small plot combine from a 5 by 27 ft area of each plot on August 6. Spring wheat and barley were harvested with a small plot combine from a 4.5 by 27 ft area of each plot on August 7.

Table 1. Application data and soil analysis

	Winter wheat	
Application date	March 31	April 25
Wild oat leaf stage	2-3	4-6
Wild oat density (plants/ft^2)	1-10	1-10
Wheat leaf stage	5.5	6.5
Air temperature (F)	65	58
Relative humidity (%)	60	72
Wind speed (mph) - direction	3-5 W	1 N
Soil temperature (F)	56	64
pH	5.1	
organic matter (%)	3.2	
CEC (meq/100g)	16.1	
texture	silt loam	
Variety	'Madsen'	

Spring crops	Spring wheat		Spring barley	
Application date	May 1	May 16	May 1	May 16
Wild oat leaf stage	1-3	3-5	1-2.5	3-5
Crop leaf stage	3	5.5	2.5	4.5
Air temperature (F)	38	44	60	50
Relative humidity (%)	90	84	57	70
Wind speed (mph) - direction	2-4 N	3 NE	3 SW	3 NE
Soil temperature (F)	44	48	54	52
Wild oat density (plants/ft^2)	10-200		34-110	
pH	5.7		5.4	
organic matter (%)	3.6		4.6	
CEC (meg/100g)	20.3		20.1	
texture	silt loam		silt loam	
Variety	'Penawawa'		'Steptoe'	

Winter wheat treated with herbicide usually yielded more grain than untreated wheat (Table 2). Ester formulations of MCPA or 2,4-D tank mixed with imazamethabenz caused 6 and 9% winter wheat injury, respectively. Injury likely was caused by MCPA and 2,4-D applied to small wheat. Wild oat control with imazamethabenz tended to be higher when combined with Sun-It II than with R-11, especially at lower imazamethabenz rates. Bromoxynil-MCPA, tribenuron, triasulfuron, and thifensulfuron-tribenuron tank mixed with imazamethabenz controlled *Amsinckia* species.

All herbicide treated spring wheat yielded more grain than the untreated wheat (Table 2). Ester formulations of MCPA or 2,4-D tank mixed with imazamethabenz caused 5 and 10% spring wheat injury, respectively. Injury likely was caused by MCPA and 2,4-D applied to small wheat. 2,4-D tank mixed with imazamethabenz caused twisted malformed heads resulting in a 15 bu/a yield loss compared to spring wheat treated with imazamethabenz at 0.38 lb/a + R11. Wild oat control with the SG formulation of imazamethabenz was equal to or better than wild oat control with the LC formulation, but grain yield was not different. Tank mixing bromoxynil-MCPA and imazamethabenz antagonized wild oat control and caused a reduction in grain yield. The addition of thifensulfuron-tribenuron to diclofop may have antagonized wild oat control, resulting in a slight grain yield reduction. Difenzoquat combined with thifensulfuron-tribenuron injured wheat 5%.

All herbicide treated barley except barley treated with difenzoquat tank mixed with thifensulfuron-tribenuron yielded more grain than the untreated barley (Table 3). 2,4-D ester tank mixed with imazamethabenz at 0.38 lb/a injured barley causing twisted and malformed heads, and yielded 550 lbs less compared to barley treated with imazamethabenz at 0.38 lb/a + R11. Difenzoquat tank mixed with thifensulfuron-tribenuron injured barley 29% resulting in a significant yield loss. All herbicide applications controlled field pennycress 91% or more. All broadleaf herbicide tank mixes except imazamethabenz with MCPA or 2,4-D controlled wild buckwheat 90% or more. Wild oat control was 9 to 21% less with all difenzoquat applications compared to imazamethabenz at 0.38 lb/a + R11. Bromoxynil-MCPA tank mixed with imazamethabenz antagonized wild oat control and reduced grain yield compared to barley treated with imazamethabenz at 0.38 lb/a + R11. Imazamethabenz SG controlled wild oat more effectively than imazamethabenz LC when applied at 0.31 lb/a. Thifensulfuron-tribenuron tank mixed with diclofop antagonized wild oat control resulting in lower grain yield compared to imazamethabenz at 0.38 lb/a + R11. Imazamethabenz alone or in combination with difenzoquat did not control common lambsquarters or mayweed chamomile. All broadleaf herbicide tank mixes except triasulfuron controlled common lambsquarters 89% or more. Bromoxynil-MCPA, clopyralid-MCPA, tribenuron, and all thifensulfuron-tribenuron tank mixes combined with imazamethabenz controlled mayweed chamomile. MCPA ester, 2,4-D ester, and triasulfuron tank mixed with imazamethabenz did not control mayweed chamomile adequately. (Idaho Agricultural Experiment Station, Moscow, ID 83843).

Table 2. Effect of imazamethabenz formulations and broadleaf herbicides on weed control and yield in winter and spring wheat

Treatment[1]	Rate	Winter wheat Yield	Winter wheat Injury	Winter wheat AVEFA	Winter wheat AMSIN	Spring wheat Yield	Spring wheat Injury	Spring wheat AVEFA
	(lb ai/a)	(bu/a)	(%)	(%control)		(bu/a)	(%)	(%control)
control		70	0	0	0	19	0	0
imazamethabenz LC	0.47	81	0	98	0	42	0	76
imazamethabenz LC	0.38	86	0	97	0	47	0	77
imazamethabenz LC	0.31	78	0	93	0	41	1	72
imazamethabenz SG	0.47	77	4	93	0	42	1	85
imazamethabenz SG	0.38	94	C	96	0	45	0	77
imazamethabenz SG	0.31	85	0	89	0	52	0	84
imazamethabenz SG +	0.23							
difenzoquat	0.5	83	0	91	0	46	0	86
imazamethabenz SG +	0.47							
Sun-It II	2.0pints	89	0	99	0	44	0	89
imazamethabenz SG +	0.38							
Sun-It II	2.0pints	83	0	99	0	38	3	70
imazamethabenz SG +	0.31							
Sun-It II	2.0pints	91	0	98	3	44	0	82
imazamethabenz SG +	0.23							
difenzoquat +	0.5							
Sun-It II	2.0pints	90	0	96	1	40	3	71
imazamethabenz SG +	0.38							
MCPA ester	0.5	91	6	95	44	40	5	70
imazamethabenz SG +	0.38							
bromoxynil-MCPA	0.5	91	0	89	98	29	0	41
imazamethabenz SG +	0.38							
2,4-D ester	0.5	89	9	92	26	30	10	67
imazamethabenz SG +	0.38							
clopyralid-MCPA	0.69	98	0	95	51	40	4	78
imazamethabenz SG +	0.38							
thifen-triben[2] +	0.023							
MCPA ester	0.25	94	0	93	99	46	0	86
imazamethabenz SG +	0.23							
difenzoquat +	0.5							
thifen-triben +	0.023							
MCPA ester	0.25	96	0	88	99	40	1	72
imazamethabenz SG +	0.38							
tribenuron	0.016	96	0	94	99	44	0	85
imazamethabenz SG +	0.38							
triasulfuron	0.013	91	0	97	97	42	0	81
diclofop[3]	1.0	84	0	93	0	36	1	53
difenzoquat[3]	1.0	89	0	93	0	28	5	76
control		73	0	0	0	16	0	0
$LSD_{(0.05)}$		13	5	7	12	12	5	18
Density (plants/ft^2)				4	8			72

[1]R-11 nonionic surfactant added to all treatments except with Sun-It II, at 0.25% v/v no surfactant was added with diclofop in the winter wheat study. difenzoquat treatments applied to 4-5 leaf AVEFA all others 2-3 leaf AVEFA.
[2]thifensulfuron-tribenuron.
[3]thifen-triben was tank mixed at 0.016 lb ai/a in spring wheat study.

Table 3. Effect of imazamethabenz formulations and broadleaf herbicides on weed control and yield in spring barley

Treatment[1]	Rate	Barley Yield	Barley Injury	THLAR 5/21	POLCO 5/21	AVEFA 7/10	CHEAL 7/10	ANTCO 7/10
	(lb ai/a)	(lb/a)	(%)	(% control)				
control		1230	0	0	0	0	0	0
imazamethabenz LC	0.47	3580	0	98	85	96	0	0
imazamethabenz LC	0.38	3540	0	96	69	90	0	0
imazamethabenz LC	0.31	3130	0	91	48	74	0	0
imazamethabenz SG	0.47	3440	0	98	81	97	0	0
imazamethabenz SG	0.38	3470	0	98	74	95	0	0
imazamethabenz SG	0.31	3420	0	98	70	89	0	0
imazamethabenz SG +	0.23							
difenzoquat	0.5	3270	0	94	74	74	3	0
imazamethabenz SG +	0.47							
Sun-It II	2.0pints	3450	0	98	86	97	4	0
imazamethabenz SG +	0.38							
Sun-It II	2.0pints	3530	0	99	88	93	0	0
imazamethabenz SG +	0.31							
Sun-It II	2.0pints	3550	0	99	84	91	0	0
imazamethabenz SG +	0.23							
difenzoquat +	0.5							
Sun-It II	2.0pints	3400	0	98	84	86	0	0
imazamethabenz SG +	0.38							
MCPA ester	0.5	3050	3	99	74	85	91	25
imazamethabenz SG +	0.38							
bromoxynil-MCPA	0.5	2820	1	99	99	61	98	98
imazamethabenz SG +	0.38							
2,4-D ester	0.5	2920	18	99	85	89	89	45
imazamethabenz SG +	0.38							
clopyralid-MCPA	0.69	3160	1	99	96	89	99	99
imazamethabenz SG +	0.38							
thifen-triben[2] +	0.023							
MCPA ester	0.25	3360	5	99	99	85	98	99
imazamethabenz SG +	0.23							
difenzoquat +	0.5							
thifen-triben +	0.023							
MCPA ester	0.25	3300	1	99	99	68	99	99
imazamethabenz SG +	0.38							
tribenuron	0.016	3350	0	99	92	93	98	99
imazamethabenz SG +	0.38							
triasulfuron	0.013	3040	0	99	90	87	60	34
diclofop[3] +	1.0	2230	0	99	99	18	99	99
difenzoquat[3] +	1.0	1750	29	-	-	73	99	99
control		1420	0	0	0	0	0	0
$LSD_{(0.05)}$		510	7	5	13	12	11	16
Density (plants/ft^2)				5	1	63	12	8

[1]R-11 nonionic surfactant added to all treatments except with Sun-It II, at 0.25% v/v. difenzoquat treatments applied to 4-5 leaf AVEFA all others 2-3 leaf AVEFA

[2]thifensulfuron-tribenuron

[3]thifen-triben was tank mixed at 0.016 lb ai/a for broadleaf weed control

Wild oat control with an air sprayer in wheat and barley. Lish, Joan M. and D.C. Thill. Air sprayers are being marketed with the claim that herbicide rate can be reduced by as much as half the amount required with a conventional sprayer. Concerns have been raised that off-target movement may occur more readily with an air sprayer than a conventional sprayer. This research was initiated to compare the Spray Air model sprayer to a conventional sprayer. Initial testing in 1991 indicated that herbicide efficacy with the air sprayer was better or equal to a conventional sprayer and that drift was not more serious with an air sprayer than a conventional sprayer.

The air sprayer has a power take off driven fan that moves air through a 6 inch aluminum pipe. The pipe has 1.25 inch round holes on the bottom spaced every 7.2 inches. A rubber grommet with a plastic deflector shield is inserted into each hole. Spray solution is carried into the side of each grommet and is directed onto the shield. The spray solution pressure is 8 psi. The air pressure is 21 inches of water at the grommet. The air pressure breaks the steady spray stream into small droplets. Spray volume was 5 gal/A. The sprayer also has a conventional boom with 80°, flat fan, hydraulic nozzles spaced every 20 inches. Delivery is 0.1 gal/min at 40 psi. Spray volume was 10 gal/A. Spray width is 15 ft for both sprayers. In addition, the conventional boom was used in combination with air in two experiments.

Postemergence wild oat herbicides were evaluated in winter wheat and spring barley (Table 1). Difenzoquat and imazamethabenz were applied with all three sprayer systems. Diclofop was applied with the conventional and air sprayer systems only.

Tribenuron plus thifensulfuron (0.3 oz ai/a) were applied to 4 to 5 node 'Columbian' peas on June 2, 1992 to evaluate drift from the three sprayers. Plots were 15 by 40 ft. Peas had 4 to 5 nodes, air and soil temperatures were 75 and 82 F, respectively, relative humidity was 50%, sky was clear, and the soil was dry and dusty. Wind speed averaged 8 mph and ranged from 5 to 10 mph. Pea plants were sampled at full bloom from 1 yd of row perpendicular to the swath. Two samples were taken at 0 (just outside of spray swath), 5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 80, 100, 120, and 160 ft downwind. Plants were dried at 140 F and weighed.

Table 1. Environmental conditions on application date.

Herbicide	imazamethabenz	diclofop	difenzoquat
Application date	April 28	May 5	May 12
Location	Grangeville, ID	Bonners Ferry, ID	Bonners Ferry, ID
Crop	winter wheat	spring barley	spring barley
Wild oat growth stage (lf)	2 to 4	1 to 3.5	2 to 5
Relative humidity (%)	64	50	45
Air temperature (F)	68	62	65
Soil temperature (F) @ 2 inch	62	71	73
Wind speed (mph)/direction	2 to 5 / SSE	0 to 2.5 / N	0 to 8 / NNW SSE near end
Soil type	Silt loam	Silt loam	Silt loam
Soil pH	5.5	7.4	7.4
Soil CEC	31.3	29.2	29.2
Soil OM (%)	5.7	9.3	9.32
Soil surface	dry, dusty with air applications	moist	dry, dusty

Wild oat control was good when diclofop at 1.0 and 0.75 lb ai/a was applied with the air or conventional spray system (Table 2). Control was good also with diclofop at 0.5 lb ai/a applied with the air sprayer. Wild oat control was better with the air sprayer (75%) than the conventional sprayer (61%) when averaged over diclofop rates (Table 3). Barley yield and test weight were not different. Some injury to barley from the high diclofop rates applied with the air sprayer may have negated beneficial effects of wild oat control. Wild oat control with difenzoquat and imazamethabenz was better with conventional application than with air spray application (Tables 4-7). Soil was dry and the air created a large amount of dust. This may have inactivated some of the herbicide. We plan to test this theory by comparing wild oat control under dry and moist soil conditions. Barley yield was better with air spray applications than with conventional applications when averaged over difenzoquat rates. Test weight was not affected. Wheat yield and test weight were not affected by sprayer application method of imazamethabenz.

Drift was less from the air assist spray system than either the conventional or conventional plus air applications (Table 8). Pea plants in the check strips had a lower average weight/plant and a higher average weight/area than pea plants from treated strips. Data is shown for each sampling distance for every spray application, but there was no statistical interaction between sprayer type and distance (Table 9). (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Air sprayer versus conventional sprayer for wild oat control in spring barley with diclofop.

Sprayer type	Diclofop rate	Wild oat control	Barley yield	Barley test weight
	(lb ai/a)	(%)	(bu/a)	(lb/bu)
Conventional	0.25	30 a[1]	41 bc	46 a
Air		30 a	30 a	46 a
Conventional	0.5	45 a	30 a	48 a
Air		82 b	46 cd	48 bcd
Conventional	0.75	80 b	49 cd	48 bc
Air		87 b	46 c	49 cd
Conventional	1.0	89 b	49 cd	49 d
Air		96 b	51 d	49 cd
Control	--	--	33 ab	46 a
Mean Separation (0.05)		LSD	LSMeans	LSMeans

[1] Means followed by the same letter are not different at significance level 0.05.

Table 3. Orthoganol contrast for air sprayer versus conventional sprayer averaged over diclofop rate.

Sprayer type	Wild oat control	Barley yield	Barley test weight
	(%)	(bu/a)	(lb/bu)
Conventional	61	43.25	47.8
Air	75	43.25	48.0
Probability > F	0.03	0.97	0.47

Table 4. Air sprayer versus conventional sprayer for wild oat control in spring barley with difenzoquat.

Sprayer type	Difenzoquat rate	Wild oat control	Barley yield	Barley test weight
	(lb ai/a)	(%)	(bu/a)	(lb/bu)
Conventional	0.25	5	45	47.6
Convent. + air		8	45	47.7
Air		11	47	47.2
Conventional	0.5	72	43	48.7
Convent. + air		65	49	48.0
Air		30	45	47.5
Conventional	0.75	94	53	48.4
Convent. + air		72	41	48.7
Air		80	52	48.8
Conventional	1.0	95	38	48.9
Convent. + air		92	44	48.6
Air		74	48	48.4
Control	--	--	48	46.9
LSD (0.05)		23	NS	NS

Table 5. Orthoganol contrast for air sprayer versus conventional sprayer averaged over difenzoquat rate.

Sprayer type	Wild oat control	Barley yield	Barley test weight
	(%)	(bu/a)	(lb/bu)
Conventional	67	44.8	47
Air	49	48.0	48
Probability > F	0.003	0.03	0.25

Table 6. Air sprayer versus conventional sprayer for wild oat control in winter wheat with imazamethabenz.

Sprayer type	Imazamethabenz rate	Wild oat control	Wheat yield	Wheat test weight
	(lb ai/a)	(%)	(bu/a)	(lb/bu)
Conventional	0.12	79	66	57.7
Convent. + air		65	64	57.7
Air		65	67	57.6
Conventional	0.24	96	69	58.1
Convent. + air		93	67	58.0
Air		79	64	58.1
Conventional	0.35	98	67	58.1
Convent. + air		95	60	57.3
Air		90	67	58.3
Conventional	0.47	96	71	58.5
Convent. + air		98	69	58.2
Air		94	68	59.4
Control	--	--	56	57.1
LSD (0.05)		13	NS	NS

Table 7. Orthoganol contrast for air sprayer versus conventional sprayer averaged over imazamethabenz rate.

Sprayer type	Wild oat control	Wheat yield	Wheat test weight
	(%)	(bu/a)	(lb/bu)
Conventional	92	68	58.1
Air	82	66	58.4
Probability > F	0.003	0.53	0.44

Table 8. Pea biomass averaged over distance.

Spray system	Pea biomass	Pea biomass
	oz/plant	oz/yd of row
Air	0.123 a	57 a
Conventional	0.110 b	54 a
Conventional + air	0.113 b	53 a
Check[1]	0.109	62

[1]Check was not include in statistical analysis.

Table 9. Pea biomass for spray application at each distance from spray swath..

Distance from swath	Pea plant weight				Biomass per yard of row			
	Check	Air	Conv. + Air	Conv.	Check	Air	Conv. + Air	Conv.
ft	oz/plant				oz/yd of row			
0	0.123	0.064	0.047	0.042	1.78	0.77	0.72	0.51
5	0.073	0.075	0.072	0.055	1.39	0.95	1.19	0.92
10	0.071	0.119	0.103	0.090	1.53	1.60	1.70	1.20
15	0.135	0.097	0.099	0.102	2.02	1.60	1.51	1.48
20	0.096	0.126	0.127	0.112	1.83	1.85	2.25	1.56
25	0.119	0.111	0.129	0.086	1.83	1.73	1.98	1.35
30	0.183	0.130	0.142	0.106	2.25	1.85	2.46	1.40
35	0.117	0.145	0.120	0.129	1.72	1.90	2.03	1.70
40	0.131	0.145	0.117	0.113	1.93	1.83	2.04	1.81
50	0.150	0.128	0.131	0.150	2.10	1.67	1.93	1.98
60	0.129	0.145	0.148	0.142	2.03	1.92	2.17	2.05
70	0.081	0.132	0.125	0.124	2.37	2.00	1.85	1.74
80	0.118	0.141	0.129	0.138	1.91	1.93	2.28	1.87
100	0.085	0.160	0.114	0.137	1.87	2.01	2.09	1.87
120	0.080	0.117	0.115	0.132	1.66	1.65	2.03	2.28
160	0.059	0.130	0.094	0.106	1.50	1.93	1.74	1.95

Broadleaf weed interference in winter wheat. Northam, F.E., P.W. Stahlman, and M. Abd El-Hamid. Experiments were conducted in Ellis, Rooks, and Russell counties in west-central Kansas to quantify winter annual broadleaf weed interference in winter wheat. Each experiment was established in naturally weedy areas in late March or early April.

Ellis County: Fifty-six pairs of meter square plots were established in variety '2167' winter wheat seeded in rows 18 cm apart at the Ft. Hays Experiment Station near Hays to quantify the interference of late-fall and early-spring-emerging flixweed (Descurainia sophia (L.) Webb ex Prantl. DESSO). The study compared the late-removal of weeds in the spring with non-removal. The number of flixweed per plot were counted, then one randomly selected plot of each pair was hand weeded between 6 to 8 April. The flixweed ranged from 15 to 30 cm tall and wheat plants were 10 to 15 cm tall with 10 or more leaves per plant. Hand-weeded plots averaged 68 flixweed/m^2 prior to removal, and non-weeded plots averaged 53 flixweed/m^2 (not significantly different). A few henbit plants were present in some plots, but flixweed composed over 90% of the total weed biomass at the time of harvest. The experiment was surface irrigated on 15-16 April (30 mm) and on 1 May (25 mm).

Wheat heads in each plot were counted and hand-harvested on 20 to 22 June and taken to the laboratory for threshing and processing. Data were analyzed using the non-paired t-test procedure.

At harvest, the number of wheat heads/m^2 averaged 693 and 749 in the non-weeded and hand-weeded plots, respectively (Table 1). Grain yields in non-weeded and hand-weeded plots averaged 404 g/m^2 and 463 g/m^2, respectively. Grain test weights did not differ between treatments (data not presented). Flixweed density was negatively correlated with wheat head density and grain yield.

Table 1. Flixweed interference in irrigated winter wheat near Hays, KS.

Winter wheat	Non-weeded[a]	Hand-weeded	Difference	Prob.	Correl. with weed density
			%		r
Heads/m^2	693	749	+ 8	0.002	-0.49
Grain yield, g/m^2	404	463	+15	0.001	-0.32

[a]Flixweed density, 53/m^2 in non-weeded plots.

Rooks County. Eight pairs of meter square plots were established in a thin stand of drought-stressed 'Victory' winter wheat seeded in rows 25 cm apart in early October, 1991. One plot of each pair was randomly chosen and hand weeded on 24 March 1992 and on 9 April. Most of the weeds emerged after early-spring precipitation and were less than 5 cm tall or diameter at the time of initial hand removal. The weed population in non-weeded plots consisted of flixweed at a density of 76 plants/m^2, wild buckwheat (Polygonum convolvulus L. POLCO) at a density of 9.3 plants/m^2, and bushy wallflower (Erysimum repandum L. ERYRE) at a density of 1.4 plants/m^2. Additional wild buckwheat seedlings emerged after the initial hand weeding and this species accounted for approximately 20% of the total weed population at harvest.

The number of wheat plants per plot were counted initially, and all wheat heads within plots were counted and hand-harvested on 30 June and taken to the laboratory for threshing and processing. Data were analyzed using the non-paired t-test procedure.

Wheat density averaged 74 and 80 plants/m^2 in non-weeded and hand-weeded plots, respectively, and were not different (Table 2). However, the number of wheat heads averaged 131/m^2 in the non-weeded plots and 196/m^2 in the hand-weeded plots and differed at $P = 0.001$. Kernel weight per head (530 mg) was the same for the two treatments, but grain yield averaged 69 g/m^2 in the non-weeded plots compared with 105 g/m^2 in the hand-weeded plots ($P = 0.002$). Grain test weights were not different between treatments (data not presented).

Table 2. Effects of broadleaf weed interference on winter wheat, Stockton, KS.

Winter wheat	Non-weeded[a]	Hand-weeded	Difference	Probability
			%	
Plants/m^2	74	80	+8	NS
Heads/m^2	131	196	+50	0.001
Kernel wt., mg/head	530	530	0	NS
Grain yield, g/m^2	69	105	+52	0.002

[a]Weed density: flixweed, 76/m^2; wild buckwheat, 9.3/m^2; bushy wallflower, 1.4/m^2.

Russell County. A chemical removal experiment was established in a dryland winter wheat field on 2 April 1992. Fourteen pairs of sprayed and unsprayed plots were established by applying chlorsulfuron + X-77 at 13 g ai/ha + 0.05% v/v to alternate 1.8 m-wide strips of wheat to remove broadleaf weeds. The wheat, seeded in rows 25 cm apart on 1 October, 1991, was 10 to 18 cm tall with 4 tillers. The wheat stand was thin and variable and grain yields were lower than normal because of an unusually dry fall and winter. There were an average of 122 wheat plants/m^2 in non-weeded plots. Each plot was divided into two 1.8 m by 13.6 m subplots. Plant populations in the untreated subplots were: henbit (Lamium amplexicaule L. LAMAM), 221/m^2; flixweed, 13/m^2; field pennycress (Thlaspi arvense L. THLAR), 13/m^2; and bushy wallflower, 1.5/m^2.

The number of wheat heads in the center two rows of a one square meter quadrat from each subplot were counted and hand-harvested on 23 June and taken to the laboratory for threshing and processing. Data were analyzed using the non-paired t-test procedure.

Chlorsulfuron-treated plots contained 62% more wheat heads and had 92% higher grain yield than non-weeded plots (Table 3). Grain test weights were not different between treatments (data not presented). (Ft. Hays Branch, Kansas Agric. Exp. Sta., Hays, KS).

Table 3. Comparison of chlorsulfuron-treated and untreated winter wheat near Russell, KS.

Winter wheat	Non-treated[a]	Chlorsulfuron	Difference	Probability
			%	
Plants/m^2	122	- -	- -	- -
Heads/m^2	266	431	+62	0.0001
Grain yield, g/m^2	156	300	+92	0.0001

[a]Weed density: henbit, 221/m^2; flixweed, 13/m^2; field pennycress, 13/m^2; bushy wallflower, 1.5/m^2.

Triasulfuron and metribuzin combinations control downy brome. Stahlman, P.W., F.E. Northam, and M. Abd El-Hamid. An experiment was conducted in west-central Kansas near Hays to determine the effectiveness of triasulfuron alone or plus metribuzin for control of pinnate tansymustard and downy brome in winter wheat.

Treatments were arranged in a randomized complete block design with three replications. Plots were 3.6 m by 9.7 m with a running untreated check in each range of plots. Soil was a Roxbury silt loam with 1.5% organic matter content and pH 8.0. The experimental area was naturally infested with pinnate tansymustard, but downy brome seed were broadcast over the area. 'TAM 107' winter wheat was seeded at 50 kg/ha in rows spaced 25 cm apart on 1 October 1991. Herbicides were applied with a tractor-mounted, compressed-air plot sprayer equipped with XR80015 flat fan tips delivering 109 L/ha at 175 kPa. Herbicides were applied either alone, sequentially, or as tank mixtures, at the following stages and dates: preemergence (PRE) on 2 October; late-fall postemergence (LFP) on 27 November, when the wheat was 5 to 7 cm tall with 1 tiller, pinnate tansymustard was less than 1 cm tall with 2 leaves, and the downy brome was 2 to 3 cm tall with 3 to 4 leaves; or early-spring postemergence (ESP) on 19 February 1992, when the wheat was 5 to 7 cm tall with 4 to 5 tillers, pinnate tansymustard was 3 to 4 cm tall, and the downy brome was 3 to 4 cm tall with 1 to 2 tillers.

Cumulative precipitation from July 1991 to May 1992 was 100 mm below normal. No effective precipitation was received within 4 weeks after PRE herbicides were applied or within 2 weeks after LFP postemergence applications. Rainfall 5 days after the ESP applications totaled 13 cm. The study was sprinkler irrigated the week of 5 October (40 mm), on 21 October (20 mm), on 15 April (28 mm), and on 1 May (25 mm).

Only metribuzin ESP alone at 140 or 280 g ai/ha (43% control) did not completely control pinnate tansymustard (see table). Also, those metribuzin treatments controlled downy brome less than 40%. Triasulfuron PRE at 30 g/ha controlled downy brome 77%, and sequential applications of metribuzin LFP at 140, 280, or 417 g/ha increased downy brome control to 93 to 100%. However, the two higher metribuzin rates, especially the highest rate, stunted wheat. When applied as tank mixtures, downy brome control decreased with delayed application: PRE > LFP > ESP. Downy brome control increased with increased metribuzin rate from 140 to 280 g/ha when tank mixed with triasulfuron and applied LFP or ESP, but the lower metribuzin rate was as effective as the higher rate when LFP followed triasulfuron PRE. Wheat grain yields were not significantly higher than the untreated control. Also, wheat stand, height, maturity, and grain test weight were not affected (data not presented). (Ft. Hays Branch, Kansas Agric. Exp. Sta., Hays, KS 67601).

Effects of triasulfuron alone or plus metribuzin on pinnate tansymustard, downy brome, and winter wheat near Hays, KS.

Herbicides	Rate	Growth[a] stage	Weed control DESPI	Weed control BROTE	Winter wheat Stunting	Winter wheat Yield
	g ai/ha		%	%	%	kg/ha
Triasulfuron + S[b]	30 + 0.25%	PRE	100	77	2	3700
Triasulfuron + metribuzin + S	30 + 70 + 0.25%	PRE	100	87	3	3970
Triasulfuron + metribuzin + S	30 + 140 + 0.25%	PRE	100	93	5	4100
Triasulfuron + S + metribuzin	30 + 0.25% + 140	PRE LFP	100	93	5	3990
Triasulfuron + S + metribuzin	30 + 0.25% + 280	PRE LFP	100	100	8	3910
Triasulfuron + S + metribuzin	30 + 0.25% + 417	PRE LFP	100	100	20	3590
Triasulfuron + metribuzin	30 + 140	LFP	100	67	0	4170
Triasulfuron + metribuzin	30 + 280	LFP	100	90	0	4190
Triasulfuron + metribuzin	15 + 280	ESP	100	43	2	4350
Triasulfuron + metribuzin	30 + 140	ESP	100	50	8	4260
Triasulfuron + metribuzin	30 + 280	ESP	100	73	0	4260
Metribuzin	140	ESP	43	27	0	4250
Metribuzin	280	ESP	43	37	0	4250
Untreated	- -	- -	0	0	0	3640
LSD (0.05)			5	12	6	NS

[a]PRE = preemergence; LFP = late-fall post; ESP = early-spring post.

[b]S = Ortho X-77 surfactant at 0.25% v/v.

Chlorsulfuron:metsulfuron mixture plus metribuzin supresses downy brome. Stahlman, P.W., F.E. Northam, and M. Abd El-Hamid. An experiment was conducted in west-central Kansas near Hays to determine the effectiveness of a prepackaged mixture of chlorsulfuron and metsulfuron (5:1) alone or plus metribuzin for control of pinnate tansymustard and downy brome in winter wheat.

Treatments were arranged in a randomized complete block design with four replications. Plots were 3.6 m by 9.7 m with a running untreated check in each range of plots. Soil was a Roxbury silt loam with 1.5% organic matter content and pH 8.0. The experimental area was naturally infested with pinnate tansymustard, but downy brome seed were broadcast over the area prior to seeding 'TAM 107' winter wheat at 50 kg/ha in rows spaced 25 cm apart on 1 October 1991. Herbicides were applied with a tractor-mounted, compressed-air plot sprayer equipped with XR80015 flat fan tips delivering 109 L/ha at 175 kPa. Herbicides were applied either alone, sequentially, or as tank mixtures preemergence (PRE) on 2 October or late-fall postemergence (LFP) on 27 November. For LFP, wheat was 5 to 7 cm tall with 1 tiller, pinnate tansymustard was less than 1 cm tall with 2 leaves, and the downy brome was 2 to 3 cm tall with 3 to 4 leaves.

Cumulative precipitation from July 1991 to May 1992 was 100 mm below normal. No effective precipitation was received within 4 weeks after PRE herbicide application or within 2 weeks after LFP herbicide application. However, the study was sprinkler irrigated the week of 5 October (40 mm), on 21 October (20 mm), 15 April (28 mm), and 1 May (25 mm).

All herbicide treatments controlled pinnate tansymustard 100% (see table). Control of downy brome with the package mixture of chlorsulfuron and metsulfuron PRE at rates of 16 to 26 g ai/ha ranged from 75% to 79%. The sequential application of metribuzin LFP at 158 g/ha following chlorsulfuron:metsulfuron PRE at 26 g/ha did not increase downy brome control compared with chlorsulfuron:metsulfuron PRE alone. The chlorsulfuron:metsulfuron mixture controlled downy brome better when applied PRE than LFP. Also, tank mixtures of chlorsulfuron:metsulfuron plus metribuzin were not as effective as chlorsulfuron:metsulfuron PRE. Wheat grain yields (see table), wheat stand, height, maturity, and grain test weight were not different at $P = 0.05$ (data not presented). (Ft. Hays Branch, Kansas Agric. Exp. Sta., Hays, KS 67601).

Effects of chlorsulfuron:metsulfuron alone or plus metribuzin on pinnate tansymustard, downy brome, and winter wheat yield near Hays, KS.

Herbicides	Rate	Growth stage	Weed control DESPI	Weed control BROTE	Wheat yield
	g ai/ha		—— % ——		kg/ha
Chlorsulfuron:metsulfuron[a]	16	PRE	100	76	2980
Chlorsulfuron:metsulfuron	21	PRE	100	79	3010
Chlorsulfuron:metsulfuron	26	PRE	100	75	3090
Chlorsulfuron:metsulfuron + metribuzin	26 158	PRE LFP	100	85	2990
Chlorsulfuron:metsulfuron + metribuzin	8 + 105	LFP	100	60	2920
Chlorsulfuron:metsulfuron + metribuzin	8 + 158	LFP	100	65	2940
Chlorsulfuron:metsulfuron + metribuzin	16 + 105	LFP	100	55	3140
Chlorsulfuron:metsulfuron + metribuzin	16 + 158	LFP	100	63	3140
Chlorsulfuron:metsulfuron + metribuzin	21 + 105	LFP	100	55	3230
Chlorsulfuron:metsulfuron + metribuzin	21 + 158	LFP	100	63	3400
Chlorsulfuron:metsulfuron + S[b]	16 + 0.25%	LFP	100	58	3190
Chlorsulfuron:metsulfuron + S	21 + 0.25%	LFP	100	40	3280
Metribuzin	315	LFP	100	86	3000
Untreated	- -	- -	0	0	3020
LSD (0.05)			-	13	NS

[a]Package mixture (5:1).
[b]Ortho X-77 surfactant at 0.25% v/v.

The effects of tillage on volunteer rye emergence and seed bank dynamics. Stump, W.L., and P. Westra. Volunteer rye (Secale cereal) from a 1989 survey infests some 285,000 acres in Colorado. Mirroring the life cycle of winter wheat, this crop escape cannot be removed selectively from wheat with existing herbicides. Volunteer rye as a weed of winter wheat has received little research attention. Because of this we have initiated some biological studies. Seed burial studies have shown volunteer rye to be quite short lived. After 14 months of burial less than 1% viable seed remained. Because of the emphemeral nature of this seed bank, volunteer rye may show promise in responding to cultural practices aimed at reducing the seed bank reserves.

Just south of Ft. Collins a randomized complete block was established on a dryland farm with uniform volunteer rye pressures. Individual plots were 15 by 80 feet and seed bank estimates were determined before treatments. Late summer tillage treatments after wheat harvest were disking, sweeping, moldboard plow, chemical fallow, and a no-till check.

Tillage had variable effects on fall emergence of the volunteer rye (see table). Rye emergence was greatest in the plots that were disked (table, 91 counts). The sweep treatment plots showed the next greatest rye emergence. The plowing treatment had the least emergence followed by the no-till treatments. The soil is characterized by having a 1 to 3 inch "duff" layer that retains little moisture. Tillage treatments that improved soil to seed contact below this layer, facilitated germination. Initial seed bank amounts (0 to 5cm soil profile) were uniform prior to treatments (see table). After one year this seed bank was drastically reduced in all treatments except the no-till check. These reduced seed banks were reflected in fall 1992 low emergence rates of the rye in the wheat crop. This study will be conducted for one more fallow/wheat cycle. (Weed Research Laboratory, Colorado State Univ., Ft. Collins, CO 80523)

TILLAGE AND CHEMICAL FALLOW FOR VOLUNTEER RYE CONTROL

			Volunteer Rye #Plants/2sqft		Volunteer Rye Seedbank est. (10cm dia.x5 depth)	
			11-12-91	11-13-92	9-27-91	8-28-92
	Treatment	Rate lb ai/A				
1	DISKING		63.1 a	1.2 b	16.9 a	0.4 b
2	SWEEPING		42.6 b	1.3 b	17.0 a	0.3 b
3	PLOWING		3.6 c	0.4 b	20.5 a	0.0 b
4	Command AAtrex	.75 .50	17.6 c	2.1 b	17.8 a	3.3 b
5	CHECK		10.8 c	21.3 a	20.6 a	22.2 a
	LSD (.05) =		13.5	6.0	8.1	7.5

Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

Quinclorac for field bindweed control in fallow and subsequent year in winter wheat. Thompson, C.R. and D.C. Thill. Field bindweed control with quinclorac in fallow was evaluated at the University of Idaho research farm 1 mile east of Moscow, Idaho. The experiment area was cultivated during mid-June, 1991 prior to initiation of the experiment. All treatments for bindweed control were applied during 1991. The experiment was a split plot design with application time as main plots and herbicide treatments as subplots. Treatments were replicated four times. Plots were 8 by 30 or 8 by 40 ft. The July 14, treatments were applied to 6 to 24 in. field bindweed. The August 13 treatments were applied to 24 to 30 in. flowering field bindweed. The September 10 treatments were applied to 36 to 40+ in. field bindweed which canopied the soil surface 95 to 100%. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 38 psi and 3 mph (Table 1). Field bindweed control was evaluated visually during 1991 on July 31, August 30, and September 26. The site was disked and seeded to 'Stephens' soft white winter wheat on October 18, 1991. Nitrate nitrogen and sulfur at 68 + 31 lb/a were broadcast applied to winter wheat on April 3, 1992. Bindweed shoots were counted in a 10.8 ft^2 area within each plot on April 22. Thifensulfuron-tribenuron + bromoxynil + R-11 at 0.032 + 0.25 lb ai/a + 0.25% v/v were broadcast to all plots for annual weed control on April 24, 1992. Bindweed control and percent ground cover within the 10.8 ft^2 area previously counted were evaluated visually on July 22 after wheat harvest. Grain was harvested from a 5 by 30 or 40 ft area on July 29, 1992.

Table 1. Application and soil analysis data, 1991

	1991			1992
Application time	July	August	September	
Relative humidity (%)	74	63	76	
Air temperature (F)	60	64	44	
Soil temperature at 2 in. (F)	78	68	54	
Wind (mph) - direction	0	0	0	
Soil pH	5.8			6.3
OM (%)	3.7			3.7
CEC (meq/100g soil)	18.1			19.8
Texture	silt loam			silt loam

Treatments applied on August 13 or September 10, 1991 controlled more field bindweed than the treatments applied on July 14 (Table 2). Quinclorac tank mixed with 2,4-D low volatile ester (LVE) initially controlled less field bindweed than other treatments when applied during July or August based on the first evaluations following application. Field bindweed densities in 1992 were reduced from all 1991 treatments; however, the August and September applied treatments reduced bindweed densitites more than the treatments applied in July. The April 1992 evaluation of bindweed density indicates that July applications of quinclorac tank mixed with dicamba more effectively delayed emergence of bindweed shoots than the July applications of quinclorac tank mixed with 2,4-D or glyphosate-2,4-D; however, no difference occurred among herbicide treatments when control was evaluated July 1992. Winter wheat grain yields, averaged over application times, were 20 to 23 bu/a more in treated than untreated bindweed plots. Winter wheat yielded 7 and 19 bu/a more grain when bindweed had been treated during August 1991 compared to bindweed treatment during July or September 1991, respectively. The 1992 low wheat yields from the September 1991 treated bindweed plots, despite excellent bindweed control, indicates the importance of controlling bindweed sometime in August, especially when moisture is limiting. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Quinclorac for field bindweed control in fallow and the following year in winter wheat

						1992 bindweed			
						Plant	Ground		
		App.[2]	1991 bindweed[3]			density[4]	cover[5]	Control[3]	Wheat
Treatment[1]	Rate	time	7/31	8/30	9/26	4/22	7/22	7/22	yield
	lb ae/a		---- (%) -----				---- (%) ----		bu/a
untreated	0.0	July	--	--	--	17	86	--	46
quinclorac +	0.25								
2,4-D LVE +	0.95								
Sun-It II	2 pt	July	39	63	51	7	52	43	65
quinclorac +	0.25								
dicamba +	0.5								
Sun-It II	2 pt	July	64	69	55	3	33	42	61
glyphosate-2,4-D	1.0	July	70	75	60	11	33	40	65
	mean	July	57	69	55	9(7)[6]	51(40)[6]	42	59(64)[6]
untreated	0.0	August	--	--	--	25	90	--	40
quinclorac +	0.25								
2,4-D LVE +	0.95								
Sun-It II	2 pt	August	--	76	93	0	8	96	68
quinclorac +	0.25								
dicamba +	0.5								
Sun-It II	2 pt	August	--	91	97	0	3	98	73
glyphosate-2,4-D	1.0	August	--	93	93	0	6	96	70
	mean	August	--	87	95	6(0)[6]	27(6)[6]	97	63(71)[6]
untreated	0.0	September	--	--	--	26	88	--	37
quinclorac +	0.25								
2,4-D LVE +	0.95								
Sun-It II	2 pt	September	--	--	90	1	6	95	51
quinclorac +	0.25								
dicamba +	0.5								
Sun-It II	2 pt	September	--	--	86	0	4	95	52
glyphosate-2,4-D	1.0	September	--	--	96	0	8	95	56
	mean	September	--	--	90	7(0)[6]	27(6)[6]	95	49(53)[6]
untreated	0.0	mean	--	--	--	23	88	--	41
quinclorac +	0.25								
2,4-D LVE +	0.95								
Sun-It II	2 pt	mean	--	69	79	4	22	78	61
quinclorac +	0.25								
dicamba +	0.5								
Sun-It II	2 pt	mean	--	80	79	1	14	78	62
glyphosate-2,4-D	1.0	mean	--	84	83	4	16	77	64
LSD $_{(0.05)}$		time	--	NS	24	NS(NS)[6]	10(10)[6]	NS	3(4)[6]
		herbicide	NS	11	NS	5(2)[6]	11(NS)[6]	NS	4(NS)[6]
		time by herbicide	--	NS	NS	NS(3)[6]	20(NS)[6]	NS	7(NS)[6]

[1] quinclorac rate is lb ai/a; Sun-It II is a methylated crop seed oil applied at 2 pints (pt)/a; glyphosate-2,4-D, 0.9:1.5 ratio ae, is a commercial formulation

[2] app. = application

[3] visual evaluation of control

[4] bindweed shoots/10.8 ft^2

[5] visual evaluation of ground covered with bindweed foliage within the 10.8 ft^2 area previously counted during April 1992

[6] means and analysis within parentheses exclude data from untreated plots

Grass and broadleaf weed control in soft white winter wheat. Thompson, C.R. and D.C. Thill. Herbicides applied postemergence to winter wheat were evaluated for interrupted windgrass and broadleaf weed control in two experiments. One experiment was 4 miles northwest of Potlatch, ID and the other was 2 miles east of Plummer. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 10 gal/a at 38 psi to 4.5 leaf 'Madsen' winter wheat, tillered interrupted windgrass (APEIN) 1 to 1.5 in. tall, 0.5 to 2 in. mayweed chamomile (ANTCO), 0.5 to 1 in. prickly lettuce (LACSE), 0.5 to 2 in. field pennycress (THLAR), 0.25 to 1.5 in. henbit (LAMAM), and 1 to 1.5 in. *Amsinckia* species at Potlatch on March 31 and to 5 leaf 'Hill-81' wheat, tillered interrupted windgrass 1 to 1.5 in. tall, 2 to 4 leaf tame oat, and 0.5 to 2.5 in. prickly lettuce at Plummer on April 2 and on April 7 (Table 1). Plummer applications were split due to chemical availability. Wheat injury and broadleaf weed control were evaluated visually on April 24. Interrupted windgrass control was evaluated visually on April 24 and on July 2 at Potlatch (Table 2). Wheat injury and weed control were evaluated visually on May 19 and interrupted windgrass control was evaluated visually on July 9 at Plummer (Table 3). Grain was harvested on August 5 from 4.5 by 27 ft and 5.0 by 27 ft areas within experimental units at Potlatch and Plummer, respectively. Treatments were arranged as a randomized complete block and replicated four times.

Table 1. Application and soil analysis data

Location		Potlatch	Plummer	
Date (month/day)		3/31	4/2	4/7
Wheat leaf stage		5.5	5.0	5.0
Temperature (F)		52	60	42
Soil temperature at 2 in. (F)		48	62	38
Relative humidity (%)		48	76	66
Wind speed (mph - direction)		2-S	1-NW	1-N
Soil	pH	6.0	4.5	
	OM (%)	3.9	2.9	
	CEC (meq/100g soil)	18.8	12.2	
	Texture	silt loam	silt loam	

All herbicide treatments controlled prickly lettuce and field pennycress 97 to 99% at Potlatch (Table 2). Dicamba tank mixtures with 2,4-D or MCPA controlled henbit, *Amsinckia* species, and mayweed chamomile less than 80%. Interrupted windgrass was controlled best at the early evaluation with metribuzin and triasulfuron tank mixed or thifensulfuron-tribenuron applied alone. Wheat was injured slightly when dicamba was tank mixed with MCPA or thifensulfuron-tribenuron. Wheat treated with thifensulfuron-tribenuron alone or tank mixed with more than 0.187 lb bromoxynil, or metribuzin tank mixed with triasulfuron yielded significantly more grain than the untreated wheat.

All herbicide treatments controlled narrow-leaf montia (MONLI) 93% or better except imazamethabenz applied alone at the Plummer site (Table 3). Thifensulfuron-tribenuron or fenoxyprop-2,4-D-MCPA applied alone or tank mixed together controlled prickly lettuce 99% on the July 9 evaluation. Metribuzin, imazamethabenz, and fenoxyprop-2,4-D-MCPA controlled interrupted windgrass 91% or better on the July 9 evaluation. Thifensulfuron-tribenuron applied alone controlled windgrass 58 to 83%; however, when tank mixed with fenoxyprop-2,4-D-MCPA it appeared to antagonize the fenoxyprop-2,4-D-MCPA activity on windgrass. Tame oat was controlled with all imazamethabenz or fenoxyprop-2,4-D-MCPA treatments. Late emerged wheat was severely injured or killed with the metribuzin treatments resulting in a 15 to 56% visual injury rating. Fenoxyprop-2,4-D-MCPA injured wheat causing up to 15% twisted and malformed heads. Wheat yields were highest at the Plummer site when wheat was treated with imazamethabenz tank mixed with thifensulfuron-tribenuron. (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Interrupted windgrass and broadleaf weed control in soft white winter wheat, Potlatch, ID

Treatment[1]	Rate	Wheat Yield	Wheat Inj[2]	APEIN 4/24	APEIN 7/2	ANTCO	LACSE	THLAR	LAMAM	AMSIN[3]
	lb ai/a	bu/a	%	(% control)						
control		56	--	--	--	--	--	--	--	--
bromoxynil	0.5	61	0	16	0	82	98	97	83	91
EXP30973A[4]	0.5	61	0	19	0	78	97	98	83	90
bromoxynil-MCPA	0.75	59	1	21	0	85	99	98	88	88
thifen-triben[5]+ R-11[6]	0.016 0.25%	66	0	80	29	97	99	99	95	93
bromoxynil+ thifen-triben+ R-11	0.187 0.016 0.25%	57	0	53	9	95	99	99	91	93
bromoxynil+ thifen-triben+ R-11	0.25 0.016 0.25%	62	0	48	3	97	99	99	88	93
bromoxynil+ thifen-triben+ R-11	0.375 0.016 0.25%	63	1	33	4	98	99	99	94	94
bromoxynil+ thifen-triben+ R-11	0.5 0.016 0.25%	62	1	41	0	96	99	99	94	90
MCPA ester+ thifen-triben+ R-11	0.25 0.016 0.25%	61	0	60	4	93	99	99	93	92
dicamba SGF[7]+ 2,4-D amine	0.125 0.375	58	1	21	0	71	98	97	72	73
dicamba SGF+ MCPA amine	0.125 0.375	59	3	15	0	63	98	98	68	52
dicamba SGF+ thifen-triben+ R-11	0.125 0.016 0.25%	60	5	39	0	92	98	98	93	93
metribuzin+ triasulfuron+ R-11	0.14 0.013 0.25%	64	0	88	70	90	99	99	96	92
	$LSD_{(0.05)}$	6	3	21	9	12	1	2	13	17
Initial density (plants/ft^2)				55		21	3	2	10	3

[1] '-' between herbicides indicates a commercially formulated mixture of the herbicides
[2] inj = injury
[3] AMSIN = *Amsinckia species* (coast fiddleneck and Palouse tarweed)
[4] EXP30973A is a mixture of heptanoic & octanoic acids of bromoxynil;
[5] thifen-triben = thifensulfuron-tribenuron
[6] R-11 surfactant was applied at 0.25% v/v
[7] SGF is the sodium salt formulation of dicamba;

Table 3. Interrupted windgrass, tame oat, and broadleaf weed control in soft white winter wheat, Plummer, ID

Treatment[1]	Rate	Wheat Yield	Wheat Injury 5/19	Wheat Injury 7/9	LACSE 5/19	LACSE 7/9	MONLI	APEIN 5/19	APEIN 7/9	Tame oat
	lb ai/a	bu/a	-- (%)	--	----------		(% control)	---------		
control		44	--	--	--	--	--	--	--	--
imazamethabenz+ R-11[2]	0.47 0.25%	35	11	0	46	15	78	90	96	99
imazamethabenz+ Sun-It[3]	0.47 2.0pt	41	5	1	48	13	44	90	93	99
thifen-triben[4]+ R-11	0.016 0.25%	47	0	0	90	99	98	43	58	0
thifen-triben+ R-11	0.023 0.25%	49	3	0	97	99	98	71	83	0
imazamethabenz+ thifen-triben+ R-11	0.38 0.016 0.25%	51	5	1	87	67	99	89	96	98
imazamethabenz+ thifen-triben+ R-11	0.47 0.016 0.25%	54	3	1	72	90	96	91	94	97
fenoxaprop- 2,4-D - MCPA[5]	0.574	46	11	6	99	99	93	86	92	97
fenoxaprop- 2,4-D - MCPA+ thifen-triben+ R-11(not applied)	0.574 0.016	43	9	4	99	99	99	70	68	99
fenoxaprop- 2,4-D - MCPA	1.14	44	15	4	99	99	98	87	95	99
fenoxaprop- 2,4-D - MCPA	0.43	48	6	5	98	99	96	87	91	99
metribuzin	0.25	43	19	15	99	99	99	97	99	75
metribuzin	0.38	40	56	24	99	99	99	97	99	86
metribuzin+ thifen-triben+ R-11	0.25 0.016 0.25%	49	34	16	99	99	99	97	99	83
LSD $_{(0.05)}$		9	14	9	19	17	14	13	15	6
Initial density (plants/ft^2)					11		<1	12		5

[1] '-' between herbicides indicates a commercially formulated mixture of the herbicides
[2] R-11 was applied at 0.25% v/v
[3] Sun-It is a methylated crop seed oil applied at 2.0 pints/a
[4] thifen-triben = thifensulfuron-tribenuron
[5] fenoxaprop-2,4-D-MCPA is a 1:1.5:4.7 ratio of active isomer of fenoxaprop:isooctylester of 2,4-D:isooctylester of MCPA

UCC-C4243 rate and application time for weed control in winter wheat. Thompson, C.R., M.J. Dial, and D.C. Thill. An experiment was established in the fall of 1991 to determine the optimum UCC-C4243 application rate and time in winter wheat. This experiment was also conducted in 1990-91 (see WSWS 1992 Research Progress Report, p. 168-170). All soil applied herbicide treatments were applied with a CO_2 backpack sprayer equipped with 8002 nozzles delivering 187 L/ha at 275 kPa. Preplant incorporated (PPI) treatments were applied and incorporated twice with a spike-tooth harrow and preplant surface (PPS) treatments were applied on October 8, 1991 (Table 1). 'Hill 81' winter wheat was seeded in 18 cm rows at 90 kg/ha, 4 cm deep on October 9, 1991. Postplant, preemergence incorporated (POPI) treatments were applied and incorporated twice with a spike-tooth harrow followed by the application of the postplant preemergence surface (POPS) treatments. Postemergence (POST) treatments were applied with a CO_2 backpack sprayer equipped with 8001 nozzles delivering 94 L/ha at 275 kPa to 5 to 5.5 leaf wheat, 2 to 5 leaf tame oat and wild oat (AVEFA), tillered interrupted windgrass (APEIN), Italian ryegrass (LOLMU), and annual brome species (downy brome and hairy chess) (*BROMUS*), 0.25 to 1 in. mayweed chamomile (ANTCO), pineappleweed (MATMT), red sandspurry (SPBRU), and henbit (LAMAM), and 0.5 to 1.5 in. field pennycress (THLAR) on April 4, 1992. The study was a split plot design with application times as the main plots and herbicide treatments as the subplots. An untreated control treatment and a thifensulfuron-tribenuron + bromoxynil + diclofop + R-11 treatment were included within each main plot for comparison. Plots were 3.0 by 12.2 m. Wheat plants/0.18 m^2 and weed species plant number/0.2 m^2 were counted on May 15. Wheat plant number and wheat biomass/0.18 m^2, and weed species biomass/0.2 m^2 were determined on July 30. Two density and biomass samples were taken from each plot and summed for analysis. Wheat grain was harvested from a 15.5 m^2 area on July 27.

Table 1. Application and soil analysis data

Application timing	PPI	PPS	POPI	POPS	POST
Air temperature (C)	24	24	26	26	4
Soil temperature at 2 in. (C)	16	16	21	21	6
Relative humidity (%)	42	42	39	39	90
Wind speed (km/h)-direction	2-E	0	1-SW	1-SW	2-W
Soil moisture condition	dry	dry	dry	dry	mod.
pH	6.7				
OM (%)	3.3				
CEC (meq/100g soil)	20.1				
Texture	silt loam				

Winter wheat stands were thin due to poor establishment conditions during the fall of 1991. UCC-C4243, regardless of rate applied, did not reduce wheat density compared to the density of untreated wheat (Table 2). When wheat shoot biomass was averaged over application timing, wheat treated with UCC-C4243 at 140 g ai/ha or thifensulfuron + tribenuron + diclofop + R-11 produced more biomass than the untreated wheat (Table 2). A similar trend was observed with wheat grain yield. The increased shoot biomass and grain yield appears to be the effect of controlling broadleaf weeds, tame oat, and Italian ryegrass. Broadleaf weed densities were reduced by all herbicide treatments (Table 2). The major broadleaf weeds present were mayweed chamomile and red sandspurry. Additional broadleaf weeds were henbit, common lambsquarters, pineappleweed, prickly lettuce, field pennycress, and volunteer rape. As increasing UCC-C4234 rates were applied, broadleaf weed densities decreased. UCC-C4243 applied to the soil surface and not incorporated more effectively controlled broadleaf weeds than if applied to the soil surface and incorporated. Tame and wild oat densities decreased as UCC-C4243 rate applied increased (Table 3). Italian ryegrass and interrupted windgrass densities were reduced by all rates of UCC-C4243 (Table 3). Thifensulfuron + tribenuron + bromoxynil + diclofop + R-11 was the most effective treatment to control oat and ryegrass. POPS is the most effective timing of application for UCC-C4243 to control broadleaf and grass weeds in winter wheat (Tables 2 & 3). (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Wheat and broadleaf weed response to UCC-C4243

		Wheat grain yield					Wheat shoot biomass				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	kg/ha					g/m^2				
control	0	2657	2372	2690	2593	2578	602	485	435	445	491
UCC-C4243	70	2858	2458	2352	3012	2670	567	482	374	585	502
UCC-C4243	101	3390	3017	2838	2750	2999	527	455	377	437	449
UCC-C4243	140	3903	3009	3382	4099	3598	624	645	763	524	639
thif-trib+	26										
brox+	280										
diclofop	1120	4983	4239	4853	4583	4664	864	529	984	693	768
Timing mean		3558	3019	3223	3407		637	519	586	537	

$LSD_{(0.05)}$ Wheat grain yield: Trt=301 Timing=NS; Trt by Timing=NS. Wheat shoot biomass: Trt=124 Timing=NS; Trt by Timing=NS

		Wheat density					Broadleaf weed density[3]				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	$plants/m^2$					$plants/m^2$				
control		45	42	41	50	45	190	220	192	156	190
UCC-C4243	70	53	39	35	50	44	100	32	59	17	52
UCC-C4243	101	49	42	41	34	42	39	17	38	6	25
UCC-C4243	140	51	48	39	39	44	24	6	19	2	13
thif-trib+	26										
brox+	280										
diclofop	1120	66	40	58	49	53	7	24	0	9	10
Timing mean		53	42	43	45		72	60	62	38	

$LSD_{(0.05)}$ Wheat density: Trt=NS Timing=8; Trt by Timing=NS. Broadleaf weed density: Trt=25 Timing=13; Trt by Timing=NS

		ANTCO density					SPBRU density				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	$plants/m^2$					$plants/m^2$				
control		19	36	20	9	21	142	144	137	102	131
UCC-C4243	70	17	12	11	14	14	71	15	38	1	31
UCC-C4243	101	12	2	13	0	7	20	14	22	1	14
UCC-C4243	140	5	1	8	1	4	15	2	10	0	7
thif-trib+	26										
brox+	280										
diclofop	1120	1	1	0	6	2	4	0	0	0	1
Timing mean		11	11	10	6		51	35	42	21	

$LSD_{(0.05)}$ ANTCO density: Trt=11 Timing=NS; Trt by Timing=NS. SPBRU density: Trt=22 Timing=12; Trt by Timing=NS

[1] Trt = Treatment

[2] thif-trib = thifensulfuron-tribenuron; brox = bromoxynil; thif-trib+brox+diclofop was applied with R-11 at 0.25% v/v

[3] composite of ANTCO, SPBRU, THLAR, CHEAL, LAMAM, MATMT, LACSE, & volunteer rape

Table 3. Grass species response to UCC-C4243

		Tame oat and AVEFA density					LOLMU density				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	-------- plants/m^2 ---------					--------- plants/m^2 --------				
control		90	104	91	73	90	36	25	62	28	37
UCC-C4243	70	87	71	102	60	80	20	12	41	3	19
UCC-C4243	101	95	64	59	80	75	29	26	23	12	22
UCC-C4243	140	57	36	39	36	42	19	15	10	8	13
thif-trib+	26										
brox+	280										
diclofop	1120	1	2	1	2	2	4	8	3	3	5
Timing mean		66	56	58	50		22	17	28	11	

$LSD_{(0.05)}$ Trt=17 Timing=NS; Trt by Timing=NS — Trt=17 Timing=NS; Trt by Timing=NS

		Bromus density					APEIN density				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	-------- plants/m^2 ---------					--------- plants/m^2 --------				
control		9	17	13	14	13	36	14	45	25	30
UCC-C4243	70	6	8	17	3	8	17	10	15	7	12
UCC-C4243	101	5	3	16	2	7	12	17	6	1	9
UCC-C4243	140	4	9	2	2	4	10	6	7	0	6
thif-trib+	26										
brox+	280										
diclofop	1120	7	12	2	34	14	6	71	13	41	33
Timing mean		6	10	10	11		16	23	17	15	

$LSD_{(0.05)}$ Trt=NS Timing=NS; Trt by Timing=NS — Trt=11 Timing=NS; Trt by Timing=21

		GRASS density[3]					Grass shoot biomass[3]				
		Application timing				Trt[1]	Application timing				Trt[1]
Treatment[2]	Rate	PPI	PPS	POPI	POPS	mean	PPI	PPS	POPI	POPS	mean
	g ai/ha	-------- plants/m^2 ---------					----------- g/m^2 -----------				
control		171	159	211	139	170	419	468	498	356	435
UCC-C4243	70	129	101	174	74	119	402	453	498	372	431
UCC-C4243	101	141	110	103	95	112	396	370	417	390	393
UCC-C4243	140	91	66	59	46	65	268	290	284	296	285
thif-trib+	26										
brox+	280										
diclofop	1120	17	94	19	81	53	60	106	24	153	
Timing mean		110	106	113	87		309	337	344	314	

$LSD_{(0.05)}$ Trt=32 Timing=NS; Trt by Timing=63 — Trt=NS Timing=85; Trt by Timing=NS

[1] Trt = Treatment
[2] thif-trib = thifensulfuron-tribenuron; brox = bromoxynil; thif-trib+brox+diclofop was applied with R-11 at 0.25% v/v
3 composite of tame oat, AVEFA, LOLMU, BROTE, BROCO, and APEIN

Broadleaf and grass weed control in winter and spring cereals with varied rates of UCC-C4243. Thompson, C.R. and D.C. Thill. Three experiments were established in cereal crops to determine crop and weed responses to UCC-C4243. Experiments were established in 'Hill 81' winter wheat 1 mile north of Moscow, ID, in 'Sprite' spring wheat 2 miles northwest of Viola, and in 'Cougbar' spring barley 4 miles northeast of Potlatch. All postplant preemergence (PRE) treatments were applied to the soil surface in 20 gal/a water and all postemergence treatments were applied in 10 gal/a water (Table 1). Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 or 20 gal/a at 38 psi traveling 3 mph. The winter wheat experiment was treated with difenzoquat at 1.0 lb ai/a for wild oat control on May 21. The spring barley was treated with diclofop at 1.0 lb ai/a for wild oat control on May 7. Crop plant densities were counted from two 3.3 ft of row (front and back half of each plot) totaling 6.6 ft of row within each experimental unit. Winter wheat, spring wheat, and barley densities were counted on March 26, April 14, and May 29, respectively. At Moscow, winter wheat injury, field pennycress (THLAR), mayweed chamomile (ANTCO), and Italian ryegrass (LOLMU) control were evaluated visually on May 13 and Italian ryegrass and interrupted windgrass (APEIN) control were evaluated on June 26. At Viola, spring wheat injury, and weed control were evaluated visually on July 2. At Potlatch, barley injury and weed control were evaluated visually on May 29. Winter wheat, spring wheat, and barley grain were harvested from plot areas 4.5 by 27 ft on July 29, August 1, and August 6, respectively. Each experiment was a randomized complete block with four replicates.

Table 1. Application and soil analysis data

Location	Moscow		Viola		Potlatch	
Crop	winter wheat		spring wheat		spring barley	
Application timing	PRE	5 lf[1]	PRE	4 lf	PRE	3 lf
Application date	10/9	4/4	3/30	5/6	4/14	5/7
Temperature (F)	78	42	60	80	60	74
Soil temperature at 2 in. (F)	70	42	44	72	56	68
Relative humidity (%)	38	85	58	48	64	55
Wind speed (mph - direction)	1-S	5-W	3-W	4-S	2-SE	2-SE
Soil pH	5.9		5.7		5.6	
OM (%)	3.3		3.1		2.6	
CEC (meq/100g soil)	19.4		18.3		12.1	
Texture	silt loam		silt loam		silt loam	

[1] lf = leaf

Winter wheat densities were low because of poor establishment conditions during the fall 1991. Seed was planted into dry soil on October 9 and wheat did not emerge until November. Winter wheat densities were not different among UCC-C4243 treatments (Table 2). Winter wheat grain yield increased as UCC-C4243 rate increased. The increasing yield maybe a wheat response to increased control of Italian ryegrass and interrupted windgrass. Wheat treated with UCC-C4243 equal to or greater than 0.045 lb ai/a or thifensulfuron-tribenuron + bromoxynil + R-11 yielded more grain and had higher test weight than the untreated wheat. UCC-C4243 at 0.045 to 0.125 lb/a controlled field pennycress and mayweed chamomile greater than 80%. UCC-C4243 at 0.06 to 0.125 lb/a controlled interrupted windgrass greater than 80%. UCC-C4243 at 0.09 and 0.125 lb/a controlled Italian ryegrass 80% or better.

UCC-C4243 did not reduce spring wheat density, grain yield, or test weight (Table 3). UCC-C4243 at 0.030 to 0.125 lb/a controlled field pennycress, mayweed chamomile, and common lambsquarters (CHEAL) greater than 90%. UCC-C4243 at 0.06 to 0.125 lb/a controlled Italian ryegrass 87% or more.

UCC-C4243 at 0.06 to 0.125 lb/a reduced spring barley density compared to the density of untreated barley (Table 4). UCC-C4243 did not reduce barley grain yield; however, did increase barley test weight compared to the test weight of untreated barley. The highest barley yield was attained when barley was treated with thifensulfuron-tribenuron + bromoxynil + R-11. Field pennycress, mayweed chamomile, and common lambsquarters were controlled with all herbicide treatments. UCC-C4243 at 0.015 to 0.045 lb/a controlled broadleaf weeds more effectively when applied in the spring than when applied in the fall. (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. Winter wheat and weed response to UCC-C4243

Treatment[1]	Rate[2]	App.[3] time	Winter wheat Yield	Testwt[4]	Den.[5]	THLAR	ANTCO	LOLMU 5/13	6/26	APEIN
	lb ai/a		bu/a	lb/bu		(% control[6])				
control			27	57	28	--	--	--	--	--
UCC-C4243	0.015	PRE	32	58	25	39	34	1	4	4
UCC-C4243	0.030	PRE	33	58	28	71	78	18	4	13
UCC-C4243	0.045	PRE	35	59	25	86	84	53	29	76
UCC-C4243	0.060	PRE	43	58	26	98	96	80	73	89
UCC-C4243	0.090	PRE	46	59	23	98	95	88	80	95
UCC-C4243	0.125	PRE	51	59	23	99	99	95	93	99
thifen-										
tribenuron+	0.023									
bromoxynil+	0.25									
R-11	0.25%	5 leaf	36	58	27	99	99	23	14	35
	$LSD_{(0.05)}$		7	1	NS	15	15	16	16	19
Weed density (plants/ft^2)						9	5	16		6

[1] EC formulation of UCC-C4234; thifen- = thifensulfuron component of a commercial formulation of thifensulfuron-tribenuron;
[2] 0.25% = R-11 was applied at 0.25% v/v
[3] App. = Application
[4] Testwt = test weight
[5] Den. = density (number of wheat plants/6.6 feet of row);
[6] visual evaluation

Table 3. Spring wheat and weed response to UCC-C4243

Treatment[1]	Rate[2]	App.[3] time	Spring wheat Yield	Testwt[4]	Den.[5]	THLAR	ANTCO	CHEAL	LOLMU
	lb ai/a		bu/a	lb/bu		(% control[6])			
control			68	62	80	--	--	--	--
UCC-C4243	0.015	PRE	69	62	87	90	80	80	47
UCC-C4243	0.030	PRE	68	62	85	94	91	92	80
UCC-C4243	0.045	PRE	68	62	85	98	97	97	73
UCC-C4243	0.060	PRE	68	62	72	99	98	99	87
UCC-C4243	0.090	PRE	70	62	79	99	99	98	91
UCC-C4243	0.125	PRE	69	62	71	99	99	99	96
thifen-									
tribenuron+	0.023								
bromoxynil+	0.25								
R-11	0.25%	4 leaf	66	62	78	99	99	99	45
	$LSD_{(0.05)}$		NS	NS	NS	4	3	4	10
	Weed density (plants/ft^2)					1	2	3	<1

[1] Wettable powder formulation of UCC-C4234; thifen- = thifensulfuron component of a commercial formulation of thifensulfuron-tribenuron;
[2] 0.25% = R-11 was applied at 0.25% v/v
[3] App. = Application
[4] Testwt = test weight
[5] Den. = density (number of wheat plants/6.6 feet of row);
[6] visual evaluation

Table 4. Spring barley and weed response to UCC-C4243

Treatment[1]	Rate[2]	App.[3] time	Spring barley Yield	Testwt[4]	Den.[5]	THLAR	ANTCO	CHEAL
	lb ai/a		lb/a	lb/bu		---- (% control[6])		----
control			3350	47	42	--	--	--
UCC-C4243	0.015	PRE	3500	48	35	89	98	87
UCC-C4243	0.030	PRE	3700	49	38	93	98	91
UCC-C4243	0.045	PRE	3700	48	34	93	99	94
UCC-C4243	0.060	PRE	3450	49	30	95	99	92
UCC-C4243	0.090	PRE	3450	49	31	97	99	98
UCC-C4243	0.125	PRE	3550	49	28	99	99	97
thifen- tribenuron+ bromoxynil+ R-11	 0.023 0.25 0.25%	3 leaf	3850	49	37	99	99	97
	$LSD_{(0.05)}$		450	2	10	7	NS	8
	Weed density (plants/ft^2)					1	2	9

[1] Wettable powder formulation of UCC-C4234; thifen- = thifensulfuron component of a commercial formulation of thifensulfuron-tribenuron;
[2] 0.25% = R-11 was applied at 0.25% v/v
[3] App. = Application
[4] Testwt = test weight
[5] Den. = density (number of wheat plants/6.6 feet of row);
[6] visual evaluation

UCC-C4243 combined with wild oat herbicides for weed control in winter and spring wheat. Thompson, C.R. and D.C. Thill. Experiments were established in 'Hill 81' winter wheat 1 mile northeast of Moscow, ID and in 'Penewawa' spring wheat 3 miles northeast of Potlatch, ID to evaluate wheat and weed responses to UCC-C4243 and wild oat herbicides. All treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 (postemergence treatments) or 20 (preemergence treatments) gal/a at 3 mph and 38 psi (Table 1). Preplant incorporated (PPI) treatments were applied and harrow incorporated twice with a spike-toothed harrow traveling at 5 to 6 mph on October 8, 1991. Winter wheat was seeded at 80 lb/a 2 in. deep with a double disk opener drill and preemergence surface treatments were applied to dry soil on October 9, 1992. Winter wheat did not germinate until 0.75 in. of precipitation was received during the last week of October. PPI treatments were applied and harrow incorporated, as previously described, and spring wheat was seeded at 95 lb/a 0.25 in. deep in moist soil on March 28, 1992. Spring wheat was seeded shallow because a firm seedbed had developed during the management of the residue. Preemergence (PRE) treatments were applied to the soil surface on March 30. Postemergence (POST) treatments were applied at the winter wheat site to 5.0 to 5.5 leaf wheat, 3 to 5 leaf wild oat (AVEFA) and tame oat (AVESA) and hairy chess (BROCO), tillered downy brome (BROTE), 0.25 to 2 in. mayweed chamomile (ANTCO), 0.5 to 1.5 in. henbit (LAMAM) and field pennycress (THLAR), and 0.25 to 1 in. red sandspurry (SPBRU) on April 4, 1992. Postemergence (POST) treatments were applied at the spring wheat site to 3.5 to 4.5 leaf wheat, 3 to 4.5 leaf wild oat, 1 to 2 in. mayweed chamomile, 1 to 3.5 in. field pennycress, and 1 to 3 in. common lambsquarters on May 6, 1992. In the winter wheat experiment, wheat plants (density)/6.6 ft of row were counted on April 15. Broadleaf and grass weed control were evaluated visually on May 13 and June 26, respectively. At the spring wheat site, wheat plants/6.6 ft of row were counted on May 29. Wheat injury, wheat stand reduction, and weed control were evaluated visually on July 2. Winter wheat was not harvested. Spring wheat grain was harvested from 4.5 by 27 ft areas of each plot on August 6. In both experiments, treatments were arranged as a randomized complete block and replicated four times.

Table 1. Application and soil analysis data

Location (wheat)	Moscow (winter)			Potlatch (spring)		
Application time	PPI	PRE	POST	PPI	PRE	POST
Temperature (F)	70	78	42	30	64	81
Soil temperature at 2 in. (F)	64	70	42	33	54	81
Relative humidity (%)	38	38	85	90	58	57
Wind speed (mph-direction)	2-W	1-S	4-W	0-	3-SE	1-SW
Soil pH		6.7			5.6	
OM (%)		3.3			2.7	
CEC (meq/100g soil)		20.1			20.2	
Texture		silt loam			silt loam	

Herbicide treatments did not injure winter wheat or reduce winter wheat density (Table 2). Triallate at 1.25 lb ai/a controlled tame and wild oat 48 to 56% in winter wheat. UCC-C4243 at 0.094 lb ai/a tank mixed with triallate at 1.25 lb/a or applied to the soil surface following a 1.25 lb/a triallate treatment, improved tame and wild oat control 18 to 40% compared to 1.25 lb/a triallate applied alone in winter wheat. Hairy chess and downy brome were not controlled adequately with any herbicide treatment. Triallate at 1.25 lb/a applied PPI plus UCC-C4243 at 0.094 lb/a applied to the soil surface controlled hairy chess and downy brome 75 and 84%, respectively. All UCC-C4243 or thifensulfuron-tribenuron + bromoxynil treatments controlled mayweed chamomile, henbit, and red sandspurry.

The UCC-C4243 WP formulation at 0.063 lb/a applied PRE alone or after triallate applied PPI reduced spring wheat density compared to the density of untreated wheat (Table 3). Likewise; all treatments with UCC-C4243 EC formulation at 0.092 lb/a applied PRE reduced spring wheat density. These evaluations were based on wheat plant counts taken on May 29. Visual evaluations on July 2 indicated that all preemergence treatments reduced spring wheat stand and that UCC-C4243 combinations with triallate reduced wheat stand more than UCC-C4243 or triallate applied alone. A shallow spring wheat seeding, 0.25 to 0.5 in. deep, likely enhanced wheat stand reduction and injury from the PPI and PRE treatments. The wheat injury and stand reduction observed did not reduce spring wheat grain yield or test weight (Table 3). Wheat treated with diclofop + thifensulfuron-tribenuron + bromoxynil + Sun-It II or triallate + UCC-C4243 at 0.046 lb/a yielded more grain than untreated wheat. UCC-C4243 at 0.063 or 0.092 lb/a applied as a tank mix with triallate or applied on the soil surface following the triallate treatment tended to enhance wild oat control compared to triallate applied alone (Table 3). Thifensulfuron-tribenuron tank mixed with diclofop appeared to reduce wild oat efficacy compared to diclofop applied alone. UCC-C4243 did not enhance wild oat control with diclofop. UCC-C4243 or thifensulfuron-tribenuron + bromoxynil controlled mayweed chamomile, field pennycress, and common lambsquarters (Table 4). (Idaho Agricultural Experiment Station, Moscow, ID 83843)

Table 2. UCC-C4243 and wild oat herbicides for weed control in winter wheat

Treatment[1]	Rate	App.[2] time	Wheat Den[3]	Wheat Inj[4]	AVEFA	AVESA	BROCO	BROTE	ANTCO	LAMAM	SPBRU
	lb ai/a			(%)[5]	(% control[5])						
control			20	--	--	--	--	--	--	--	--
triallate	1.0	PPI	17	0	51	41	9	34	0	0	0
triallate	1.25	PPI	20	0	56	48	25	29	25	0	0
triallate+	1.0	PPI									
thifen-triben+	0.023	POST									
bromoxynil+	0.25	POST									
R-11	0.25%	POST	17	0	55	44	6	41	95	99	98
UCC-C4243	0.063	PPI	18	0	10	13	16	24	93	99	96
UCC-C4243	0.094	PPI	21	0	14	24	41	55	95	99	98
triallate+	1.0	PPI									
UCC-C4243	0.063	PPI	19	0	41	48	40	38	90	99	98
triallate+	1.25	PPI									
UCC-C4243	0.063	PPI	17	0	68	60	54	71	91	99	97
triallate+	1.0	PPI									
UCC-C4243	0.094	PPI	18	0	74	65	63	69	95	99	98
triallate+	1.25	PPI									
UCC-C4243	0.094	PPI	14	1	74	75	65	76	97	99	98
triallate+	1.0	PPI									
UCC-C4243	0.063	PRE	17	0	45	49	61	62	95	99	99
triallate+	1.25	PPI									
UCC-C4243	0.063	PRE	18	0	80	74	61	60	98	99	99
triallate+	1.0	PPI									
UCC-C4243	0.094	PRE	20	1	71	82	60	87	98	99	99
triallate+	1.25	PPI									
UCC-C4243	0.094	PRE	15	1	85	88	75	84	98	99	99
UCC-C4243	0.063	PRE	20	0	3	4	8	13	94	98	99
UCC-C4243	0.094	PRE	17	0	19	20	26	55	99	99	99
thifen-triben+	0.023	POST									
bromoxynil+	0.25	POST									
R-11	0.25%	POST	15	0	3	4	1	3	99	98	99
diclofop	0.5	POST	16	0	69	73	42	21	0	0	0
diclofop	1.0	POST	19	0	99	99	49	48	0	0	0
diclofop+	0.5	POST									
UCC-C4243	0.063	PRE	18	0	93	95	24	33	98	99	99
diclofop+	1.0	POST									
UCC-C4243	0.063	PRE	15	0	99	99	38	52	98	99	99
diclofop+	0.5	POST									
UCC-C4243	0.094	PRE	18	0	91	97	58	60	97	99	99
diclofop+	1.0	POST									
UCC-C4243	0.094	PRE	19	0	99	99	34	60	98	99	99
diclofop+	1.0	POST									
thifen-triben+	0.023	POST									
bromoxynil+	0.25	POST									
R-11	0.25%	POST	19	2	99	99	33	28	96	99	99
LSD(0.05)			23	2	19	17	23	29	16	1	15

[1] thifen-triben is a commercially formulated mixture of thifensulfuron and tribenuron; R-11 is applied at 0.25% v/v; EC formulation of UCC-C4243
[2] App = application;
[3] Den = density (number of wheat plants in 6.6 feet of row)
[4] Inj = injury
[5] visual evaluation

Table 3. UCC-C4243 combinated with wild oat herbicides in spring wheat

Treatment[1]	Rate	App.[2] time	Wheat[3] Yield	Wheat[3] Test weight	Wheat[3] Den.	Wheat[3] Stand red.	Wheat[3] Inj.	Control AVEFA	Control ANTCO	Control THLAR	Control CHEAL
	lb ai/a		bu/a	lb/bu		(%)	(%)	(%)	(%)	(%)	(%)
control			63	62	47	--	--	--	--	--	--
triallate	1.25	PPI	67	63	43	14	3	77	0	0	0
UCC-C4243 WP	0.063	PRE	66	62	36	18	4	16	99	99	99
UCC-C4234 EC	0.063	PRE	70	62	41	13	4	15	99	99	99
triallate+ UCC-C4243 EC	1.25 0.063	PPI PPI	66	62	44	34	13	83	96	97	97
triallate+ UCC-C4243 EC	1.25 0.046	PPI PRE	73	62	37	30	13	70	96	96	97
triallate+ UCC-C4243 EC	1.25 0.063	PPI PRE	69	62	41	36	15	84	99	99	99
triallate+ UCC-C4243 WP	1.25 0.063	PPI PRE	69	62	33	28	9	87	99	99	99
triallate+ UCC-C4243 EC	1.25 0.092	PPI PRE	70	62	34	39	16	81	99	99	99
triallate+ thifensulfuron- tribenuron+ bromoxynil+ R-11	1.25 0.008 0.187 0.25%	PPI POST POST POST	70	63	42	19	5	64	99	99	99
diclofop+ Sun-It II	0.75 1.0 pt	POST POST	62	62	53	0	4	97	0	0	0
UCC-C4243 EC+ diclofop+ Sun-It II	0.046 0.75 0.25%	PRE POST POST	70	62	38	26	10	96	97	99	97
UCC-C4243 EC+ diclofop+ Sun-It II	0.063 0.75 1.0 pt	PRE POST POST	66	62	44	20	2	96	99	99	99
UCC-C4243 EC+ diclofop+ Sun-It II	0.092 0.75 1.0 pt	PRE POST POST	62	62	32	25	13	97	99	99	99
diclofop+ thifensulfuron- tribenuron+ bromoxynil+ Sun-It II	0.75 0.008 0.187 1.0 pt	POST POST POST POST	79	62	53	0	4	84	99	99	99
thifensulfuron- tribenuron+ bromoxynil+ R-11	 0.008 0.187 0.25%	 POST POST POST	65	62	55	0	0	3	98	98	98
$LSD_{(0.05)}$			9	1	10	10	6	13	3	1	2

[1] WP = wettable powder; thifensulfuron-tribenuron is a formulated mixture
[2] App. = application;
[3] Den. = plants/6.6 feet of row; red. = reduction; Inj. = injury

PROJECT IV

EXTENSION, EDUCATION AND REGULATORY

Stott Howard - Project Chairperson
Phil Peterson - Project Chairperson-Elect

Newly reported weed species; potential weed problems in Idaho. Callihan, R. H. and S. L. Carson. The distribution of weed species submitted from all sources for identification by weed science diagnostic personnel, and of weed species otherwise called to our attention, were examined to 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 1992. Two species were found to be new records for Idaho in 1992. Extensions of the ranges of several species that have been present in Idaho for several years were also recorded. Thirty-two species, including the two species new to Idaho, were found to be new records for individual counties in 1992. 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 escaped ornamentals; none are native to the location reported. The reporting period for these data was November 31, 1991 to November 1, 1992. The following lists cite the scientific name, Bayer code (when available), 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, Moscow, Idaho, 83843)

GROUP I: New regional records: species not previously reported for Idaho, nor 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. *Oxalis dillenii* Jacq. (OXAST) Dilleni woodsorrel; Oxalidaceae.
   County: Gem.
2. *Proboscidea louisianica* (Mill.) Thellung (PROLO) devil's-claw; Martyniaceae;
   County: Franklin.

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

1. *Aegilops cylindrica* Host. (AEGCY) jointed goatgrass; Poaceae.
   County: Caribou.
2. *Amaranthus albus* L. (AMAAL) tumble pigweed; Amaranthaceae.
   County: Twin Falls.
3. *Amaranthus hybridus* L. (AMACH) smooth pigweed; Amaranthaceae.
   County: Oneida.
4. *Anchusa arvensis* (L.) Bieb. (LYCAR) small bugloss; Boraginaceae.
   County: Latah.
5. *Bryonia alba* L. (BYOAL) white bryony; Cucurbitaceae.
   County: Franklin.
6. *Centaurea pratensis* Thuill. (*) meadow knapweed; Asteraceae.
   County: Bonner.
7. *Crupina vulgaris* Cass. (CJNVU) common crupina; Asteraceae.
   County: Nez Perce.
8. *Cytisus scoparius* (L.) Link (SAOSC) Scotch broom; Fabaceae.
   County: Bonner.
9. *Echium vulgare* L. (EHIVU) blueweed; Boraginaceae.
   County: Latah.
10. *Erigeron strigosus* Muhl. ex Willd. (ERIST) rough fleabane; Asteraceae.
   County: Valley.
11. *Glechoma hederaceae* L. (GLEHE) ground ivy; Lamiaceae.
   County: Caribou.

12. *Hesperis matronalis* L. (HEVMA) damsel rocket; Brassicaceae.
County: Idaho.
13. *Hieracium auranticum* L. (HIEAU) orange hawkweed; Asteraceae.
County: Idaho.
14. *Lycium halimifolium* Mill. (LYUHA) matrimonyvine; Solanaceae.
County: Butte.
15. *Polygonum cuspidatum* Sieb. & Zucc. (POLCU) Japanese knotweed; Polygonaceae.
Counties: Fremont, Bannock.
16. *Polypogon monspeliensis* (L.) Desf. (POHMO) rabbitfoot grass; Poaceae.
County: Owyhee.
17. *Potamogeton crispus* L. (PTMCR) curlyleaf pondweed; Potamogetonaceae.
County: Washington.
18. *Potentilla recta* L. (PTLRC) sulfur cinquefoil; Rosaceae.
County: Shoshone.
19. *Ranunculus testiculatus* Crantz (CCFTE) bur buttercup; Ranuculaceae.
Counties: Canyon, Lewis, Camas, Teton.
20. *Rhinanthus crista-gallis* L. (RHIMI) yellow-rattle; Scrophulariaceae.
County: Kootenai.
21. *Sagina procumbens* L. (SAIPR) birdseye pearlwort; Caryophyllaceae.
County: Boundary.
22. *Setaria verticillata* (L.) Beauv. (SETVE) bristly foxtail; Poaceae.
County: Nez Perce.
23. *Silene noctiflora* L. (MELNO) nightflowering catchfly; Caryophyllaceae.
County: Kootenai.
24. *Sisymbrium officinale* (L.) Scop. (SSYOF) hedge mustard; Brassicaceae.
County: Idaho.
25. *Skimmia japonica* Thunb. (*) skimmia; Rutaceae.
County: Canyon.
26. *Solanum rostratum* Dun. (SOLCU) buffalobur; Solanaceae.
County: Nez Perce.
27. *Thelypodium integrifolium* (Nutt.) Endl. (*) entire-leaved thelypody; Brassicaceae.
County: Idaho.
28. *Trichostema oblongum* Benth. (*) mountain blue-curls; Lamiaceae.
County: Ada.
29. *Veronica anagallis-aquatica* L. (VERAA) water speedwell; Scrophulariaceae.
County: Owyhee.
30. *Zannichellia palustris* L. (ZAIPA) horned pondweed; Zannichelliaceae.
County: Cassia.

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

Simplified weed-mapping computer software for individual counties. Callihan, R. H. and L. W. Lass. A county map data base and commercial computer-assisted design program were used to produce a software system by which data can be entered on a county map, changed and stored on a personal computer. This software produces a computer map of an individual county (Fig.1). It may be obtained for any county in the U.S. It is a simple, useful system that allows the user to generate a map of part of all of the county without the expense of a full Geographic Information System (GIS) and highly trained support personnel. It was developed for non-cartographers, and has easy-to-use pull-down menus. The user can learn the fundamentals for all major features within one hour.

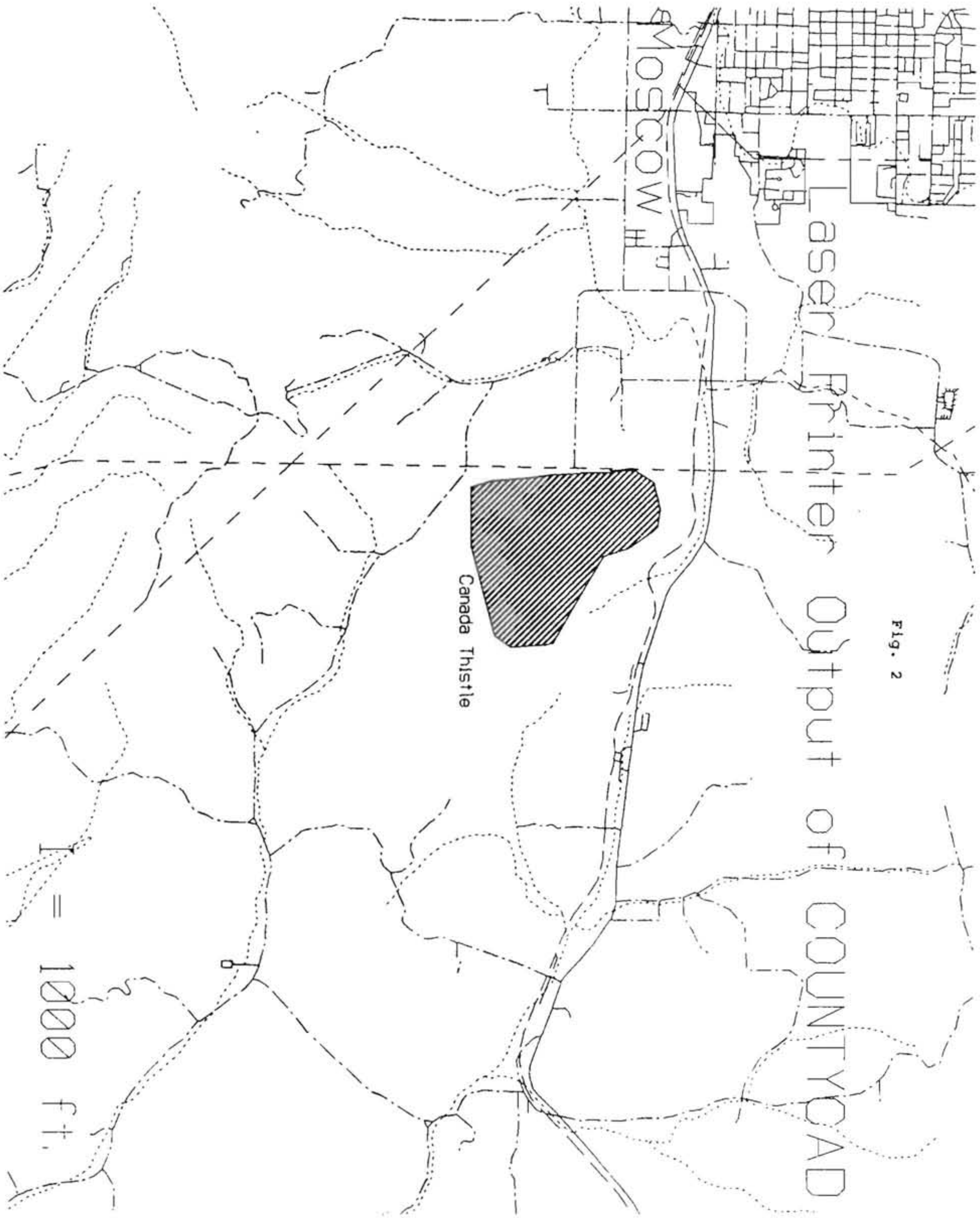
The cartographic data are represented as a series of layers; they are used much like overlaying transparencies on an overhead projector. Any layer can be turned on or off for visibility on the screen or on a computer-printed map. Layers show highways, streets, trails, streams, lakes, and political boundaries in a county. The user can create additional layers to represent weed or other pest infestations, property ownership, soil data, sewer and water lines, or other desired map features. A zoom feature allows magnification (Fig. 2) to any size area within the county, down to a farm, a city lot, or to as small an area as one square foot, if the user has data that will permit identification of the location.

This software should be useful for extension, instruction, research, student use, fieldmen or farmers. It offers the possibility of computer mapping for instructional or other extension purposes in any county, with a modest investment of time and money for software and data. It is not GIS or surveyor grade for legal property boundaries, but it costs substantially less, does not require extensive training, is far more user-friendly, and the data are all transferrable to GIS if necessary. It provides a system that any PC owner can use, that includes the county data base, that will provide a quick turnaround of information, and that is useful for many applications, including classes and group presentations if the user has access to an overhead projector and pc viewer. The user can retrieve the base map to the computer monitor screen, zoom to any part of the county desired, edit the data supplied, and add data such as:

1. Field demonstration and experiment locations -- a map for each year.
2. Noxious weed, plant disease or insect infestations - - a map for each species in each year, that can be presented in year-after-year county or local overlays to monitor temporal changes.
3. Crop history - rotation, management practices, production.
4. Soil erosion.
5. Pesticide monitoring studies.
6. Land ownerships or individual fields.
7. Protected species areas.
8. Soils.
9. Meteorological data.
10. Pest quarantine or restricted crop production areas.

Overlay data are linked together with the State Plane Coordinates system, which uses English distance measurement units. The software allows entry data from a Loran or Global Positioning System (GPS) to create or add stored survey data bases to the map. GPS data may be directly linked if the GPS receiver units are made by Trimble. Software is included for translation of latitude-longitude distance measurements from other GPS and Loran units into the State Plane Coordinates measurement system.

The county map data are assembled for individual counties and are most easily used through the commercial program EasyCAD-2, manufactured by Evolution Computing Company. The assembled map data package, called COUNTYCAD, will work on other CAD programs, but requires adaptation to those programs. This data package will run on any IBM or compatible computer with a hard disk. It will load to a 286 computer in about 2 minutes; it requires about 20 seconds on a 486 computer. Depending on the size of the county, the hard disk space required is generally less than 3 MB for all the components of COUNTYCAD. Larger area and distance calculations will require that the computer have a math co-processor. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, Idaho 83843).



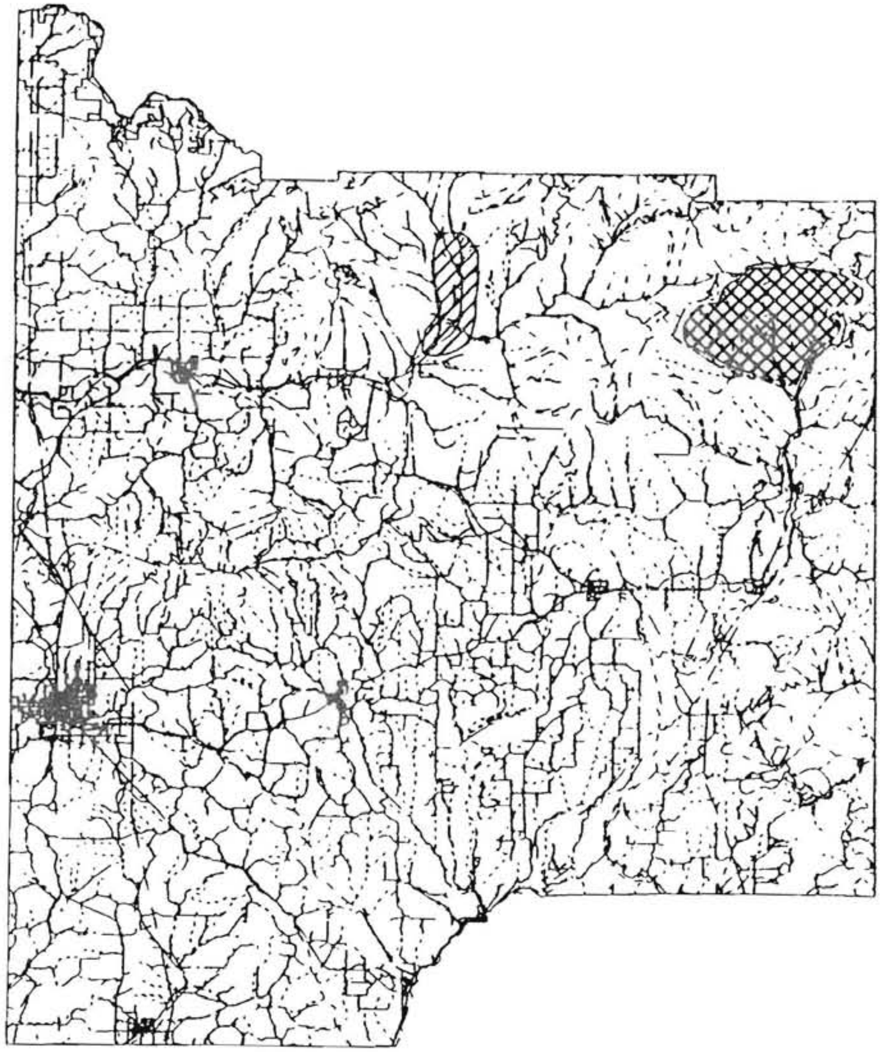
Laser Printer Output of COUNTYCAD
MOSCOW
Canada Thistle
1 = 1000 ft.

Fig. 2

Fig. 1. Example of COUNTYCAD:

Latah County, Idaho

- Neighborhood roads & unimproved roads
- Highways
- Intermittent water
- Perennial streams and water bodies
- Railroad
- Unclassified roads
- Non-visible boundaries
- Jeep trails
- Connecting roads & county roads
- Ridge and fence lines
- Power transmission lines, ski lifts & pipelines
- Land marks
- Special roads
- Hypothetical weed infestation
- Hypothetical weed infestation



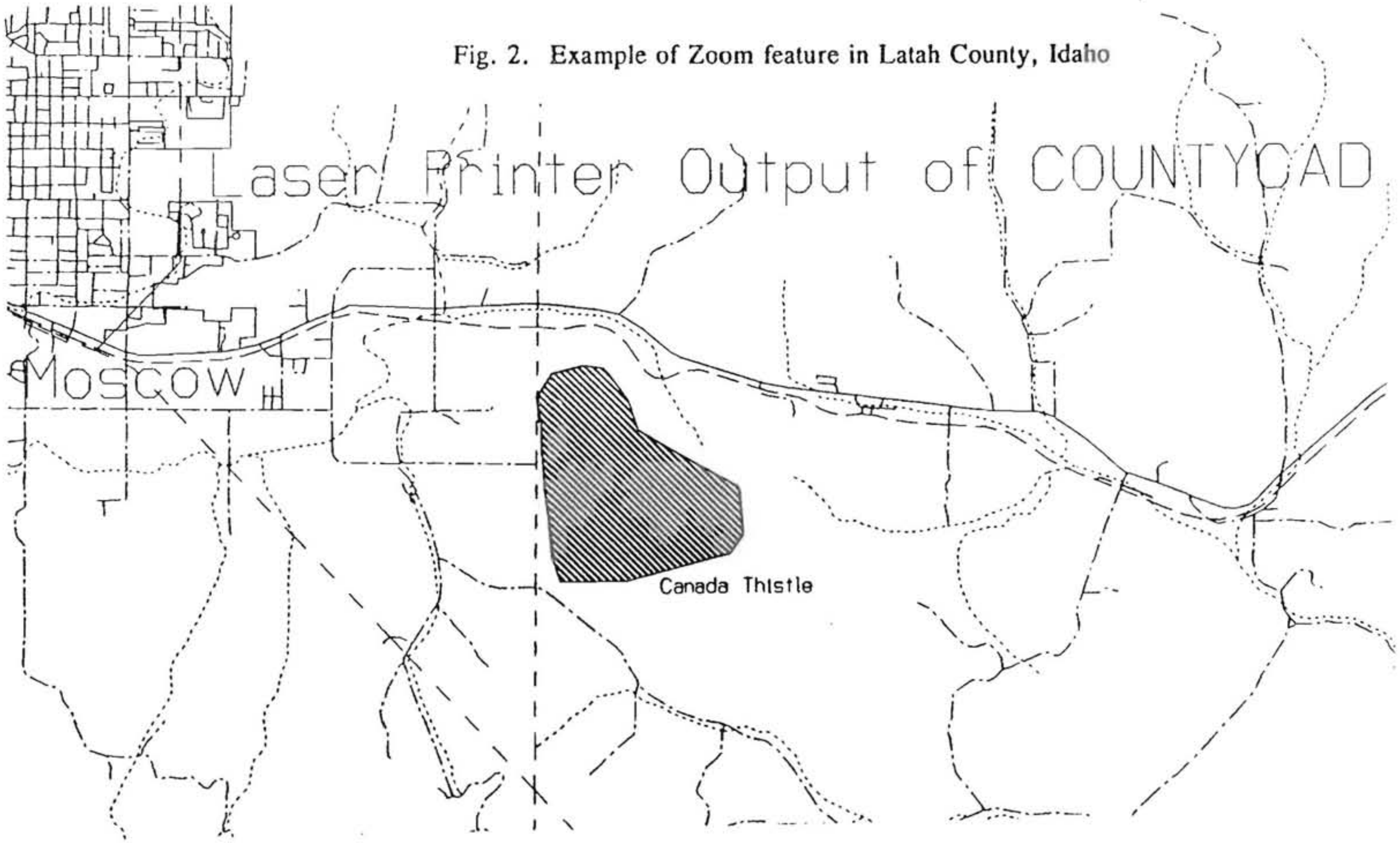


Fig. 2. Example of Zoom feature in Latah County, Idaho

Weed identification for county extension and weed control programs in Idaho. Callihan, R.H., R.R. Old and S. 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 weed identification program at the University of Idaho provides data useful in documenting changes in the Idaho weed flora, which includes: (1) identifying weed species present in Idaho, (2) determining distribution of weeds, (3) recording weed dispersal into new areas, (4) detecting new alien weeds, (5) recognizing the season(s) that particular weed identification problems arise, (6) identifying education deficiencies to assist in planning programs for extension and regulatory personnel on weed identification, and (7) an available historical data base. This report also serves the important function of advising research, extension, and regulatory personnel in other states of weed distributions in Idaho that may significantly affect those states.

One hundred seventy-four specimens submitted for identification or verification in the reporting period November 31, 1991 to November 1, 1992 are listed below. These data are from identification requests submitted to weed identification personnel by county extension agents and county weed superintendents. 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, Moscow, Idaho, 83843).

Identification	County	Date
Acer negundo, Aceraceae	Ada	04/13/92
Aegilops cylindrica, Poaceae	Caribou	05/04/92
Agoseris glauca, Asteraceae	Lewis	08/04/92
Agrostis scabra, Poaceae	Bonner	04/03/92
Althaea rosea, Malvaceae	Minidoka	06/03/92
Amaranthus albus, Amaranthaceae	Twin Falls	01/27/92
Amaranthus hybridus, Amaranthaceae	Oneida	08/26/92
Ambrosia artmesiifolia, Asteraceae	Washington	06/24/92
Ambrosia tomentosa, Asteraceae	Blaine	06/26/92
Amsinckia intermedia, Boraginaceae	Bonner	08/04/92
Anchusa arvensis, Boraginaceae	Latah	06/11/92
Arnica sororia, Asteraceae	Latah	06/09/92
Arrhenatherum elatius, Poaceae	Idaho	10/12/92
Artemisia biennis, Asteraceae	Boundary	06/09/92
Artemisia ludoviciana, Asteraceae	Kootenai	06/19/92
Asperugo procumbens, Boraginaceae	Gem	04/20/92
Bidens frondosa, Asteraceae	Gooding	08/18/92
Brassica campetris, Brassicaceae	Ada	03/18/92
Brassica kaber, Brassicaceae	Minidoka	05/21/92
Brassica napus, Brassicaceae	Bonneville	08/26/92
Brassica nigra, Brassicaceae	Bonner	08/04/92
Brassica rapa, Brassicaceae	Bonneville	08/17/92
Brassica rapa, Brassicaceae	Bonneville	08/26/92
Bromus carinatus, Poaceae	Lewis	04/17/92
Bromus carinatus, Poaceae	Nez Perce	09/24/92
Bromus mollis, Poaceae	Bonner	12/03/91
Bromus tectorum, Poaceae	Caribou	06/01/92
Bromus tectorum, Poaceae	Idaho	10/28/92
Bryonia alba, Cucurbitaceae	Fremont	06/11/92
Bryonia alba, Cucurbitaceae	Franklin	07/01/92
Bryonia alba, Curcurbitaceae	Minidoka	08/24/92
Campanula rapunculoides, Campanulaceae	Bonneville	05/22/92
Campanula rapunculoides, Campanulaceae	Canyon	05/13/92
Campanula rapunculoides, Campanulaceae	Twin Falls	08/03/92
Cardamine oligosperma, Brassicaceae	Ada	02/03/92
Cardaria draba, Brassicaceae	Ada	03/18/92

Cardaria draba, Brassicaceae	Twin Falls	03/18/92
Centaurea pratensis, Asteraceae	Bonner	05/21/92
Ceratophyllum demersum, Ceratophyllaceae	Ada	06/19/92
Cirsium canescens, Asteraceae	Canyon	07/01/92
Cleome serrulata, Capparidaceae	Bonneville	08/26/92
Collomia grandiflora, Polemoniaceae	Idaho	06/04/92
Conyza canadensis, Asteraceae	Clearwater	08/21/92
Conyza canadensis, Asteraceae	Lewis	08/28/92
Corydalis aurea, Fumariaceae	Boundary	04/13/92
Crateagus carrierei, Rosaceae	Ada	01/27/92
Cynoglossum officinale, Boraginaceae	Caribou	04/27/92
Cytisus scoparius, Fabaceae	Bonner	04/03/92
Delphinium glaucum, Ranunculaceae	Clark	08/24/92
Descurainia sophia, Brassicaceae	Ada	04/13/92
Disporum trachycarpum, Liliaceae	Custer	09/24/92
Distichlis stricta, Poaceae	Minidoka	05/21/92
Echium vulgare, Boraginaceae	Latah	06/09/92
Elodea canadensis, Hydrocharitaceae	Valley	09/24/92
Epilobium augustifolium, Onagraceae	Caribou	07/24/92
Epilobium paniculatum, Onagraceae	Idaho	04/13/92
Epilobium paniculatum, Onagraceae	Valley	08/26/92
Equisetum arvense, Equisetaceae	Clearwater	05/27/92
Equisetum arvense, Equisetaceae	Caribou	06/01/92
Erigeron strigosus, Asteraceae	Valley	08/06/92
Eriophyllum lanatum, Asteraceae	Canyon	05/13/92
Euphorbia myrsinites, Euphorbiaceae	Canyon	05/26/92
Euphorbia myrsinites, Euphorbiaceae	Canyon	07/14/92
Festuca arundinacea, Poaceae	Canyon	06/01/92
Festuca arundinacea, Poaceae	Nez Perce	06/10/92
Festuca idahoensis, Poaceae	Latah	08/07/92
Galeopsis tetrahit, Lamiaceae	Benewah	05/04/92
Gaura coccinea, Onagraceae	Twin Falls	07/23/92
Glechoma hederaceae, Lamiaceae	Caribou	09/15/92
Hesperis matronalis, Brassicaceae	Idaho	05/21/92
Hieracium aurantiacum, Asteraceae	Idaho	08/24/92
Hieracium canadense, Asteraceae	Bonner	04/16/92
Holosteum umbellatum, Caryophyllaceae	Canyon	04/29/92
Hordeum leporinum, Poaceae	Canyon	06/01/92
Hordeum leporinum, Poaceae	Nez Perce	07/23/92
Hypericum perforatum, Clusiaceae	Nez Perce	08/10/92
Juncus bufonius, Juncaceae	Bonneville	08/24/92
Knautia arvensis, Dipsacaceae	Custer	03/08/92
Kochia scoparia, Chenopodiaceae	Lewis	08/28/92
Lactuca muralis, Asteraceae	Bonner	10/12/92
Lactuca pulchella, Asteraceae	Caribou	07/23/92
Lamium amplexicaule, Lamiaceae	Ada	04/03/92
Lappula redowskii, Boraginaceae	Cassia	07/01/92
Lappula redowskii, Boraginaceae	Butte	04/27/92
Lappula redowskii, Boraginaceae	Custer	04/27/92
Lepidium latifolium, Brassicaceae	Owyhee	01/16/92
Linaria dalmatica, Scrophulariaceae	Payette	03/31/92
Linaria dalmatica, Scrophulariaceae	Caribou	06/01/92
Linaria vulgaris, Scrophulariaceae	Custer	03/08/92
Linaria vulgaris, Scrophulariaceae	Kootenai	06/19/92
Linaria vulgaris, Scrophulariaceae	Caribou	07/14/92
Lithospermum ruderale, Boraginaceae	Idaho	04/29/92
Lolium multiflorum, Poaceae	Owyhee	07/02/92
Lolium perenne, Poaceae	Twin Falls	05/28/92
Lotus corniculatus, Fabaceae	Ada	07/16/92
Lotus corniculatus, Fabaceae	Valley	08/07/92
Lycium halimifolium, Solanaceae	Butte	06/26/92
Lythrum salicaria, Lythraceae	Twin Falls	07/23/92
Machaeranthera canescens, Asteraceae	Washington	09/22/92
Mentzelia albicaulis, Loasaceae	Butte	08/24/92
Mentzelia laevicaulis, Loasaceae	Twin Falls	06/11/92
Microseris nigrescens, Asteraceae	Benewah	07/01/92
Montia perfoliata, Portulacaceae	Ada	06/11/92
Myriophyllum spicatum, Haloragaceae	Ada	06/15/92
Myriophyllum spicatum, Haloragaceae	Ada	08/04/92
Navarretia squarrosa, Polemoniaceae	Latah	07/23/92
Oenothera strigosa, Onagraceae	Bonner	07/01/92

Oenothera strigosa, Onagraceae	Bonner	07/01/92
Oenothera strigosa, Onagraceae	Bonneville	07/06/92
Origanum vulgare, Lamiaceae	Lewis	10/12/92
Ornithogalum umbellatum, Liliaceae	Gem	04/20/92
Osmorhiza occidentalis, Apiaceae	Bear Lake	06/11/92
Oxalis dillenii, Oxalidaceae	Gem	04/20/92
Penstemon palmeri, Scrophulariaceae	Ada	02/17/92
Penstemon palmeri, Scrophulariaceae	Twin Falls	06/19/92
Phacelia linearis, Hydrophyllaceae	Lewis	05/21/92
Plantago lanceolata, Plantaginaceae	Idaho	04/27/92
Plantago lanceolata, Plantaginaceae	Twin Falls	05/21/92
Poa bulbosa, Poaceae	Canyon	02/28/92
Polygonum cuspidatum, Polygonaceae	Fremont	05/19/92
Polygonum cuspidatum, Polygonaceae	Benewah	06/03/92
Polygonum cuspidatum, Polygonaceae	Ada	10/12/92
Polygonum cuspidatum, Polygonaceae	Bannock	10/12/92
Polygonum persicaria, Polygonaceae	Idaho	08/24/92
Polypogon monspeliensis, Poaceae	Owyhee	07/02/92
Potamogeton crispus, Potamogetonaceae	Washington	05/15/92
Potamogeton illinoiensis, Potamogetonaceae	Latah	05/21/92
Potentilla recta, Rosaceae	Shoshone	06/19/92
Proboscidea louisianica, Martyniaceae	Franklin	08/10/92
Prunella vulgaris, Lamiaceae	Latah	06/09/92
Prunus virginiana, Rosaceae	Ada	08/04/92
Quercus robur, Fagaceae	Ada	07/06/92
Ranunculus testiculatus, Rananculaceae	Canyon	03/05/92
Ranunculus testiculatus, Ranunculaceae	Lewis	04/09/92
Ranunculus testiculatus, Ranunculaceae	Camas	04/20/92
Ranunculus testiculatus, Ranunculaceae	Teton	05/20/92
Rhamnus frangula, Rhamnaceae	Ada	08/04/92
Rhinanthus crista-galli, Fabaceae	Kootenai	06/09/92
Robinia viscosa, Fabaceae	Ada	07/01/92
Rubus ursinus, Roasceae	Bannock	10/30/92
Rumex acetosella, Polygonaceae	Bonner	01/27/92
Rumex acetosella, Polygonaceae	Twin Falls	07/23/92
Rumex venosus, Polygonaceae	Payette	03/26/92
Sagina procumbens, Caryophyllaceae	Boundary	09/24/92
Secale cereale, Poaceae	Nez Perce	08/26/92
Senecio debilis, Asteraceae	Oneida	06/15/92
Senecio serra, Asteraceae	Kootenai	05/01/92
Senecio serra, Asteraceae	Benewah	06/19/92
Senecio serra, Asteraceae	Caribou	07/14/92
Setaria verticillata, Poaceae	Nez Perce	02/20/92
Setaria viridis, Poaceae	Butte	03/10/92
Silene noctiflora, Caryophyllaceae	Kootenai	06/09/92
Silene noctiflora, Caryophyllaceae	Kootenai	06/15/92
Sisymbrium altissimum, Brassicaceae	Ada	04/13/92
Sisymbrium officinale, Brassicaceae	Idaho	04/27/92
Sium suave, Apiaceae	Gem	07/23/92
Skimmia japonica, Rutaceae	Canyon	08/26/92
Solanum dulcamara, Solanaceae	Ada	04/03/92
Solanum dulcamara, Solanaceae	Oneida	08/04/92
Solanum rostratum, Solanaceae	Nez Perce	06/05/92
Solanum rostratum, Solanaceae	Idaho	07/22/92
Solidago occidentalis, Asteraceae	Ada	08/24/92
Spergularia rubra, Caryophyllaceae	Latah	03/26/92
Spergularia rubra, Caryophyllaceae	Kootenai	06/11/92
Thelypodium integrifolium, Brassicaceae	Idaho	06/04/92
Thermopsis montana, Fabaceae	Lewis	06/01/92
Toxicodendron radicans, Anacardiaceae	Kootenai	06/09/92
Trichostema oblongum, Lamiaceae	Ada	08/07/92
Verbascum blattaria, Scrophulariaceae	Bingham	10/28/92
Veronica anagallis-aquatica, Scrophulariaceae	Owyhee	07/01/92
Veronica peregrina, Scrophulariaceae	Nez Perce	07/01/92
Viola renifolia, Violaceae	Bingham	08/24/92
Zannichellia palustris, Zannchelliaceae	Cassia	09/29/92

Twenty-three specimens that were identified only to genus, and over 100 specimens submitted from other sources, are not included in this list.

Learning style preferences: Can we achieve collaborative action between regulators, public, and agriculture? William, R. D. Agriculturists often assume that people will share similar interpretations if the same data were analyzed. Thus, farmers and consumers would agree about food safety, for example, if risk/benefit data for pesticide residues were presented factually. Research involving learning and behavioral style preferences suggest that this assumption is false. In fact, learning theory suggests that preferences influence worldviews and actions. Thus, people sharing similar learning preferences select similar jobs or actions and communicate comfortably using similar logic and language.

Farmers, agricultural supply, and Extension faculty often share common learning approaches, but they differ from basic researchers, environmental leaders, trustees, politicians, etc. Data about learning style preferences and actions of individuals and groups will be presented. Then we will explore whether regulators also share similar learning preferences, worldviews, and actions among themselves. Then, we'll invent actions that suggest status quo or some new approach involving collaborative problem-solving. You are invited to participate and see where group imagination and creativity leads us with respect to Extension, education, and regulatory issues. (Horticulture Dept., Oregon State Univ., Corvallis, OR 97331).

PROJECT V

WEEDS OF AQUATIC, INDUSTRIAL AND NON-CROP AREAS

Ron P. Crockett - Project Chairperson
Scott M. Stenquist - Project Chairperson-Elect

<u>Saltcedar control with imazapyr.</u> Duncan, K. W. Saltcedar is an introduced phreatophyte which occupies millions of hectares of riparian areas throughout the southwestern United States. Saltcedar's ability to not only colonize riparian areas rapidly but also to change its environment by salt exudation often results in monoculture stands of the exotic phreathophyte.

Saltcedar growing in two 5.26 ha dry lakes near Artesia, New Mexico, were aerially sprayed with a fixed-winged aircraft on August 8, 1989. Imazapyr (Arsenal) was applied at 1.1 kg ai/ha in a total volume of 65.4 l/ha with 0.25% v/v of Activator surfactant and 0.25% v/v Nalcotrol. The two dry lakes are approximately 30 m apart and were permanent spring-fed lakes prior to invasion of the saltcedar.

On August 15, 1989, a 5.7 cm diameter hole was hand augered into the bottom of one of the two lakes. The hole was bored to a depth of 5.8 m and a 6.1 m joint of 5.1 cm pvc pipe inserted into the hole. A removable cap was placed over the end of the pipe to prevent moisture or debris from entering the hole from above ground. A soil sample was removed from the bottom of the hole and percentage soil moisture content determined gravimetrically. Soil samples were taken and soil moisture determined at approximately 60 day intervals for 12 months (A report of the soil moisture data was included in the 1991 Research Progress Report of the Western Society of Weed Science, Seattle, Washington.)

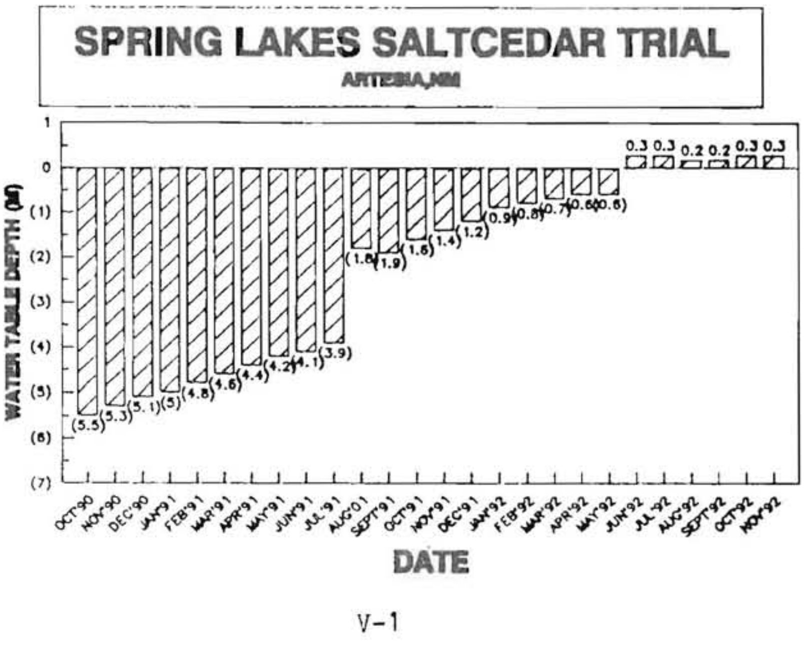
An attempt was made to collect soil samples in October, 1990, 14 months after application. However, the water table had risen to a point where water occupied the bottom 0.9 m of the hole. Since that date, the depth to the water table has been measured at 30 day intervals.

A graph of the data indicates that the water table at the project site rose approximately 0.2 m each month from October, 1990 to July, 1991. From July to August, 1991, the water table rose 2.1 m. The water table dropped slightly from August to September, then rose 0.3 m from September to October and continued to rise approximately 0.1-0.3 m each month until May, 1992, when water was 0.6 m below the soil surface.

During the last two weeks of May, 7.9 cm rainfall was received on the area. In June, 0.3 m water was recorded on the surface of Spring Lakes for the first time since 1969. The water level declined slightly during August and September but deepened to 0.3 m again in October and November, 1992.

The graph indicates the water table at Spring Lakes has risen from a depth of greater than 5.5 m below the soil surface to the surface within 34 months after application. Measurements of the water table will continue.

Saltcedar canopy reduction and mortality was estimated on September 28, 1992, to be 99% and 95.1% respectively. (Coop. Ext. Serv., New Mexico State Univ., Artesia, NM 88210).



Control of purple lythrum at Laurel, MT. Zamora, D.L. Purple lythrum (*Lythrum salicaria*) has only recently been discovered in Montana. Minimal surveys have identified less than 200 acres of infested sites. Feral populations have been found along the Missouri River, in managed wetlands, and along irrigation canals. Cultivated populations can be found in numerous towns in Montana. An experiment to examine the effect of several herbicides on purple lythrum control was started in 1992.

The experiment was a randomized complete block design with three replications. Plot size was 7 by 20 ft. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 22 gpa at 42 psi through 8002 flat fan nozzles. Treatments were applied at the mid-flower stage of growth on 8/5/92. Percentage control (necrosis, chlorosis, and height) was visually evaluated on 9/22/92. Seeds were collected on 9/27/92 from randomly chosen plants to determine their ability to germinate. (Tests were not completed in time for this report).

There were no differences in control among treatments. (Plant and Soil Science Department, Montana State University, Bozeman, MT 59717).

Control of purple lythrum with herbicides near Laurel, MT.

Herbicide[1]	Rate	Control
	(lbs ai/a)	(%)
Glyphosate	2.0	63
Glyphosate	4.0	87
Triclopyr	3.0	83
Triclopyr	6.0	87
2,4-D amine	1.9	80
2,4-D amine	3.8	77
Check		-
PR > F		0.10
LSD (0.05)		16

[1] All treatments included a nonionic surfactant at 0.5% v/v.

PROJECT VI

BASIC SCIENCES: ECOLOGY, BIOLOGY, PHYSIOLOGY, GENETICS, AND CHEMSTRY

William E. Dyer - Project Chairperson
William McCloskey - Project Chairperson-Elect

Growth characteristics of winter annual grasses in winter wheat. R. L. Anderson. Winter annual grasses such as downy brome, jointed goatgrass, and volunteer rye are difficult-to-control weeds infesting winter wheat in the Western U.S. Lack of effective in-crop herbicides has stimulated research in exploring cultural practices to reduce the impact of these grasses on winter wheat production. Knowledge of the growth characteristics of these species will aid in developing effective cultural control practices. This study was conducted to characterize the growth and development of downy brome, jointed goatgrass, and volunteer rye in a winter wheat canopy.

'Tam 107' winter wheat was planted at 50 kg/ha in 30-cm rows on Sep. 16, 1991. Downy brome, jointed goatgrass, and volunteer rye were planted in peat pellets and incubated in a greenhouse until the seedlings emerged. Seedlings of each species were then transplanted equidistant between winter wheat rows and 30 cm apart. For a replication, eight seedlings of each species were randomized within a plot size of 2 by 2 m. There were 6 replications. Four plants of each species were marked in each replication, and the developmental stage (based on the Zakoks-Chang-Konzak scale) and height of the tallest tiller were recorded on a weekly basis between April 1 and anthesis (May 21). Two plants from each site were harvested 1 to 2 weeks before maturity to avoid seed shattering. Height of tallest and shortest tiller, tillers, biomass, and seed production/plant were recorded.

Development

Jointed goatgrass and volunteer rye developed similarly to Tam 107, however, downy brome reached heading 8 days and anthesis 11 days before Tam 107 (Table 1). The species also varied in height development. Volunteer rye grew taller than Tam 107, being over 20 cm taller by anthesis on May 21 (Figure 1). Downy brome and jointed goatgrass were shorter than Tam 107 throughout the spring, and were approximately 20 cm shorter on May 21.

Table 1. Comparison of downy brome, volunteer rye, and jointed goatgrass development with winter wheat 'Tam 107'.

	Growth stage		
Species	Jointing	Heading	Anthesis
	-----(days before winter wheat)-----		
Downy brome	0	8	11
Jointed goatgrass	0	0	0
Volunteer rye	0	1	1
LSD (0.05)	NS	2	2

Some producers cut their infested winter wheat for forage to reduce weed seed production. To ensure that seed from cut plants do not develop viability, mowing should occur before anthesis. Producers could use Tam 107 (or a similarly maturing variety) as a guide for timing mowing operations in fields infested with volunteer rye and jointed goatgrass, but if downy brome infests the crop, producers should time the mowing based on downy brome's growth stage. A second growth characteristic influencing mowing effectiveness for weed control is plant height. Because of its height, volunteer rye could be effectively controlled by mowing. However, mowing would be less effective on downy brome and jointed goatgrass because at harvest, the height of the lowest tiller was 25, 15, and 10 cm for volunteer rye, downy brome, and jointed goatgrass, respectively. Some of the shorter tillers of downy brome and jointed goatgrass may escape the mowing operation and produce seed.

Productivity

On an individual plant basis, volunteer rye produced 15 and 6 times the biomass of downy brome and jointed goatgrass, respectively (Table 2). These data suggests that the threshold population level for yield loss would be lower for volunteer rye than the other two species, as the larger plant would consume more growth factors such as water and nutrients. However, seed production per plant did not reflect biomass production. Downy brome produced 1050 seeds per plant, volunteer rye 768 seeds/plant, and jointed goatgrass 217 spikelets per plant. For each g of plant biomass,

Table 2. Productivity of downy brome, volunteer rye, and jointed goatgrass at maturity.

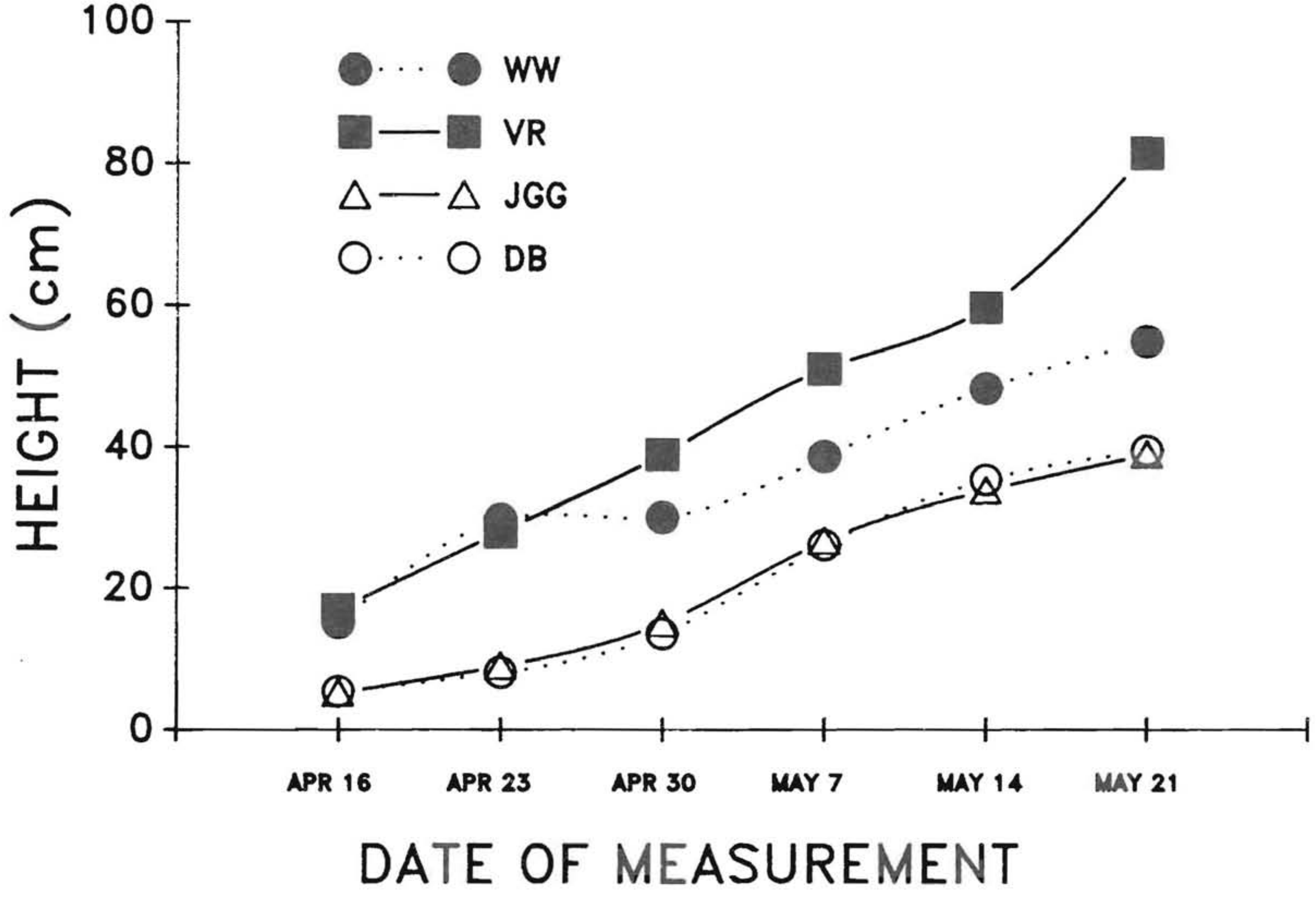
Species	Biomass	Tillers	Seed yield	Reprod. Ratio#
	(g/plant)	--(no./plant)---		(%)
Downy brome	4.2	7.0	1050	58
Jointed goatgrass	9.3	21.0	217*	47
Volunteer rye	60.4	30.7	768	38
LSD (0.05)	8.0	7.9	330	6

#Reproductive ratio is the dry weight of the inflorescent unit divided by the dry weight of the entire plant.

*Seed yield for jointed goatgrass represents number of spikelets/plant (the dispersal unit for this species).

downy brome produced 250 seeds, while volunteer rye produced only 13 seeds/g of plant biomass. This seed to plant size characteristic of downy brome also was shown in the reproductive ratio, where 58% of the mature plant was invested in the reproductive structure of downy brome, but only 38% of volunteer rye's biomass was invested in reproduction by maturity. The seed production per plant data demonstrates that isolated plants of any of the above species will contribute significantly to the soil seedbank. (USDA-ARS, P.O. Box 400, Akron, CO 80720).

FIGURE 1. PLANT HEIGHT AT WEEKLY INTERVALS



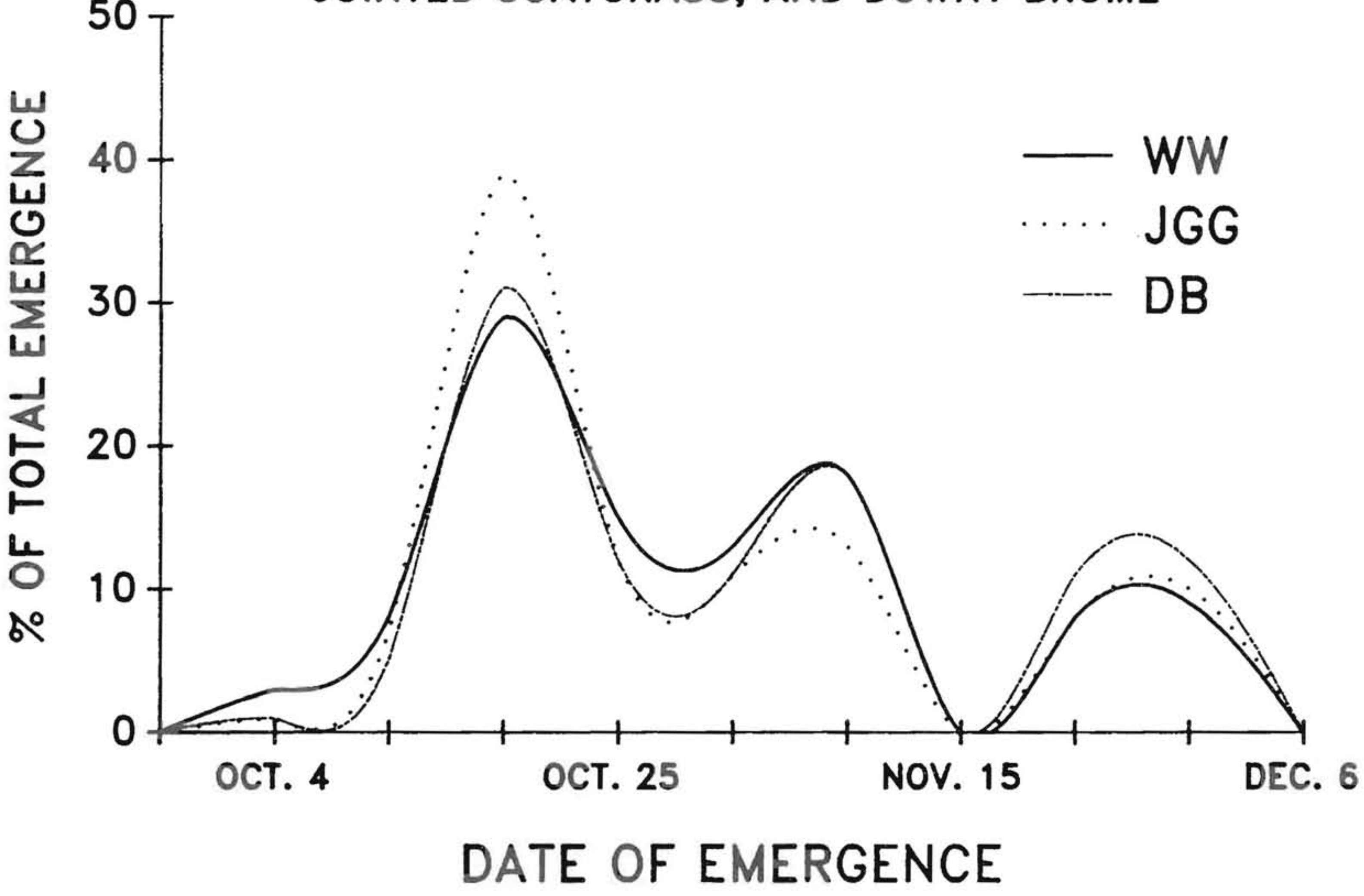
Emergence patterns of volunteer wheat, jointed goatgrass and downy brome. R. L. Anderson and D. C. Nielsen. Jointed goatgrass and downy brome are difficult-to-control weeds that infest winter wheat in the Western U.S. Since herbicide options for within-crop weed control are limited, producers are using alternative cropping rotations to reduce the weed seed bank in soil before planting the next winter wheat crop. Researchers at the Central Great Plains Research Station have explored crop canopy impact on seed bank dynamics, using volunteer wheat as the indicator species. This study was conducted to compare the emergence pattern of jointed goatgrass and downy brome with volunteer wheat. If the species have similar emergence patterns, then concepts developed with volunteer wheat could be used to guide future research with jointed goatgrass and downy brome.

This study was located at Akron, CO, where the 85-yr average precipitation and air temperature for Sep., Oct, and Nov. are 3.1, 2.1, and 1.4 cm, and 16.8, 10.2, and 2.6 C, respectively. Jointed goatgrass at 200 cylinders/m^2 and downy brome at 200 seeds/m^2 were planted 1 to 3 cm deep in 72 1-m^2 sites on August 22, 1990. Volunteer wheat was present in the soil seed bank, as the study was established in winter wheat stubble. Plots were maintained in a no-till system, with weeds present on August 22 being controlled with paraquat at 0.6 kg/ha. The soil was a Rago silt loam. Seedlings were counted weekly between August 29 and Dec. 1. After counting, seedlings were removed from the plot area. Precipitation between Sep 1. and Dec. 1 was 96% of normal, with precipitation events greater than 0.25 cm occurring every 7 to 10 days from Sep 17 until Dec. 1.

Emergence of the three species began approximately 15 days after the first rainfall on Sep. 17, and continued for approximately 65 days until Dec. 6 (See Figure). The emergence pattern was similar among the three species. Emergence peaks for all species occurred on Oct. 18, Nov. 8, and Nov. 29. Total number of emerged seedlings were 184, 42, and 38 seedlings/m^2 for volunteer wheat, jointed goatgrass, and downy brome, respectively.

The similarity in emergence among the species suggests that cultural practices reducing the seed bank of volunteer wheat may be applicable for jointed goatgrass and downy brome. For example, fall germination of volunteer wheat is greater in corn than in proso millet. Thus, summer-annual crop choice may affect the rate of seed bank decline of jointed goatgrass and downy brome. (USDA-ARS, P.O. Box 400, Akron, CO 80720).

FIGURE. EMERGENCE PATTERNS OF VOLUNTEER WHEAT, JOINTED GOATGRASS, AND DOWNY BROME



Assessment of herbicide residues in soil and water from larkspur control on high elevation watersheds. Evans, J.O., M.H. Ralphs and B. Bunderson. Larkspur is a one of the most serious poisonous plants infesting western rangelands. Proper use of herbicides can produce an internal rate of return of over 60% when considering the number of cattle saved from poisoning. This study was completed to evaluate the amount of herbicide residues found in surface water and in rangeland soils on watersheds exposed to larkspur control.

Herbicide treatments were applied June 26, 1990 at Oakley, ID, on a mountain big sagebrush vegetation site at 2270 m using a five-nozzle boom to create 2.5 m by 10 m plots, setup in a random block design with 3 replications. Runoff water and soil samples were collected from each plot. Runoff occurred with the spring snow melt and was collected at the bottom of each plot where it was funneled into collection barrels. Soil samples were removed from 0-2.5 cm, 2.5-7.5 cm, and 7.5-15 cm depths at random locations within each plot.

Picloram concentrations in runoff water ranged from 6.3 to 10 ppb and should not present a threat to nearby vegetation or other biological species. Metsulfuron methyl residues in runoff water were less than one part per billion and consequently present no impact to the ecosystem.

Picloram residues in the soil ranged from 57 to slightly more than 800 ppb. Herbicide concentrations decreased rapidly and consistently with increasing soil depth. Picloram appears to remain in the soil for several months after treatment but remains in the upper soil levels and is not likely to move with water through the soil profile. Metsulfuron binds tightly to soils and was observed almost exclusively in the top layer of soil. Metsulfuron residues in the soil were low and ranged from zero to 2.5 ppb. Metsulfuron does not present a threat to adjacent nontarget vegetation via surface water movement nor to deep percolation through the soil layers. It appears to bind tightly to soil colloids and is therefore less likely to migrate in surface-moving waters. (Utah Agricultural Experiment Station, USDA/ARS Poisonous Plants Laboratory, Logan, UT. 84322-4820)

Herbicide residues one year after application in surface water runoff and at three soil depths.

Treatment	Rate kg ai/ha	Runoff water	Soil depth (cm)		
			0-2.5	2.5-7.5	7.5-15
		ppb			
Metsulfuron	0.07	.04	1.6	.4	0
Metsulfuron	0.14	0	2.5	1.2	0
Picloram	1.1	6.3	363	173	57
Picloram	2.2	10	816	350	141

Influence of field dodder on tomato production. Lanini, W. Thomas and Gene Miyao. Field dodder parasitism has been increasing in processing tomatoes throughout California. The objective of research conducted in a grower's field near Davis was to examine the growth of dodder on tomatoes and the yield response of tomatoes.

Tomatoes were planted on April 1, 1992 (wheat in 1991) and the field was monitored for dodder emergence and attachment in a 75 ft by 150 ft area. Each attached dodder was marked and spread (length of row infested with dodder) measured. Tomatoes were hand harvested from dodder areas on August 5, with tomatoes being visually evaluated in terms of degree of dodder infestation at 1-ft intervals immediately prior to harvest. Visual evaluations were based on a combination of cover and density of cover.

A total of 125 dodder infestations were evaluated in the study area. Percent of the tomato row with dodder cover on the three measurement dates and visual estimates of dodder infestation at harvest were closely related (Table 1). Dodder continued to spread until near harvest, at which time more energy went into flowering and seed set.

Tomato yields were reduced by medium to very heavy dodder infestations (Table 2). These areas corresponded to areas with 50% or more cover during the time of tomato flowering. Tomatoes with light dodder infestations (less than 33% cover) during flowering did not suffer reductions in yield, even when dodder coverage was up to 60% by harvest. Total number of fruit was reduced by over 70% by very heavy dodder infestations, with lighter infestations being proportionally less influential on tomato number. The growth of heavily dodder-infested tomato plants was reduced by about 50%. (Botany Department, University of California, Davis, CA 95616).

Table 1. Dodder cover (%) on tomatoes relative to evaluation date and level of infestation at harvest.

Dodder infestation @ harvest	Measurement date[1] June 1	June 22	July 7	Relative biomass (visual eval.) August 7
	%			
very heavy	87.1	97.3	100.0	97
heavy	65.5	82.3	99.7	80
medium	51.3	76.8	99.4	58
medium light	32.9	45.1	60.0	38
light	0.0	3.7	43.9	20
none to light	2.6	4.6	14.7	4
LSD .05	23.6	21.6	19.0	5

[1] Tomatoes were in flower on June 1, fruit sizing and about 1 to 1.25 in. on June 22, and fruit beginning to color on July 7.

Table 2. Tomato yield relative to the level of dodder infestation

Dodder infestation	Yield (tons/acre) Reds	Greens	Rots	Plant weight[1] (tons/acre)	No. fruit per ft
very heavy	10.2	0.5	0.3	4.0	24.7
heavy	17.6	0.7	0.8	5.3	43.1
medium	32.7	1.4	0.9	7.7	77.2
medium light	41.7	1.5	1.6	8.4	100.8
light	42.5	2.3	1.2	14.6	98.7
none to light	41.6	3.3	0.7	9.2	95.4
LSD .05	6.5	1.0	0.6	4.3	17.0

[1] Plant weight includes tomato vines, leaves, and attached dodder.

Weed distribution changes in Kansas, 1992. Northam, F.E. and P.W. Stahlman. Weedy plants are characterized by their ability to disperse into areas where they were previously unknown. The phenomenon of invading plants is a continuing threat to human welfare, and can result in new weed infestations appearing several hundred miles from known populations. Several plant species were found in Ellis Co. Kansas in 1992 that were previously unknown or unreported in west-central Kansas. The citations below include the scientific nomenclature, Bayer computer code, common name, plant family, longevity, location of new occurrence, and comments for each species. Voucher specimens will be deposited in appropriate herbia.

Avena fatua L.; AVEFA; wild oat; Poaceae; annual; dozens of plants along US Hwy 183 right-of-way north of Hays; rare in west-central Kansas.

Elytrigia repens (L.) Nevski; AGRRE; quackgrass; Poaceae; rhizomatous perennial; found along roadside and in a grass waterway near Hays; fifth Kansas county to have a confirmed quackgrass infestation; this species is on the Kansas Noxious Weed List; also known as *Agropyron repens* (L.) Beauv

Eriochloa gracilis (Fourn.) A.S. Hitchc.; ERBGR; southwestern cupgrass; Poaceae; annual; found along farm roadsides and edges of cultivated fields; according to R.L. McGregor (botantist, Univ. of Kansas, Lawerence) this species not previously reported anywhere in Kansas; also known as *E. acuminata* (Presl.) Kunth var *acuminata*

Poa bulbosa L.; POABU; bulbous bluegrass; Poaceae; bulbous perennial; several hundred plants found in a vacant lot within the city limits of Hays; rare in north- and west-central Kansas.

The following sources were contacted to confirm the identification of one or more of the species and to determine if the species previously had been reported in the area: W.T. Scott, Kansas State Board of Agriculture, Topeka; T.M. Barkley, botanist and herbarium curator, Kansas State University, Manhattan; R.L. McGregor, botanist, University of Kansas, Lawrence; H.C. Reynolds (retired), botanist and former herbarium curator, Ft. Hays State University, Hays; D.M. Sutherland, University of Nebraska, Omaha; M.E. Barkworth, Utah State University, Logan. (Ft. Hays Branch, Kansas Agric. Exp. Sta., Hays, KS 67601).

PROJECT VII

ALTERNATIVE METHODS OF WEED CONTROL

Edward Schweizer - Project Chairperson
Dan Ball - Project Chairperson-Elect

Evaluating barley plant population and herbicide rate for broadleaf weed management. Downard, R. W. and D. W. Morishita. This study was conducted at the Kimberly Research and Extension Center. The purpose was to compare two barley varieties 'Moravian III' and 'AC-10'; each with different plant architectures, planted at different populations for their competitiveness against kochia (KCHSC). Barley was planted April 6 at 600,000, 1,000,000 and 1,400,000 seeds/A. Soil temperature at planting was 50 F and soil conditions were very dry. Treatments were arranged in a 2 by 2 by 2 factorial randomized complete block design with four replications. Plots were 5 by 30 feet. Herbicides were broadcast with a hand-held sprayer equipped with 11001 flat fan nozzles on 16-inch spacing. The sprayer was calibrated to deliver 10 gpa at 38 psi. Additional application data are presented in Table 1. Weed species and densities at application were kochia (KCHSC) at 25 plants/ft^2 common lambsquarters (CHEAL) at 1 plant/ft^2 and redroot pigweed (AMARE) at 4 plants/ft^2. Crop injury and weed control evaluations were taken June 10 and July 27. Grain was harvested July 27 with a small-plot combine.

Russian wheat aphid injured the crop in treated and untreated plots. Herbicide treatments did not injure the barley. Common lambsquarters and redroot pigweed control were excellent (data not shown). An interaction between seeding rate and herbicide treatment was seen in kochia control (Table 2). Differences were among the herbicide treatments at the lowest seeding rate and between the untreated and treated at the two higher seeding rates. Barley yield was affected by an interaction between variety and seeding rate, but this was only at the lowest seeding rate (Table 3). Overall as seeding rates increased yields increased. These data indicate that both barley varieties were not affected by kochia competition. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, Idaho 83303).

Table 1. Application data.

Application date	5/18
Air temperature (F)	83
Soil temperature (F)	70
Relative humidity (5)	39
Wind velocity (mph)	0 to 8

Table 2. Weed control as affected by seeding rate and herbicide treatment.

Treatment	Seeding rate	Rate	KCHSC control[1]	
			6/10	7/27
	(1,000 seeds/A)	(lb ai/A)	--------------- % -------------	
Check	600		0	0
Bromoxynil & MCPA[2] + thif. & trib.[3]	600	0.375 0.0104	0	65
Bromoxynil & MCPA[2] + thif. & trib.[3]	600	0.75 0.0208	88	84
Check	1,000		0	0
Bromoxynil & MCPA[2] + thif. & trib.[3]	1,000	0.375 0.0104	90	91
Bromoxynil & MCPA[2] + thif. & trib.[3]	1,000	0.75 0.0208	93	96
Check	1,400		0	0
Bromoxynil & MCPA[2] + thif. & trib.[3]	1,400	0.375 0.0104	93	93
Bromoxynil & MCPA[2] + thif. & trib.[3]	1,400	0.75 0.0208	96	96
LSD (0.05)			3	10

[1]Weed species evaluated was kochia (KCHSC).

[2]Surfactant added at 0.25% v/v.

[3]thif. & trib. = thifensulfuron & tribenuron

Table 3. Barley yield by variety and seeding rate.

Variety	Seeding rate	Yield
	(1,000 seeds/A)	(bu/A)
Moravain	600	56
AC-10	600	40
Moravain	1,000	61
AC-10	1,000	54
Moravain	1,400	79
AC-10	1,400	70
LSD (0.05)		10

Weed control in potatoes with green manure crops. Boydston, Rick. Previous work has cited the benefits of rapeseed and sudangrass green manure crops for nematode control in potatoes. This work was conducted to determine if green manure crops of rapeseed and sudangrass have any weed control benefits. Rapeseed (variety Jupiter) and sudangrass (variety Trudan 8) were planted in August of 1991 as green manure crops preceding Russet Burbank potatoes planted in April 1992. Rapeseed was seeded at 6 lb/a and sudangrass at 25 lb/a on a Hezel sand soil. Treatments included incorporation of green manure crops versus leaving the green manure crop on the soil surface followed by strip tilling prior to potato planting. A standard herbicide treatment of pendimethalin plus metribuzin (1 + 0.38 lb ai/a) was applied on May 6, 1992, to half of each main plot.

Rapeseed produced 2.5 T/a dry matter and controlled common lambsquarters, redroot pigweed, and barnyardgrass nearly equal to that of the standard herbicide treatment. Potato yields in plots that did not receive any herbicides were greater when rapeseed was grown as a green manure crop (32.3 T/a) than in fallow plots (28.6 T/a), or in plots with sudangrass as a green manure crop (25.2 T/a). Greatest potato yields (35.9 T/a) were in plots that included both herbicides and rapeseed.

Sudangrass seeded in August 1991 produced 1 T/a dry matter, did not control weeds in potatoes, and reduced potato yields. Potatoes following sudangrass were stunted early in the season, closed the rows later, and became as weedy as plots with no green manure crop. Potato yield in sudangrass plots was reduced by 12% in weed-free plots that had been treated with the standard herbicide treatment.

No significant effect on weed control was observed by incorporating the green manure crops versus leaving the residue on the soil surface and strip tilling before potato planting. These studies are the first citing the benefits of weed control in potatoes with a green manure crop of rapeseed. (U.S. Department of Agriculture, Agricultural Research Service, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350)

COVER CROPS FOR WEED SUPPRESSION AND YIELD ENHANCEMENT IN RED RASPBERRIES

Kaufman, D., R. Karow, A. Sheets, and R. William. The recent interest in farming with reduced chemical inputs has revived interest in the potential of cover crops for weed suppression. This is the second year of a study in which we have compared various cover crop species for adaptability, winter survival, biomass production, and weed suppression when planted between rows of red raspberries in a field in Sandy, Oregon. After observing no harmful effect on raspberry plants from the presence of the mowed cover through the summer (1990 data), the cooperating grower wished to evaluate the effect of various mowed cover crop species on red raspberry yield by recording and tabulating machine harvest yields through the summer.

Both aisles on each side of a berry row were seeded on September 25, 1991 with 1 of 7 cover crops in unreplicated demonstration plots. Cover crops evaluated were: 'Amity' winter oat; 'Flora' triticale; 'Wheeler' cereal rye; 'Galt' barley; Austrian winter pea; Crimson clover, the perennial grass 'Serra' hard fescue, and a native vegetation control. Topography, soil conditions, and predominant weed species were uniform throughout the entire test area. However, plots had previsouly (1990-91) been seeded to other cover crops (see Table 2). Plot size was 6,000 square feet (600 linear feet x 5 feet wide x 2 sides of the berry row). Plots were rototilled shallowly after broadcast seeding by hand. With the exception of 'Serra' hard fescue, which was slow to establish, all covers established well. The winter was unusually mild, resulting in luxuriant growth and good weed suppression in all of the covers (with the exception of the 'Serra' hard fescue which became weedy). Weeds present in the various covers were counted on April 15, 1992, prior to mowing (Table 1). Smartweed was the predominant weed species in the native cover control. However, it was suppressed effectively by all of the covers. Annual bluegrass was the major weed species in the crimson clover, 'Flora' triticale, and 'Galt' barley. Little bittercress was the major weed species in the 'Serra' hard fescue.

Machine harvest red raspberry yield data was compiled by the grower (Table 2). The highest yield was in the oats (91-92) following Austrian peas (90-91). All cover crops resulted in a minimum of 180 pounds more fruit per 600 foot long row than the native cover control, which consisted primarily of smartweed.

Encouraged by these results, we will evaluate several promising cover crops in red raspberries in a replicated trial this year. (Extension Service, Oregon State University, Aurora, OR 97002).

Table 1 - Number of weeds in the various covers, prior to mowing, at Sandy, Oregon, April 15, 1992*
Cover Crop Treatments**

WEED SPECIES	CRIMSON CLOVER	TRITICALE	'WHEELER' CEREAL RYE	'GALT' BARLEY	AUSTRIAN PEA	'AMITY' OAT	'SERRA' HARD FESCUE	CONTROL
Smartweed	19	12	5	11	0	4	31	327
Bittercress	6	3	2	1	20	8	159	12
Annual blue	76	76	7	~120	1	10	18	7
Mouse ear chickweed	5	10	1	1	0	1	1	4
Wild radish	0	1	0	0	0	4	2	0

*Cumulative total from 20 random 0.66 ft^2 samples in each cover crop plot (6,000 ft^2).
**Sow date: September 25, 1991

Table 2 Red Raspberry Yield by Cover Crop, 1992

COVER CROP[x]	TOTAL YIELD IN LBS OF FRUIT PER 600 FEET OF ROW	TOTAL YIELD IN LBS OF FRUIT PER 600 FEET OF ROW WHEN ADJUSTED FOR WEAK AND MISSING PLANTS
Crimson Clover following native cover control	823	874
'Flora' triticale following 'Galt' barley	838	872
'Wheeler' cereal rye following Amity' oat	786	836
'Galt' barley following Crimson clover	805	873
Austrian pea following 'Flora' triticale	786	836
'Amity' oat following Austrian pea	964	988
'Serra' hard fescue	782	825
Native cover control (mostly Smartweed)	609	625

[x]Sow date: September 25, 1991

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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.

Common Name or Designation	Chemical Name	Page
acifluorfen	5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoic acid	II-19
alachlor	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide	III-49,50,51, 52,53,54,55, 60,62,65
asulam	methyl sulfanilycarbamate	I-2
atrazine	6-chloro-N-ethyl-N'-(1-methyl-ethyl)-1,3,5-triazine-2,4-diamine	I-2,9,22,23, 99,103; III-49,50,65, 68,103,180
benefin	N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine	II-5
bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide	II-23;III-41, 111

Common Name or Designation	Chemical Name	Page
bromoxynil	3,5-dibromo-4-hydroxybenzonitrile	II-12;III-1, 5,14,19,24, 26,28,30,34, 35,56,58,68, 73,120,144 146,148,150, 155,160,165, 183,186,189, 192;VII-2
chlorsulfuron	2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] benzenesulfonamide	I-39,105; III-137,153, 155,173,178
CL-782	4-(2,4-dichlorophenoxy)butanoicl-67 acid	I-67
clethodim	(E,E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	III-24,90,96
clomazone	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone	III-143,163, 180
clopyralid	3,6-dichloro-2-pyridinecarboxylic acid	I-12,13,16, 18,20,31,41, 43,57,59,62, 64,65,99,102, 105,107; III-30,77, 82,116,122, 165

Common Name or Designation	Chemical Name	Page
cyanazine	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methyl-propanenitrile desmedipham ethyl[3-[[(phenylamino) carbonyl]oxy]phenyl]carbamate	III-62,65,68, 87,88,89, 98,107
cycloate	S-ethyl cyclohexylethylcarbamothioate	III-117,127
DCPA	dimethyl 2,3,5,6-tetrachloro-1, 4-benzenedicarboxylate	II-5
desmedipham	ethyl[3[[(phenyamino)carbonyl]oxy] phenyl]carbamate	III-116,117, 122,131,133, 135
dicamba	3,6-dichloro-2-methoxybenzoic acid	I-9,16,18,20, 22,29,32,39, 41,43,46,57, 59,64,65,70, 77,78,81,82, 90,95,103, 105;II-3; III-35,49, 50,58,73,146, 160,181,183
diclofop	(±)-2-[4-(2,4-dichlorophenoxy) phenoxy]propanoic acid	III-46,144,151, 155,165,169, 186,192
diethatyl ethyl	N-(chloroacetyl)-N-(2,6-diethylphenyl) glycine	III-117,127
difenzoquat	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	III-30,46, 151,165,169

Common Name or Designation	Chemical Name	Page
dimethenamid	not available	III-49,50, 51,52,53,54, 55
diuron	N'-(3,4-dichlorophenyl)-N,N-dimethylurea	III-103
DPX-66037	not available	III-67,116, 117,122,129
DPX-PE350	not available	III-88,89, 90,91
endothall	7-oxabicyclo[2.2.1]heptane-2, 3-dicarboxylic acid	III-116,131
EPTC	S-ethyl dipropylcarbamothioate	III-60,62, 68,92
ethalfluralin	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine	III-80,105, 109
ethametsul-furon	2[[[[[4-ethoxy-6-(methylamino)-1,3,5-triazin-2-yl]amino]carbonyl] amino]sulfonyl]benzoic acid	III-77,80,82
ethofumesate	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate	III-67,127, 131,133,135
fenoxaprop	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid	III-96,183
fluazifop	(±)2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid	III-75,90,96

Common Name or Designation	Chemical Name	Page
fluroxypyr	[(4-amino-3,5-dichloro-6-fluoro--pyridinyl)oxy]acetic acid	I-20,41,57,59
glyphosate	N-(phosphonomethyl) glycine	I-9,36,53,55, 63,67,70,81, 82,103; III-32,96, 100,153,181; V-2
hexazinone	3-cyclohexyl-6-(dimethylamino)-1- methyl-1,3,5-triazine-2,4 (1H,3H)-dione	III-17,22
imazameth-abenz	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-4(and 5)-methylbenzoic acid (3:2)	I-79;III-30, 46,120,151, 165,169,183,
imazapyr	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridine-carboxylic acid	I-2,63;V-1
imazaquin	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinolinecarboxylic acid	I-79,86
imazethapyr	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid	I-64,79,82, 83,86; II-19,23; III-1,5, 12,14,19,21, 23,24,26,28, 36,39,41,68, 98,105,107, 109

Common Name or Designation	Chemical Name	Page
isoxaben	N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxy-benzamide	II-2-3
lactofen	(±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoate	II-19;III-89, 111
linuron	N'-(3,4-dichlorophenyl)-N--methoxy-N-methylurea	II-8,10
MC68PA	(4-chloro-2-methylphenoxy) acetic acid	II-12
MCPA	(4-chloro-2-methylphenoxy) acetic acid	II-12;III-30, 34,35,109, 111,120,144, 146,155,160, 165,183;VII-2
MCPB	4-(4-chloro-2-methylphenoxy) butanoic acid	III-109,111
mecoprop	(±)-2-(4-chloro-2-methylphenoxy) propanoic acid	II-3
metham	methylcarbamodithioic acid	III-86
metolachlor	2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(2-methoxy-1-methyl-ethyl)acetamide	II-23;III-39, 41,48,49, 50,51,52,53, 54,55,62,109

Common Name or Designation	Chemical Name	Page
metribuzin	4-amino-6-(1,1-dimethylethyl)-3- (methylthio)-1,2,4-triazin-5 (4H)-one	III-7,14,17, 56,58,72,103, 105,107,111, 146,153,155, 176,178,183; VII-4
metsulfuron	2-[[[[(4-methoxy-6-methyl-1,3, 5-triazin-2-yl)amino]carbonyl] amino]sulfonyl]benzoic acid	I-7,13,16,18, 20,22,29,31, 39,43,46,51, 53,55,57,59, 63,64,65,67, 102,107; III-137,153, 155,178;VI-6
MON12000	not available	I-103
MON12037	not available	III-65
MON12041	not available	III-65
MON13200	not available	I-103;III-9,12
MON13203	not available	III-9,12,17,22
MON13211	not available	III-87
MON13256	not available	III-9
MON13280	not available	III-9,12,22,150
MSMA	monosodium acid methylarsonic acid	II-1;III-91
NA 307	not available	III-131,135
NA 308	not available	III-131,135

Common Name or Designation	Chemical Name	Page
napropamide	N,N-diethyl-2-(1-naphthalenyloxy)propanamide	II-20
nicosulfuron	2-[[[[(4,6-dimethoxy-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl]-N,N-dimethyl-3-pyridinecarboxamide	I-63,79,86; III-56,58, 60,62,64,65, 68,72,73,96, 113
oryzalin	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide	II-12
oxyfluorfen	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene	II-12,19; III-36,39, 89,103
paraquat	1,1'-dimethyl-4,4'bipyridinium ion	I-9;III-26, 28,60,62
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	I-23,26; II-10,23; III-12,36, 39,41,62,68, 80,98,105, 107,109,111, 157;VII-4
phenmedipham	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate	III-116,117, 122,131,133, 135

Common Name or Designation	Chemical Name	Page
picloram	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	I-13,16,18, 20,22,29,31, 39,41,43,46, 49,53,55,57, 59,63,64,65, 66,67,70,74, 75,77,78,79, 81,82,84,86, 88,89,90,92, 94,95,96,99, 102,103,105, 107;VI-6
primisulfuron	2-[[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl] amino]sulfonyl]benzoic acid	I-79;III-64, 96,113
prometryn	N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine	III-87-89
pronamide	3,5-dichloro(N-1,1-dimethyl-2-propynyl)benzamide	III-12
pyridate	O-(6-chloro-3-phenyl-4-pyridazinyl)-S-octyl carbamothiate	II-13;III-65
quinclorac	3,7-dichloro-8-quinoline-carboxylic acid	I-79,83,86, 88,95; III-32,98,181
quizalofop	(±)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid	III-77,96
rimsulfuron	not available	III-64,113
SAN 582H	not available	III-62-114

Common Name or Designation	Chemical Name	Page
sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	II-16;III-9, 17,60,62,75, 77,80,82,90, 125
simazine	6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine	II-20
sulfometuron	2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]benzoic acid	I-2,63,92
tebuthiuron	N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea	I-102
terbacil	5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione	III-103
thifensul-furon	3-[[[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino] carbonyl] amino]sulfonyl]-2-thiophene-carboxylic acid	III-30,34, 120,146,148, 150,165,169, 183,186,189, 192;VII-2
triallate	S-(2,3,3-trichloro-2-propenyl) bis(1-methylethyl)carbamothioate	III-80,144, 155,192
triasulfuron	2-(2-chloroethoxy)-N-[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzene-sulfonamide	III-137,155 165,176,183
tribenuron	2-[[[[(4-methoxy-6-methy-1,3,5-triazin-2-yl)methylamino] carbony]amino]sulfonyl] benzoic acid	III-30,34, 120,146,148, 150,160,165, 169,183,186, 189,192;VII-2

Common Name or Designation	Chemical Name	Page
triclopyr	[(3,5,6-trichloro-2-pyridinyl) oxy]acetic acid	I-41,46,62, 65,70,102; II-2,3;V-2
trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine	II-10,17; III-3,7,9, 12,14,45,80, 87,109,157
2,4-D	(2,4-dichlorophenoxy)acetic acid	I-12,13,16, 18,20,22,23, 29,31,41,43, 46,49,51,57, 59,63,64,65, 67,74,75,77, 78,81,82,84, 86,88,89,90, 92,95,96,103, 105,107;II-3; III-30,32,34,35, 56,58,73,120, 146,160,165, 183;V-2
2,4-DB	4-(2,4-dichlorophenoxy)butanic acid	III-1,14,19,21, 24,26,
UBI-C4243	not available	I-103; III-111,155
UCC-C4243	not available	III-98,144, 146,148,186, 189,192
V-53482	7-flouro-6-[(3,4,5,6-tetrahydro) phthalimido]-4-(2-propynyl)-1,4-benzoxazin-3(2H)-one	I-70

Common Name or Designation	Chemical Name	Page
V-54382	not available	I-79
XRM-5255	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	I-70

ABBREVIATIONS USED IN 1992 REPORT

@ . . . . at
A, a, or ac . . . . acre(s)
ae/a(c) . . . . acid equivalent per acre
ae . . . . acid equivalent
ae/ha . . . . acid equivalent per hectare
Agric. . . . . Agricultural
ai or a.i. . . . . active ingredient
ai/a . . . . active ingredient per acre
ALS . . . . acetolactate synthase
AM . . . . apparent mortality
AM . . . . ante meridian
AMARE . . . . redroot pigweed, *Amaranthus retroflexus* L.
appl or applic. . . . . application
ARS . . . . Agricultural Research Service
ATV . . . . all-terrain vehicle
Aug . . . . August
AVEFA . . . . wild oats
avg . . . . average

blueg . . . . bluegrass
bu/a . . . . bushel per acre

C . . . . degree(s) Celsius
cc . . . . cubic centimeter
CEC . . . . cation exchange capacity
CHEAL . . . . common lambsquarters,*Chenopodium album* L.
chem . . . . chemical
CHEMU . . . . nettleleaf goosefoot
CIRAR . . . . Canada thistle (Cirsium arvense)
cm . . . . centimeter(s)
cm^3 . . . . cubic centimeters
CO . . . . Colorado
Co . . . . county
CO . . . . Colorado
CO_2 or CO2 . . . . carbon dioxide
COC . . . . crop oil concentrate
cont . . . . control
Coop. . . . . Cooperative
COPSQ . . . . creeping wartcress
Cotyl . . . . cotyledon
CR . . . . canopy reduction

CRP	Conservation Reserve Program
CV or cv	coefficient of variation
CYPRO	purple nutsedge
°	degree
DAP	days after planting
DAT	days after treatment
DBH	diameter at breast height
Den	density
Dept	department
DF	dry flowable
dia	diameter
dorm	dormancy
DS	dry soluble formulation
Dun	duncecap
EC	emulsifiable concentrate
ECHCO	junglerice
EP	early postemergence
EPA	Environmental Protection Agency
Ephr	Ephraim
EPOST	early postemergence
equip	equipment
ESP	early spring postemergence
ethamt	ethametsulfuron
Exp.	Experiment
Ext.	Extension
F	degrees Fahrenheit
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
flwr	flower
ft	foot or feet
ft^2 or sq ft	square feet
g/m^2	grams per square meter
g	gram or grams
g/ha	grams per hectare
G	granule
G/A, GPA or gpa	gallon(s) per acre
gal/A, gal/a, G/A	GPA or gpa gallon(s) per acre
gal	gallon(s)
>	greater than
h	hour

ha . . . . hectare
hr(s) . . . . hour(s)
Hycr . . . . Hycrest

ID . . . . Idaho
in or " . . . . inch(es)
Inter . . . . intermediate

Jan . . . . January
Jul . . . . July

K . . . . potassium
KCHSC . . . . *Kochia scoparia* (L.) Schrad.
Kent . . . . Kentucky
kg . . . . kilogram
kg ai/ha . . . . kilograms active ingredient per hectare
kg/ha . . . . kilogram(s) per hectare
kPa . . . . kilopascal

L/ha . . . . liters per hectare
l/ha . . . . liter(s) per hectare
L . . . . liter
lab . . . . laboratory
lb/a . . . . pound(s) per acre
lb . . . . pound(s)
lb ai/A, lb a.i./A
or lb ai/a . . . . pound(s) active ingredient per acre
LC . . . . liquid concentrate
lf . . . . leaf
LFP . . . . late fall postemergence
LP . . . . low pressure (nozzles)
LP . . . . low pressure
LPOST . . . . late post-emergence
LS . . . . liquid soluble formulation
LSD . . . . Least Significant Difference
LVE . . . . low volatile ester

m . . . . meter(s)
m^2 . . . . square meter
μM . . . . micromolar
MAFT . . . . months after first treatment
Mar . . . . March
MAT . . . . months after treatment
mCi . . . . microcurie

mE . . . . microeinsteins
meq/g . . . . millequivalents per gram
meq . . . . millequivalent
mg . . . . milligram
mg/L . . . . milligrams per liter
MIF . . . . modified in furrow
min . . . . minute
ml . . . . milliliter, microliter
mm . . . . millimeter
mM . . . . millimolar
mmol . . . . micromol
mo . . . . month(s)
mos . . . . months
MP . . . . mid postemergence
mph . . . . miles per hour
MT . . . . Montana

N . . . . nitrogen, north
N.D or ND . . . . North Dakota
NE . . . . northeast
NIRS . . . . near infrared spectroscopy
No./m^2 . . . . number per meter squared
No. or no. . . . . number
Nord . . . . Nordan
Nov . . . . November
NS . . . . non significant
NW . . . . northwest

Oatg . . . . Oatgrass
Oct . . . . October
OM . . . . organic matter
OR . . . . Oregon
Orch . . . . orchard
oz . . . . ounce(s)
oz/A . . . . ounce(s) per acre
oz ai/a . . . . ounces active ingredient per acre

p or % . . . . percent
P . . . . probability
P.S.& E.S. . . . . Plant, Soil, & Entomological Sciences
Paiu . . . . Paiute
PDIR . . . . post-directed
pH . . . . -log hydrogen ion concentration
PHYWR . . . . Wright groundcherry

picl . . . . picloram
pl, plt, plts . . . . plant(s)
PLS or pls . . . . pure live seed
plts/m2 . . . . plants per square meter
PM . . . . post meridian
PoPI . . . . post-plant incorporated
POROL . . . . common purslane
POST . . . . postemergence
PP . . . . preplant
PPI or ppi . . . . preplant incorporated
ppmw . . . . parts per million by weight
PR > F . . . . Probability of a greater F value
PRE . . . . preemergence
pre trt. . . . . pre-treatment
PREE . . . . preemergence
psi . . . . pounds per square inch
pt/A . . . . pints per acre
Pub, pubesc . . . . pubescent
pvc . . . . polyvinylchloride

qt/A . . . . quart(s) per acre
qt . . . . quart(s)

R . . . . resistant

7 d ltr . . . . 7 days later
s . . . . second/seconds
S . . . . south, susceptible
SE . . . . Southeast
seeds/A . . . . seeds per acre
Sep or Sept. . . . . September
Serv. . . . . Service
seth . . . . sethoxydim
SG . . . . soluble granules
Sib . . . . sibiricum
SOLSA . . . . hairy nightshade, *Solanum sarrachoides* Sendt.
SONOL . . . . Annual sowthistle
spp . . . . species
sq . . . . square
sqft . . . . square foot
St . . . . state
Sta. . . . . Station
Stream . . . . stream, streambank
sume . . . . sulfometuron

SW . . . . southwest

T/A or T/a . . . . ton(s) per acre
tria . . . . triallate
trif . . . . trifluralin
Tutal Tualatin

U.S. United States
univ . . . . university
USDA . . . . United States Department of Agriculture

v/v . . . . volume per volume
var. variety
vs . . . . versus

W . . . . west
w/v . . . . weight to volume
WAT . . . . weeks after
WAT . . . . weeks after treatment, transplanting
WDG . . . . water dispersible granule
Wheatg . . . . wheatgrass
WP . . . . wettable powder
wsp . . . . water soluble powder
WY . . . . Wyoming

yd^2 . . . . square yards
yr . . . . year