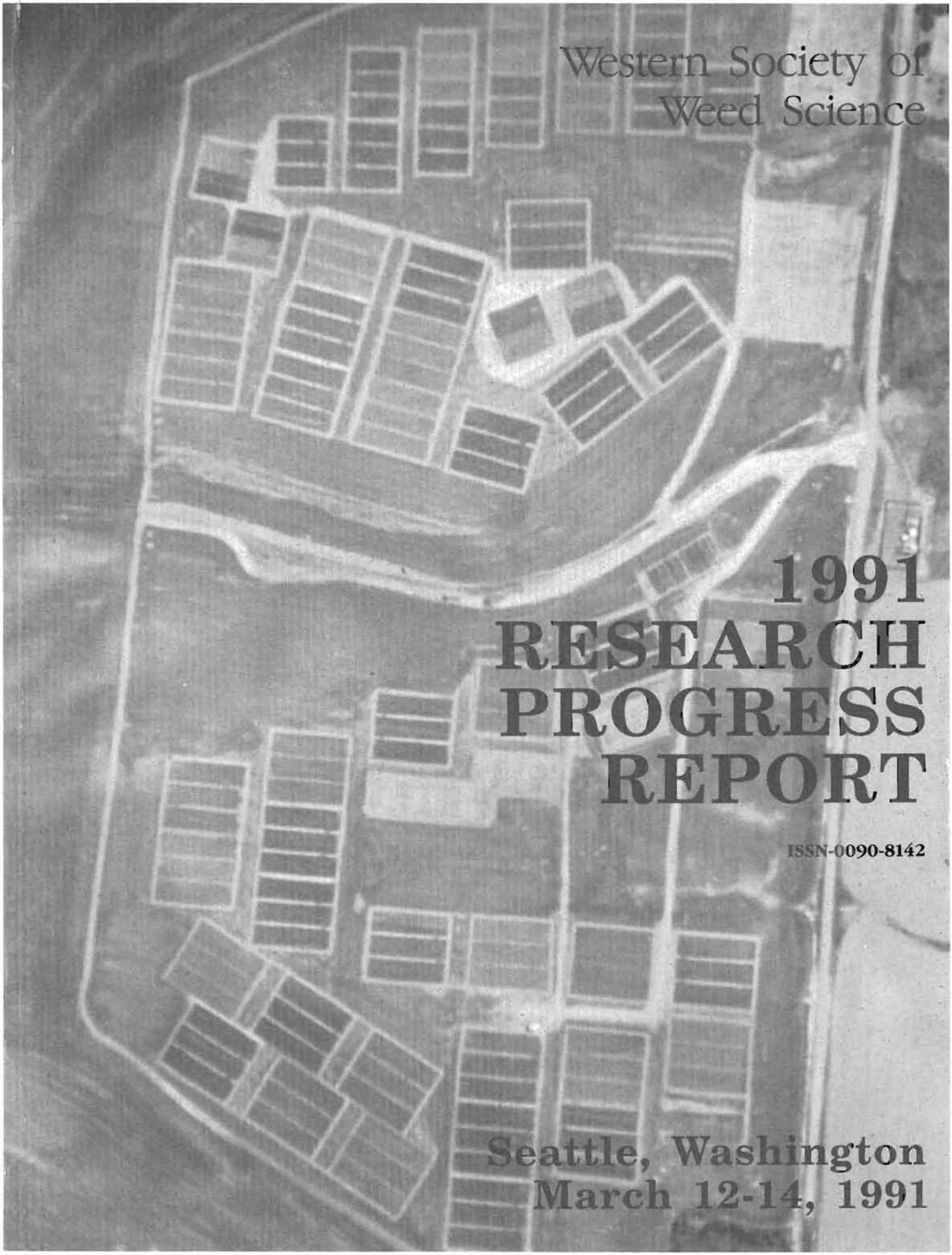

Western Society of Weed Science

1991 RESEARCH PROGRESS REPORT

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Research Progress Report

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FORWORD

The 1991 Research Progress Report of the Western Society of Weed Science (WSWS) is a compilation of contributed results of research work conducted by weed scientists in the Western United States. This report contains preliminary information and is not for publication, endorsements, or recommendations to the general public. 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.

At the 1990 summer meeting the Executive Committee rearranged, realigned, deleted, and added to the seven research conference sections. The seven sections had not been changed since their formation in the 1950's and it was felt they did not reflect the present day weed science discipline accurately. Major restructuring included: a) Combining the old perennial weeds, herbaceous weeds of range and forest, and undesirable woody plants into one project entitled Weeds of Range and Forest; b) Expanding the chemical and physiological studies project into a Basic Sciences: Ecology, Biology, Physiology, Genetics, and Chemistry Project; and c) Adding two new projects: Extension, Education and Regulatory, and Alternative Methods of Weed Management.

The reports contained herein and their respective content, format, and style are submitted by and the responsibility of each author (s). Reports are not retyped or edited significantly and are photoreproduced for publication. The seven project chairpersons and chairpersons-elect were responsible for collecting and indexing reports within their projects. Much thanks is extended to the chair and chairperson-elect of each project as well as to the authors who took time to share their research with other members of WSWS. Final compilation of this report is the responsibility of the Research Section Chairperson.

Frank L. Young
Chairperson, Research Section
Western Society Weed Science
1991

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PROJECT 1

WEEDS OF RANGE AND FOREST

DIANE WHITE - COCHAIRPERSON

JOHN BROCK - COCHAIRPERSON

MICHAEL RALPHS - CHAIRPERSON - ELECT

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

Visual evaluations were taken on July 22, September 15, 1988, September 13, 1989 and July 24, 1990, approximately 1, 3, 15, and 25 months after treatment (MAT) application, respectively. Picloram, dicamba, and clopyralid treatments applied alone and all tank mixes with dicamba, except dicamba plus chorsulfuron (0.5 + 0.023 or 0.047 lb ai/a), provided excellent plumeless thistle control 30 days after treatment (Table 2). Chlorsulfuron (0.023 lb ai/a), metsulfuron (0.009 lb ai/a), and dicamba plus picloram (1.0 + 0.13 lb ai/a) provided good to excellent control 3 and 15 (MAT). Poor control was provided by 2,4-D alone (1.0 lb ai/a) 3 MAT, however, control was excellent 15 MAT. Picloram, picloram plus dicamba, dicamba plus clopyralid, and dicamba plus chlorsulfuron (0.5 lb + 0.009 lb ai/a) maintained excellent CRUAC control 25 MAT.

Treatments will be evaluated in 1991 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

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

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

Weed data

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

Table 2. Plumeless thistle control on Colorado rangeland.

Herbicide	Rate (lb ai/a)	Plumeless thistle control				
		CRUAC[1]	CRUAC[2]	CRUAC	CRUAC	CRUAC[4]
		Sept 15, 1988		Sept 13.1989		July 24, 1990
		% of check				
picloram	0.13	100	100	100	100	91
picloram	0.25	100	100	90	90	96
picloram	0.5	100	100	100	100	93
dicamba	0.5	100	100	100	93	70
dicamba	1.0	100	100	100	100	85
dicamba + picloram	0.5 + 0.25	100	100	100	100	93
dicamba + picloram	1.0 + 0.13	100	100	65	60	100
2,4-D	1.0	68	39	94	94	12
dicamba + 2,4-D	0.5 + 1.0	100	100	100	96	53
clopyralid	0.13	100	99	100	94	68
clopyralid	0.25	100	100	100	100	84
dicamba + clopyralid	0.5 + 0.25	100	100	100	100	86
dicamba + clopyralid	1.0 + 0.13	100	100	100	100	98
chlorsulfuron[3]	0.023	54	28	15	17	18
chlorsulfuron	0.047	95	81	88	88	82
metsulfuron[3]	0.009	71	50	34	15	23
metsulfuron	0.019	84	76	58	63	50
dicamba + chlorsulfuron	0.5 + 0.023	100	98	98	100	95
dicamba + chlorsulfuron	0.5 + 0.047	93	93	100	100	53
dicamba + chlorsulfuron	1.0 + 0.023	100	100	91	86	78
LSD (0.05)		19	16	27	24	34

1 second year plumeless thistle plants found in first data column at each evaluation date.

2 first year plumeless thistle rosettes found in second data column at each evaluation date.

3 X-77 added at 0.25% v/v to all chlorsulfuron and metsulfuron treatments.

4 first and second year plumeless thistle plants grouped as one.

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

Visual evaluations were taken on October 7, 1987, August 3, 1988, August 9, 1989, and June 17, 1990, approximately 3 months, 1 , 2, and 3 years after treatments were applied. Picloram alone (2.0 lb ai/a) and picloram plus fluroxypyr (1.0 + 1.0 lb ai/a) provided excellent LINVU control 3 months after application (Table 2). Picloram (2.0 lb ai/a) and picloram (> 0.25 lb ai/a) plus fluroxypyr tank mixes maintained fair to good yellow toadflax control one year after application. Picloram alone (2.0 lb ai/a) maintained good control two years and fair control 3 years after treatment.

Herbicide treatments will be evaluated again in 1991 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

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

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

Weed data

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

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

Herbicide	Rate (lb ai/acre)	Yellow toadflax control Oct 7, 1987	Aug 3, 1988	Aug 9, 1989	Jun 17, 1990
		------------(% of check)			------------
fluroxypyr	1.0	45	30	0	0
picloram	1.0	48	60	45	13
picloram	2.0	93	86	76	69
fluroxypyr	0.25				
+ picloram	0.25	44	30	6	0
fluroxypyr	0.25				
+ picloram	0.50	79	65	31	13
fluroxypyr	0.25				
+ picloram	1.0	79	63	34	18
fluroxypyr	0.50				
+ picloram	0.25	66	10	0	0
fluroxypyr	0.50				
+ picloram	0.50	88	43	17	13
fluroxypyr	0.50				
+ picloram	1.0	91	58	49	21
fluroxypyr	1.0				
+ picloram	0.25	65	55	25	2
fluroxypyr	1.0				
+ picloram	0.50	80	56	12	0
fluroxypyr	1.0				
+ picloram	1.0	70	75	50	19
LSD (0.05)		12	36	26	24

Wild caraway control with picloram, dicamba, and 2,4-D in Colorado hay meadows. Sebastian, J.R. and K.G. Beck. A hay meadow experiment was established near Clark, CO to evaluate wild caraway (CARCA) control with picloram, dicamba, and 2,4-D. Wild caraway was sprayed at rosette (May 21, 1990) and flower (June 19, 1990) growth stages for timing comparison. The design was a randomized complete block with four replications. All treatments were applied with CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Plot size was 20 feet by 60 feet.

Two 5.4 square foot quadrats were harvested per plot on August 6, 1990. Grass and weeds were allowed to air dry in a greenhouse. CARCA, grass, clover, and miscellaneous weeds were separated and weighed as percent of check (77 days after treatment) for each treatment. Picloram alone and picloram plus 2,4-D or dicamba provided good to excellent CARCA control 77 days after rosette application (Table 2). Picloram alone (0.5 lb ai/a) and picloram plus 2,4-D (0.25 + 0.5 lb ai/a) provided excellent and good CARCA control 49 days after flowering application.

Herbicide treatments will be evaluated again in 1991 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

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

Environmental data		
Application date	August 21, 1990	June 19, 1990
Application time	10:00 AM	7:00 AM
Air temperature, C	17	18
Cloud cover, %	40	0
Relative humidity, %	53	66
Wind speed/direction, mph	0 to 5/W	0 to 2/W
Soil temperature (2.0 in), C	15	15

Weed data

Application date	Species	Growth stage	Ht/diam (in)	Density (plts/ft^2)
August 21, 1990	CARCA	rosette	4 to 7	1 to 4
	TAROF	rosette	5 to 7	1 to 4
	BROSP	3 to 4 leaf	3 to 5	N/A
	PHLPR	3 to 4 leaf	3 to 5	N/A
	POAPR	vegetative	2 to 4	N/A
June 19, 1990	CARCA	full bloom	20 to 24	1 to 7
	BROSP	flower	14 to 20	N/A
	PHLPR	boot	12 to 14	N/A
	POAPR	closed panicle	10 to 12	N/A
	DACGL	flower	9 to 16	N/A

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

Herbicide	Rate	Timing	CARCA[1]	CARCA[2]	Grass	Clover	Misc.[3]
	(lb ai/a)		Control by wt.	---------lbs/acre---------			
picloram	0.25	ros	75	59	1997	0	5
picloram	0.5	ros	78	51	1929	0	3
2,4-D	0.5	ros	99	2	1835	5	12
dicamba	0.5	ros	19	187	2022	0	41
picloram	0.13						
+ 2,4-D	0.5	ros	99	2	1599	0	1
picloram	0.25						
+ 2,4-D	0.5	ros	99	3	1878	0	0
picloram	0.13						
+ 2,4-D	0.5						
+ nitrogen		ros	100	0	2084	0	0
picloram	0.13						
+ dicamba	0.5	ros	93	16	1876	0	7
picloram	0.25	flwr	16	193	1608	0	7
picloram	0.5	flwr	90	23	1953	0	1
2,4-D	0.5	flwr	48	121	1802	2	15
dicamba	0.5	flwr	68	72	1831	0	7
picloram	0.13						
+ 2,4-D	0.5	flwr	39	142	1653	0	6
picloram	0.25						
+ 2,4-D	0.5	flwr	85	3	1713	0	7
picloram	0.13						
+ dicamba	0.5	flwr	0	283	1457	0	2
check			0	230	1970	17	26
LSD (0.05)			62	144	791	14	31

[1] CARCA control refers to % control by weight of check. This figure does not refer to actual field observation but mean CARCA weights of harvested plants.

[2] CARCA weights included all live and dead vegetation present at harvest date.

[3] Miscellaneous weeds were dandelion and buttercup.

Diffuse knapweed control in Colorado rangeland. Sebastian, J.R. and K.G. Beck. A rangeland experiment was established near Castle Rock, CO to evaluate diffuse knapweed (CENDI) control with clopyralid, clopyralid plus dicamba, picloram, picloram plus dicamba, dicamba plus 2,4-D, dicamba, and 2,4-D. The design was a randomized complete block with four replications. All treatments were applied on June 2, 1988 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 were taken on September 1, 1988, July 31, 1989, and July 5, 1990 approximately 3, 13, and 37 months after treatment (MAT) application. Picloram plus dicamba, dicamba plus 2,4-D, and clopyralid plus dicamba provided good to excellent CENDI control 3 MAT application. Picloram alone (0.25 lb ai/a) and picloram plus dicamba tank mixes maintained fair to good CENDI control 13 MAT. Clopyralid alone and clopyralid plus dicamba provided no residual CENDI control 37 MAT, while picloram and picloram plus dicamba provided poor to fair CENDI control 37 MAT.

Herbicide treatments will be evaluated again in 1991 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for diffuse knapweed control in Colorado rangeland.

Environmental data	
Application date	June 2, 1988
Application time	10:30 AM
Air temperature, C	20
Cloud cover, %	5
Relative humidity, %	44
Wind speed/direction, mph	7 to 9
Soil temperature (2.0 in), C	8

Weed data

Application date	Species	Growth stage	Height (in)	Density (shoots/ft)
June 2, 1988	CENDI	bolting	6 to 14	2 to 5
	CENDI	rosettes	-	2 to 5

Table 2. Diffuse knapweed control in Colorado rangeland.

Herbicide	Rate (lb ai/a)	Diffuse knapweed control		
		Sept 1, 1988	July 31, 1989	July 5, 1990
		(% of check)		
clopyralid	0.13	48	46	0
clopyralid	0.25	44	41	0
picloram	0.13	30	41	45
picloram	0.25	51	76	64
dicamba	0.50	70	58	0
dicamba	1.00	76	41	0
picloram + dicamba	0.13 0.50	83	65	35
picloram + dicamba	0.25 0.50	84	75	48
picloram + dicamba	0.13 1.00	98	51	36
picloram + dicamba	0.25 1.00	93	65	58
clopyralid + dicamba	0.13 0.50	83	36	0
clopyralid + dicamba	0.25 0.50	95	60	5
clopyralid + dicamba	0.13 1.00	90	16	0
clopyralid + dicamba	0.25 1.00	86	25	0
dicamba + 2,4-D	0.50 1.00	98	45	0
2,4-D	1.00	63	24	0
LSD (0.05)		17	33	15

Field bindweed control/suppression with fall treatments on Colorado CRP. Sebastian, J.R., K.G., Beck, and D.E. Hanson. A Conservation Reserve Program (CRP) experiment was established near Briggsdale, CO to evaluate field bindweed (CONAR) control with picloram, dicamba, 2,4-D, and their tank mixes. The design was a randomized complete block with four replications. All treatments were applied on October 19, 1988 with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is in Table 1. Plot size was 10 feet by 30 feet.

Visual evaluations were taken on May 25, 1989, October 25, 1989, May 5, 1990, and October 25, 1990 approximately 6, 12, 18, and 24 months after treatments (MAT) were applied, respectively. All picloram, dicamba, and tank mixes of picloram and dicamba provided good to excellent control 6 and 9 MAT (Table 2). Dicamba plus 2,4-D and 2,4-D alone provided poor to fair control. Picloram (>0.13 lb ai) and all picloram plus dicamba tank mixes maintained good to excellent CONAR control 1 year and fair to good control 2 years after treatment application.

Herbicide treatments will be evaluated again in 1991 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

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

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

Weed data

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

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

Herbicide	Rate (lb ai/a)	Field bindweed control May 25 1989	October 25 1989	May 5 1990	October 25 1990
		---------------% of check			-------------
dicamba	1.0	100	41	40	29
dicamba	2.0	100	63	55	46
2,4-D amine	1.0	41	0	0	0
2,4-D amine	2.0	55	0	0	0
picloram	0.13	100	48	35	15
picloram	0.25	100	87	84	74
picloram	0.50	100	100	95	89
dicamba + picloram	0.50 0.13	100	87	71	57
dicamba + picloram	0.50 0.25	100	92	84	76
dicamba + picloram	1.0 0.13	100	81	72	65
dicamba + picloram	1.0 0.25	100	97	92	81
2,4-D amine + dicamba	1.0 0.50	100	25	11	0
LSD (0.05)		12	18	21	23

Canada thistle control with metsulfuron and metsulfuron plus 2,4-D on Colorado rangeland. Sebastian, J.R. and K.G. Beck. A rangeland experiment was established near Longmont, CO to evaluate Canada thistle (CIRAR) control with metsulfuron, and metsulfuron plus 2,4-D. The design was a randomized complete block with four replications. Bolting (June 4) and early flower (EFLWR, June 26) applications were sprayed for timing comparison. All treatments were sprayed with X-77 surfactant (0.25% v/v) and applied with 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 were taken on July 6, August 7, September 7, and October 5, 1990. All bolting treatments provided good to excellent CIRAR control approximately 30, 60, and 90 days after treatment application. Early flower treatments provided fair to good CIRAR control through this same evaluation interval.

Herbicide treatments will be evaluated again in 1991 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for Canada thistle control with metsulfuron and metsulfuron plus 2,4-D on Colorado rangeland.

Environmental data		
Application date	June 4, 1990	June 26, 1990
Application time	11:00 P	8:45 P
Air temperature, C	30	22
Cloud cover, %	20	50
Relative humidity, %	54	72
Wind speed/direction, mph	0	0
Soil temperature (2.0 in), C	18	18

Weed data

Application date	species	growth stage	height (in)	density (shoot/ft^2)
June 4, 1990	CIRAR	bolting	4 to 9	3 to 6
June 26, 1990	CIRAR	early flower	12 to 16	3 to 6

Table 2. Canada thistle control with metsulfuron and metsulfuron plus 2,4-D on Colorado rangeland.

Herbicide	Rate (oz ai/acre)	Timing	Canada thistle control July 6	Aug. 7	Sept. 7	Oct. 5
			----------(% of check)			---------
metsulfuron[1]	0.15	bolting	66	88	78	69
metsulfuron	0.3	bolting	68	90	83	75
metsulfuron	0.45	bolting	69	97	87	78
metsulfuron	0.6	bolting	76	96	90	84
metsulfuron + 2,4-D[2]	0.15 4.0	bolting	65	88	80	76
metsulfuron + 2,4-D[3]	0.15 4.0	bolting	67	91	88	83
metsulfuron	0.15	eflwr	26	71	73	51
metsulfuron	0.3	eflwr	23	79	75	68
metsulfuron	0.45	eflwr	29	76	78	64
metsulfuron	0.6	eflwr	19	76	85	77
metsulfuron + 2,4-D[2]	0.15 4.0	eflwr	39	78	85	76
metsulfuron + 2,4-D[3]	0.15 4.0	eflwr	44	74	67	51
LSD (0.05)			10	9	14	25

[1] X-77 surfactant added at 0.25% v/v.
[2] butoxyethyl ester formulation of 2,4-D.
[3] prepackaged formulation of dimethylamine and diethanolamine salts of 2,4-D.

Russian knapweed control with herbicides on Colorado rangeland. Sebastian, J.R. and K.G. Beck. Two rangeland experiments were established near Eagle and Pagosa Springs, CO to evaluate Russian knapweed (CENRE) control with picloram, dicamba, picloram plus dicamba, chlorsulfuron, and metsulfuron. Fall (September 12 or November 17, 1989) and spring (June 18 or May 31, 1990) applications were sprayed 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 were taken at the Eagle site June 18, July 19, and August 19, 1990; and at the Pagosa Springs site May 31, July 31, and September 19, 1990. Picloram (1.0 lb ai/a) applied at both sites in the fall or spring provided good to excellent CENRE control approximately 11 and 2 months after treatment (MAT), respectively (Table 2). All other treatments provided only poor to fair CENRE control. Fall CENRE control at the Eagle site was greater than at the Pagosa Springs site possibly due to CENRE dormancy and droughty conditions found at Pagosa Springs. Herbicide treatments will be evaluated again in 1991 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	Eagle, CO		Pagosa Springs, CO	
Location	Eagle, CO		Pagosa Springs, CO	
Application date	Sep 12 1989	Jun 18 1990	Nov 17 1989	May 31 1990
Application time	1:00 P	9:00 A	10:00 A	10:00 A
Air temperature, C	12	16	13	18
Cloud cover, %	100	10	40	65
Relative humidity, %	60	44	40	35
Wind speed/direction, mph	0	0	0 to 2 SW	5 to 7/W
Soil temperature (2.0 in), C	11	16	10	12

Weed data

Application date	Species	Growth stage	Height (in)	Density ($shts/ft^2$)
Eagle, CO				
September 12, 1989	CENRE	fall vegetative	10 to 12	1 to 6
June 18, 1990	CENRE	bolting	6 to 10	1 to 6
Pagosa Springs, CO				
November 17, 1989	CENRE	post flwr/dorm	12 to 24	1 to 15
May 31, 1990	CENRE	bolting	6 to 10	1 to 6

Table 2. Russian knapweed control on Colorado rangeland.

Treatment	Rate (lb ai/a)	Timing	Russian knapweed control: Eagle, CO Jun 18, 1990	Eagle, CO Jul 19, 1990	Eagle, CO Aug 19, 1990	Pagosa Springs, CO May 31, 1990	Pagosa Springs, CO Jul 31, 1990	Pagosa Springs, CO Sep 19, 1990
			(% of check)					
picloram	0.25	fall	75	61	60	92	50	20
picloram	0.50	fall	92	83	81	100	78	56
picloram	1.00	fall	100	95	94	100	96	90
dicamba	0.50	fall	51	15	13	50	5	9
dicamba	1.00	fall	77	51	41	75	0	0
picloram	0.25							
+ dicamba	0.50	fall	92	54	49	97	58	28
picloram	0.13							
+ dicamba	1.00	fall	96	83	71	97	24	4
chlorsulfuron[1]	0.38	fall	63	37	31	45	10	0
chlorsulfuron	0.75	fall	86	71	59	71	6	0
metsulfuron[1]	0.30	fall	78	60	48	68	4	0
picloram	0.25	bolting	0	44	59	0	43	45
picloram	0.50	bolting	0	46	70	0	48	54
picloram	1.00	bolting	0	74	80	0	71	81
dicamba	0.50	bolting	0	44	50	0	11	0
dicamba	1.00	bolting	0	60	67	0	54	34
picloram	0.25							
+ dicamba	0.50	bolting	0	66	72	0	46	51
picloram	0.13							
+ dicamba	1.00	bolting	0	51	65	0	53	26
chlorsulfuron	0.38	bolting	0	29	39	0	23	21
chlorsulfuron	0.75	bolting	0	38	68	0	34	6
metsulfuron	0.30	bolting	0	38	56	0	41	25
LSD (0.05)			11	22	20	12	23	24

1 X-77 surfactant added at 0.25% v/v to all chlorsulfuron and metsulfuron treatments.

The effects of pyridine herbicides in combination with atrazine for grass establishment in yellow starthistle habitat. Callihan R.H., L.W. Lass, and F.E. Northam. Yellow starthistle (Centaurea solstitialis L. (CENSO)) is become a dominant species within the Columbia River drainages in the Pacific Northwest, and has entered the Great Basin. Yellow starthistle easily invades range sites and co-habit 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 a herbicide 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)
Wheatgrass, tall, (Thinopyrum ponticum (Podp.) Barkw. and D.R. Dewey (Agropyron elongatum) cv. Alkar)
Wheatgrass, crested, (Agropyron cristatum (L.) Gaertner cv. Ephraim)
Wheatgrass, crested, (Agropyron cristatum Gaerthn. cv. Hycrest)
Wheatgrass pubescent, (Thinopyrum intermedium spp barbulatum (Schu) Barkw. cv. Luna (Agropyron tricophorum))
Wheatgrass, crested (Agropyron desertorum (Fisher ex link) Shultes cv. Nordan)
Wheatgrass, intermediate, (Thinopyrum intermedium spp intermedium (Host) Bark. and D.R. Dewey (Agropyron intermedium) cv. Oahe)
Wheatgrass bluebunch, (Pseudorogneria spicata (Nevski) A. Love (Agropyron spicatum) cv. Secar)
Wheatgrass, Siberian, (Agropyron fragile (Roth) Candargy (A. sibiricum) cv. P-27)
Wheatgrass, streambank (Elymus lanceolatus (Scribner & J.G. Smith) Gould (Agropyron riparium) cv. Sodar).

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

The experiment was established near Lapwai, ID. on a Linville-Waha silt loam. The field was in wheat production in 1988 and was placed in the U.S.D.A. Conservation Reserve Program (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 at a depth of 1 inch on May 12 to 15 using a drill seeder with 7 inch spacing and packer wheels. Prior to grass emergence, 0.5 lb ai /a glyphosate was applied on May 20, for control of emerged weeds. 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 and travelled 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 surface, 68F at a depth of 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 0.74 m^2 (8 sq ft) rectangular quadrats in each plot in mid-July 1989. Visual estimate of chlorophyll loss were recorded on July 12 1989. Visual estimates of grass and yellow starthistle density were recorded on March 27, 1990.

1989. The average number of yellow starthistle in the untreated check was 7.5 plants per 1 m^2 (Table 1). The number of living yellow starthistle plants in the clopyralid- and picloram-treated areas were fewer than 1 per m^2. 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 (data shown in WSWS 1990 Research progress report pp. 83). Atrazine injury was detected in 12 of 13 established grasses in the picloram main plots, in 10 of 13 established grasses in the clopyralid plots, and in 7 of 13 established grasses, where no pyridine herbicides was applied. Atrazine did not appear to interact with pyridine herbicides to the detriment of the 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. The picloram and clopyralid treatments controlled 100% of the yellow starthistle in 1990 (Table 1). Atrazine alone at rates of 1.0 lb ai/a reduced yellow star thistle density by about 50% and 1.5 lb ai/a suppressed 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.

Grass density was increased two-fold in Luna pubescent and P-27 Siberian Wheatgrass and three-fold in Ephraim crested wheatgrass plots when treated with clopyralid or picloram, when compared to the untreated check (Table 2). Durar hard fescue density increased four-fold when treated with clopyralid and 10-fold when treated with picloram. Atrazine alone increased the density of Hycrest crested wheatgrass by 7±3% and Nordan crested wheatgrass by 29 to 129% when compared to the check. The density of Ephraim crested wheatgrass was increased two-fold when treated with only 0.5 and 1.0 lb/a atrazine and three-fold when treated with only 1.5 lb/a and compared to the check. The densities of other grasses treated with atrazine alone were not statistically different from those of the untreated grasses.

The addition of clopyralid to atrazine reduced Hycrest crested wheatgrass density by 12% and Luna pubescent wheatgrass by 28% when the atrazine rate was 1.5 lb/a, and compared to those species treated with only clopyralid. Other combinations of atrazine and clopyralid with the other grasses did not significantly affect the density when compared to those species treated with clopyralid only. Picloram in combination with atrazine at 0.5 lb/a increased Covar sheep fescue density by 3-fold. The combination of picloram plus 1.5 lb/a atrazine reduced Durar hard fescue density by about 50%.

Since yellow starthistle has not re-established in the pyridine treatments, further evaluations will be necessary to determine the competitive nature of the grasses in combination with the herbicides. (Univ. of Idaho, Dept. of Plant, Soils, & Ent. Sci., Moscow, 83843)

Table 1

Effects of pyridine herbicides in combination with atrazine on the control of yellow starthistle.

Herbicide	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)	(CENSO plants/M2 in 1989)													
Check +														
Atrazine 0	14 A	5 A	7 BA	5 A	4 A	5 A	3 BA	6 A	10 A	7 A	6 A	6 A	9 A	7 BC
Atrazine 0.5	15 A	2 B	6 BA	7 A	2 BA	4 BA	5 A	8 A	4 B	11 A	6 A	8 A	10 A	14 A
Atrazine 1	7 B	1 B	4 BA	2 B	4 A	1 BC	3 BA	1 B	4 B	5 BA	1 B	5 BA	10 A	10 BA
Atrazine 1.5	1 C	1 B	1 B	1 B	0 B	2 BC	1 B	1 B	3 CB	1 B	1 B	1 B	1 B	3 DC
Clopyralid 0.12 +														
Atrazine 0	0 C	0 B	0 B	1 B	1 B	0 C	0 B	0 B	0 C	0 B	0 B	1 B	0 B	0 D
Atrazine 0.5	1 C	0 B	0 B	0 B	1 BA	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Atrazine 1	1 C	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Atrazine 1.5	0 C	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Picloram 1.0 +														
Atrazine 0	0 C	0 B	12 A	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Atrazine 0.5	0 C	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Atrazine 1	0 C	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
Atrazine 1.5	0 C	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 B	0 B	0 B	0 B	0 D
	(CENSO plants/M2 in 1990)													
Check +														
Atrazine 0	5106 A	3428 A	3204 A	244 A	1114 A	1736 A	1907 A	173 A	2732 A	1118 B	1408 A	3694 A	3285 A	3375 A
Atrazine 0.5	2529 B	2043 BA	1448 B	116 BA	102 B	370 BA	1004 BA	30 B	105 B	1688 A	591 B	2063 BA	864 B	2773 BA
Atrazine 1	2280 B	471 BC	32 B	137 BA	2 B	1721 A	137 B	17 B	17 B	221 C	17 B	1619 B	369 CB	1614 BC
Atrazine 1.5	1877 B	53 C	235 B	53 B	0 B	2 B	2 B	53 B	4 B	2 C	51 B	19 B	53 C	476 DC
Clopyralid 0.12 +														
Atrazine 0	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 0.5	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 1	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 1.5	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	51 B	0 C	0 B	0 B	0 C	0 D
Picloram 1.0 +														
Atrazine 0	0 B	0 C	10 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 0.5	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 1	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D
Atrazine 1.5	0 B	0 C	0 B	0 B	0 B	0 B	0 B	0 B	0 B	0 C	0 B	0 B	0 C	0 D

1. Any two means having a common letter are not significantly different at the 5 % level of Significance, using the Protected Duncan's Test. Statistical year-to-year comparisons should not be made in this table, because years were analyzed separately .

Table 2

Effects of pyridine herbicides in combination with atrazine on grass density.

Herbicide	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)	(Grass plants/M2 in 1989)													
Check +														
Atrazine 0	0 B	21 BA	35 A	72 BAC	70 A	56 C	94 A	187 B	88 BAC	43 BAC	106 BA	5 BA	68 BA	61 BA
Atrazine 0.5	0 B	32 BA	56 A	63 BC	107 A	70 BAC	91 A	195 B	96 BA	50 BAC	119 A	4 B	69 A	36 B
Atrazine 1	0 B	10 B	25 A	79 BAC	109 A	57 C	92 A	188 B	86 BAC	46 BAC	106 BA	1 B	58 BA	44 BA
Atrazine 1.5	0 B	24 BA	35 A	85 BAC	97 A	68 BAC	81 A	155 B	72 BC	36 BC	77 B	1 B	44 BA	41 BA
Clopyralid 0.12 +														
Atrazine 0	0 B	25 BA	37 A	104 A	100 A	79 BA	86 A	220 A	90 BAC	54 BAC	112 BA	5 BA	59 BA	78 A
Atrazine 0.5	0 B	3 B	68 A	90 BAC	93 A	85 A	84 A	179 B	70 BC	44 BAC	124 A	1 B	62 BA	53 BA
Atrazine 1	0 B	33 BA	56 A	99 BA	115 A	61 BC	64 A	180 B	68 C	42 BAC	119 A	4 B	66 BA	78 A
Atrazine 1.5	0 B	15 BA	44 A	69 BAC	85 A	76 BA	55 A	149 B	40 D	42 BAC	88 BA	3 B	46 BA	50 BA
Picloram 1.0 +														
Atrazine 0	1 A	36 BA	43 A	82 BAC	106 A	75 BAC	82 A	152 B	110 A	62 A	110 BA	6 BA	65 BA	45 BA
Atrazine 0.5	1 BA	47 A	57 A	79 BAC	104 A	72 BAC	82 A	155 B	85 BC	59 BA	116 A	11 A	68 BA	65 BA
Atrazine 1	0 B	18 BA	38 A	65 BC	89 A	80 A	92 A	123 D	80 BC	35 C	92 BA	2 B	52 BA	45 BA
Atrazine 1.5	0 B	14 BA	32 A	54 C	95 A	78 BA	67 A	109 D	74 BC	45 BAC	87 BA	1 B	39 B	44 BA
(lb ai/A)	(Grass plants/M2 in 1990)													
Check +														
Atrazine 0	3 B	6 B	4 C	98 BAC	70 A	83 A	31 D	90 C	41 E	51 BC	62 D	15 A	42 C	23 BC
Atrazine 0.5	13 BA	6 B	9 C	101 BAC	71 A	98 A	79 BAC	101 B	75 BDC	36 C	79 DC	4 A	64 BC	12 C
Atrazine 1	6 BA	3 B	6 C	98 BAC	71 A	86 A	79 BAC	98 B	94 BA	42 C	90 BDAC	3 A	45 C	12 C
Atrazine 1.5	4 BA	4 B	7 C	90 BC	78 A	94 A	94 BAC	94 B	53 ED	75 BA	86 BDC	11 A	64 BC	17 C
Clopyralid 0.12 +														
Atrazine 0	39 BA	12 B	18 C	101 BAC	86 A	83 A	94 BAC	94 B	86 BAC	79 BA	83 BDC	21 A	79 BA	45 BA
Atrazine 0.5	45 A	11 B	19 C	94 BAC	98 A	90 A	94 BAC	98 B	75 BDC	56 BAC	83 BDC	29 A	75 BAC	49 A
Atrazine 1	45 A	9 B	23 BC	98 BAC	98 A	101 A	86 BAC	90 C	90 BA	75 BA	86 BDC	25 A	90 BA	45 BA
Atrazine 1.5	45 A	3 B	14 C	83 C	86 A	98 A	71 C	83 C	62 EDC	60 BAC	83 BDC	19 A	75 BAC	41 BA
Picloram 1.0 +														
Atrazine 0	13 BA	8 B	45 BA	113 BA	98 A	104 A	98 BA	116 B	98 BA	83 A	109 BA	11 A	82 BA	45 BA
Atrazine 0.5	30 BA	29 A	64 A	116 A	86 A	111 A	101 A	120 A	109 A	86 A	116 A	24 A	100 A	60 A
Atrazine 1	6 BA	12 B	45 BA	101 BAC	83 A	94 A	101 A	101 B	101 BA	64 BAC	101 BAC	20 A	86 BA	45 BA
Atrazine 1.5	6 BA	4 B	19 C	101 BAC	98 A	105 A	75 BC	94 B	90 BA	71 BA	98 BAC	5 A	70 BAC	41 BA

1. Any two means having a common letter are not significantly different at the 5 % level of Significance, using the Protected Duncan's Test. Statistical year-to-year comparisons should not be made in this table, because years were analyzed separately.

Spotted knapweed control in a non-crop site. Lass, L.W. and R.H. Callihan. This experiment evaluated the effects of six herbicides at three rates each on mature spotted knapweed (*Centaurea maculosa* Lam.) in non-crop land.

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

Treatments were applied in 23 gal/a water carrier, with TeeJet 8002 nozzles at 43 psi, from a backpack sprayer operated at 3 mph. The plots were sprayed on June 9, 1986. The air temperature at the time was 83F, soil temperature at 3 inch depth was 70F, and relative humidity was 46%. The sky was 80% cloudy, and no dew was present. Visual estimates of biomass were recorded July 17 and October 22, 1986; April 28 and August 11, 1987; July 11, 1988; August 1, 1989 and August 8, 1990.

Results of the first year (1986) indicated that metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron slightly suppressed the biomass of spotted knapweed following application (Table). However, clopyralid and picloram reduced the spotted knapweed biomass by 95-100% during growth of the first year after application (P=0.0001). Less than 5% of the plants treated with metsulfuron, DPX-L5300, sulfometuron, clopyralid, and picloram produced seeds the first year (Data not shown). In the summer of the second year the suppression of spotted knapweed growth was less than that observed in the first year, in the plots of metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron (Table). Successful control of spotted knapweed was maintained in the second year with clopyralid (96%) and picloram (100%). The metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron did not reduce seed production the second year (data not shown). Evaluations of picloram and clopyralid plots in the third and fourth year indicated a slight reduction in control in those plots. The reappearance of spotted knapweed may be due in part to the existing seed bank, in addition to the seed rain from border plants and check plots. In the fourth year, the loss of spotted knapweed competition apparently allowed yellow toadflax (*Linaria vulgaris* Hill) to become the dominant species in the clopyralid treatments but not in the picloram plots. These data (not shown) suggests picloram suppressed yellow toadflax and has apparently prevented its increase.

In the fifth year, the highest rates of picloram and clopyralid controlled 62 to 79% of the spotted knapweed. Unexpected activity of lower rates after five years may not be a result of herbicide carry-over, but reductions in the seed bank together with grass competition, since plants in these plots did not show epinastic symptoms.

These results suggest that 0.5 lb ai/a picloram and 0.4 lb ai/a clopyralid should control spotted knapweed growth and seed production in this area for 3 years and possibly least 4 years. Higher rates appear unlikely to extend control sufficiently to warrant the added costs and risks. Although both herbicides provide a method of controlling spotted knapweed, criteria for herbicide selection should include ability to control other potential invading species after the removal of spotted knapweed competition. (University of Idaho, Dept. of Plant, Soils, & Ent. Sci., Moscow 83843)

Table.
Spotted Knapweed Control in Non-crop

Herbicide	Rate	Biomass Summer 7/86	Fall 10/86	Spring 4/87	Summer 8/87	Summer 7/88	Summer 8/89	Summer 8/90
	(ai/A)	---------------(% of Check)-----------------						
Metsulfuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 oz	62 a	90 a	97 ab	100 a	100 a	100 a	100 a
	1.0 oz	72 a	100 a	100 a	100 a	100 a	100 a	100 a
	2.0 oz	70 a	77 a	97 ab	100 a	100 a	100 a	100 a
DPX-L5300	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 oz	67 a	93 a	82 ab	100 a	100 a	100 a	100 a
	1.0 oz	70 a	95 a	97 ab	100 a	100 a	100 a	100 a
	2.0 oz	65 a	91 a	77 b	100 a	100 a	100 a	100 a
Chlorsulfuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 oz	88 a	88 a	100 a	100 a	100 a	100 a	100 a
	1.0 oz	82 a	81 a	100 a	100 a	100 a	100 a	100 a
	2.0 oz	87 a	74 a	97 a	100 a	100 a	100 a	100 a
Clopyralid	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.4 lb	2 b	0 b	0 c	4 b	4 b	8 b	52 b
	0.9 lb	1 b	0 b	0 c	4 b	1 b	10 b	55 bc
	1.8 lb	0 b	0 b	0 c	4 b	1 b	5 b	38 c
Sulfometuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 oz	58 a	80 a	81 ab	100 a	100 a	100 a	100 a
	1.0 oz	53 a	89 a	97 ab	100 a	100 a	100 a	100 a
	2.0 oz	50 a	74 a	77 b	100 a	100 a	100 a	100 a
Picloram	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 lb	5 b	0.5 b	0 c	0 b	2 b	6 b	40 bc
	1.0 lb	2 b	0 b	0 c	0 b	1 b	10 b	40 bc
	2.0 lb	1 b	0 b	0 c	0 b	3 b	12 b	21 d

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

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

Each grass was planted in strips 8 by 105 ft with a seven-row Gandy box drill with 7 inch row spacing on May 16, 1989. The planting depth was 3/4 inch. The glyphosate was applied after all species (except Idaho fescue) had 90% emergence. Seedling heights ranged from 1/4 to 1 inch in height at the time of application. Plant populations ranged from 5 to 10 plants per 1 ft of row, except Idaho fescue, which produced less than 1 plant per ft of row. Glyphosate was applied June 6 in 15 by 72 ft strips across the grass taxa to form a strip-strip block design. Treatments were applied with a motorized plot sprayer using flat fan nozzles (TeeJet 8001) operating at 2 mph and delivering 8 gal/a. Application was between 09:07 and 10:52 am. The air temperature was 75F and the wind was 2 to 4 mph from the west. Soil temperatures were 102F at surface, 71F at 2 inches depth, and 64F at 6 inches depth. The relative humidity was 43%. The sky was clear and dew was not present. Grass height measurements and visual estimates of the percentage of the leaves showing chlorotic and necrotic lesions were made June 28, 1989; height measurements and cover estimates were recorded on May 25, 1990.

In 1989, height reduction appeared to occur in all grasses treated with 0.75 lb ai/a glyphosate. Grasses not showing height reductions at 0.5 lb ai/a were Covar sheep fescue, Durar hard fescue, Reubens Canada bluegrass and Fawn tall fescue. Heights of creeping red fescue, and chewings fescue were not affected by 0.38 lb ai/a glyphosate. Alta tall fescue height was not effected by 0.25 lb ai/a. All glyphosate treatments reduced redtop height by more than 50%.

Grasses showing less than 30% chlorosis in 1989 from at 0.5 lbs ai/a glyphosate were Alta tall fescue, chewings fescue, Durar hard fescue, Reubens Canada bluegrass, and redtop. Creeping red fescue and Fawn tall fescue showed less than 30% chlorosis at 0.38 lb ai/a glyphosate. Other did not show chlorosis where treated with 0.26 lb ai/a glyphosate.

The ability of the grasses to take advantage of reduced weed competition from glyphosate treatment was evaluated by documenting grass height and visually estimating grass cover. All grasses treated with glyphosate tended to be taller than the untreated check one year after treatment. Glyphosate did not reduce the percent cover of chewings fescue. The percent cover when Alta tall fescue, Covar sheep fescue, creeping fescue, Durar hard fescue, Reubens Canada bluegrass, Fawn tall fescue, and redtop, when treated with 1.0 lb ai/a glyphosate or more were equal to or less than the check. Glyphosate treatments between 0.25 to 0.75 lb ai/a tended to improve grass cover. The tolerance of the tested fescue and other grass taxa to low doses of glyphosate indicates the possible use of glyphosate in weed management of seedling grass fields such as CRP. (University of Idaho, Dept. of Plant, Soils, & Ent. Sci., Moscow 83843)

Table. Effects of glyphosate on seedling grasses.

Grass	Glyphosate rate	Height 6/89	Height 5/90	Chlorosis 6/89	Cover 5/90
	(lb ai/a)	---(cm)---		(%)	(%)
Fescue, Alta tall	0.00	10	75	0	95
	0.25	10	90	5	95
	0.38	5	92	10	90
	0.50	6	94	23	88
	0.75	4	95	67	83
	1.00	4	102	75	59
	1.50	4	96	75	36
Fescue, chewings	0.00	8	57	0	71
	0.25	4	69	0	88
	0.38	4	65	15	75
	0.50	2	66	25	90
	0.75	2	62	25	60
	1.00	1	69	28	60
	1.50	2	59	51	63
Fescue, Covar sheep	0.00	2	44	0	35
	0.25	2	47	0	53
	0.38	2	49	53	33
	0.50	2	57	92	53
	0.75	1	50	23	43
	1.00	1	56	28	33
	1.50	0	35	75	13
Fescue, creeping red	0.00	9	52	0	83
	0.25	9	64	0	78
	0.38	6	65	8	80
	0.50	4	70	48	80
	0.75	4	66	65	70
	1.00	3	70	80	53
	1.50	3	59	50	35
Fescue, Durar hard	0.00	6	66	0	83
	0.25	7	66	0	96
	0.38	4	69	30	83
	0.50	3	69	29	83
	0.75	4	75	53	68
	1.00	2	69	52	58
	1.50	1	73	75	40
Bluegrass, Reubens Canada	0.00	5	27	0	78
	0.25	4	24	0	87
	0.38	3	29	28	83
	0.50	5	28	26	88
	0.75	2	27	70	79
	1.00	2	31	55	85
	1.50	0	29	95	60
Fescue, Fawn tall	0.00	9	96	0	95
	0.25	13	94	3	100
	0.38	6	99	28	95
	0.50	6	99	40	96
	0.75	6	109	70	80
	1.00	5	107	68	65
	1.50	3	107	80	45
Redtop	0.00	9	38	0	81
	0.25	4	51	25	75
	0.38	4	53	28	94
	0.50	4	49	27	83
	0.75	0	54	50	60
	1.00	1	52	65	56
	1.50	3	59	75	78
LSD		3	19	46	27

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

Herbicide tolerance of seedling grasses for erosion control in a spotted knapweed infested parkland. Lass, L.W., and R.H. Callihan. Grass establishment practices on parkland infested with spotted knapweed (Centaurea repens Lam.) allow weeds to dominate during and after grass establishment unless rigorous weed suppression is practiced. Early application of certain herbicides may cause injury to some seedling grasses. The tolerance of 21 seedling grass taxa to picloram (0.25, and 0.5 lb ai/a) and clopyralid (0.25 and 0.5 lb ai/a) was tested in Farragut State Park.

Grass seedlings were:

bluebunch x quackgrass	(Agropyron spicatum (Pursh)Scribn.&Smith x A. repens (L.)Beauv.
bluegrass, Canada	(Poa compressa L. cv. Reubens)
bluegrass, Kentucky	(Poa pratensis L. cv. Kenblue)
brome, meadow	(Bromus erectus Huds cv. Regar)
brome, smooth	(Bromus inermis Leyss. cv. Manchar)
fescue, creeping red	(Festuca rubra L. cv. Logro)
fescue, hard	(Festuca ovina L. spp. duriuscula cv. Durar)
fescue, sheep	(Festuca ovina L. cv. Covar)
fescue, sheep	(Festuca ovina L. cv. Mecklenburg)
fescue, tall	(Festuca arundinacea Schreb. cv. Alta)
fescue, tall	(Festuca arundinacea Schreb. cv. Fawn)
orchard grass	(Dactylis glomerata L. cv. Paiute)
redtop	(Agrostis alba L. cv. Exerata)
redtop	(Agrostis alba L. cv. Streaker)
timothy, common	(Phleum pratense L. cv. Climax)
wheatgrass, crested	(Agropyron cristatum Gaertn. cv. Ephraim),
wheatgrass, intermediate	(Agropyron intermedium (Host)Beauv. cv. Rush)
wheatgrass, intermediate	(Agropyron intermedium (Host)Beauv. cv. Tegmar)
wheatgrass, pubescent	(Agropyron trachycaulum (Link)Malte cv. Luna)
wheatgrass, streambank	(Agropyron riparium Scribn. & Smith cv. Sodar)
wheatgrass, western	(Agropyron smithii Rybd. c.v. Arriaba).

The experiment was initiated on a Farragut silt loam on Oct. 1, 1987. Plots were treated with 0.5 lb ai/a glyphosate to kill living vegetation. Plots were disked on November 1, 1987 and April 5 to 15. Prior to the spring disking 41 lbs/a nitrogen fertilizer was spread on March 22, 1988. Individual plots measured 16 by 30 ft, randomized in a split-strip block design with four replications. Grasses were planted on April 18, 1988 using a 8 ft drill with drag chains, calibrated to deliver 9 lb/a rice hulls. The row spacing was 7 inches and the depth of planting was 1/2 to 3/4 inch. Rice hulls were used to adjust seed volume to a constant seeding rate to compensate for different grass seed sizes.

Treatments were applied in 35 gal/a water carrier, with TeeJet 8003 nozzles at a pressure of 32 psi, from a tractor-mounted sprayer with a 25 ft boom operated at 1.8 mph. The application date was July 18 and 19, 1988. The air temperature following application on July 19 was 86F, soil temperature was 107F at surface, 100F at the depth of 2 inches. The relative humidity was 40% and the sky was clear. The wind was from the east at 1 to 2 mph. A visual estimate of the percentage of the grass leaves showing necrosis or browning of edges was made in the second week in August of 1988. Plant population found in 3 feet of row and height of the grasses were measured at the same time as the necrosis estimate. Percent grass and knapweed cover was estimated on July 24, 1989 and August 8, 1990.

Manchar smooth brome was the only grass to establish in 1988 in all treatment areas (data not shown here). Ephraim crested wheatgrass established in 19 of the 20 treatment areas. Regar meadow brome was present in 18 of the 20 treatment areas. Paiute orchard grass established in 17 of the 20 treatment areas. Luna pubescent wheatgrass was present in 15 of the 20 treatment areas. Kenblue Kentucky bluegrass, Reubens Canada bluegrass, Logro creeping red fescue, Streaker redtop, Exerata redtop, and Arriaba western wheatgrass failed to establish in more than 6 of the 20 treatment areas.

In 1989, spotted knapweed populations were significantly reduced (95 to 100%) in the clopyralid and picloram treatments, when compared to the untreated checks (data not shown here). Rush intermediate wheatgrass was the only grass to provide more than 50% cover in the plots. Grasses providing more than 30% cover were Regar meadow brome, Mecklenburg sheep fescue, Paiute orchard grass, Luna pubescent wheatgrass, and Sodar streambank wheatgrass. Grasses failing to provide more than 10% cover were Reubens Canada bluegrass, Logro creeping, red fescue, Exerata redtop, and Streaker redtop. The chance of establishing a grass species was 5 to 7 times greater in the herbicide treatments than in the check plots.

In 1990, sheep fescues were dropped from the study observations since considerable contamination from the original plant community occurred. Results of the 1990 evaluation shows five grass species have established well in all replicates. Average estimated cover, in the herbicide treatments, provided by Luna pubescent wheatgrass was 61%, by Manchar smooth brome was 37%, by Paiute orchard grass was 30%, by Reubens Canada bluegrass was 28%, and by Rush intermediate wheatgrass was 69%. Without herbicides less than 8% of the plant cover was provided by the planted grasses. Most of the vegetation which was classified as "other plant cover" was the sheep fescue from the original community. Although pre-treated with glyphosate, the sheep fescue survived and was stimulated by the reduced weed competition and fertilization. Spotted knapweed in the herbicide treatments constituted 16% or less of the plant cover in 1990.

Without herbicides to reduce spotted knapweed competition all grasses failed to establish in this site. The rocky nature of this Farragut silt loam was to harsh for some grass species to establish. The success of sheep fescue from the original community would suggest renovation and maintenance of perennial grass communities may be preferable to establishment of a new species. (University of Idaho, Dept. of Plant, Soils, and Ent. Sci., Moscow, 83843)

Table
Effects of herbicides upon reducing spotted knapweed reinfestation after two years.

Cover types		Planted grass species					
Herbicide	Rate	Check	Luna Pubescent Wheatgr.	Manchar Smooth Brome	Paiute Orchard Grass	Reubens Canada Bluegr.	Rush Intermed. Wheatgr.
	(lb ai/a)	(% cover)					
Grass cover							
Check		0 G[1]	2 FG	2 FG	8 EFG	7 EFG	1 G
Clopyralid	0.25	0 G	55 ABCD	49 BCD	16 DEFG	27 DEFG	55 ABCD
Clopyralid	0.43	0 G	71 ABC	34 CDEFG	33 CDEFG	32 CDEFG	75 AB
Picloram	0.25	0 G	45 BCDE	21 DEFG	19 DEFG	32 CDEFG	57 ABCD
Picloram	0.50	0 G	74 AB	43 CDEF	51 BCD	22 DEFG	91 A
Other plant cover							
Check		13 F G	25 DEFG	15 EFG	26 DEFG	11 FG	8 G
Clopyralid	0.25	98 A	44 BCDEFG	46 BCDEF	81 AB	70 ABC	45 BCDFG
Clopyralid	0.43	97 A	29 CDEFG	65 ABCD	63 ABCD	66 ABCD	25 EDFG
Picloram	0.25	96 A	52 BCDEF	63 ABCD	73 AB	66 ABCD	38 BCDEFG
Picloram	0.50	98 A	26 DEFG	55 ABCDE	47 BCDEFG	78 AB	9 G
Spotted knapweed cover							
Check		88 A	73 AB	83 AB	66 B	82 AB	91 A
Clopyralid	0.25	3 C	1 C	5 C	3 C	4 C	1 C
Clopyralid	0.43	3 C	0 C	2 C	4 C	2 C	1 C
Picloram	0.25	4 C	3 C	16 C	9 C	3 C	6 C
Picloram	0.50	2 C	0 C	3 C	2 C	0 C	0 C

[1] Any two means within a cover type having a common letter are not significantly different at the 5% level of significance, using the Protected Duncan's Test.

Response of yellow hawkweed to sulfonylurea and pyridine herbicides. Lass, L.W., R.H. Callihan and T.W. Miller. The purpose of this experiment was to determine the effects of six different herbicides at three rates on established meadow hawkweed (*Hieracium pratense* Tausch. HIECA) in a redtop-smooth brome grass pasture. The experiment was initiated on a Helmer silt loam, June 19, 1986 at Fernwood, Idaho. Plots measured 10 by 25 ft, with four replications of a split-strip block design. Treatments consisted of single applications of chlorsulfuron, sulfometuron, metsulfuron, and DPX-L5300 (each at 0.5, 1.0, 2.0 oz ai/a and check), picloram (0.1, 0.4 and 0.6 lb ae/a and check) and clopyralid (0.0, 0.25, 0.5 and 1 lb ae/a and check). Treatments were applied in 23 gal/a water carrier with flat-fan 8002 nozzles at 40 psi from a CO2-pressurized backpack sprayer operated at 3 mph. The air temperature at the time of treatment was 66F, the soil temperature at 6 inches was 59F and the relative humidity was 55%. There was 50% cloud cover and dew was present. Each herbicide treatment was split with an ammonium nitrate solution (check and 50 lbs N/a) on March 17, 1987 during a rain. Plots were mowed and clippings were removed September 20, 1987.

The first years results were evaluated by estimating percent chlorosis of treated yellow hawkweed on July 17, 1986. The second and third year's evaluation consisted of gravimetric vegetative sampling. Evaluations in the fourth and fifth years consisted of visual estimates of hawkweed control and standing grass biomass, each expressed as a percent of the check. Estimates were made on July 31, 1989 and June 29, 1990.

The first year results indicated extensive chlorosis in 0.4 and 0.6 lb/a picloram treatments (93 to 100%) and in all clopyralid treatments (80 to 100%). Metsulfuron caused moderate chlorosis at 1 to 2 oz ai/a (71 to 66%). Chlorsulfuron, sulfometuron, and DPX-L5300 caused some chlorosis, but the effect was erratic and not pronounced. The vegetative analysis in the second year showed that hawkweed dry weights had decreased 72 to 100% in the picloram plots, 89 to 100% in the clopyralid plots and 70% in the 2.0 oz/a metsulfuron treatment. Grass dry weights more than doubled in all plots treated with clopyralid, and in plots treated with picloram at 0.4 or 0.6 lb/a, with chlorsulfuron at 0.5 or 2.0 oz/a, or with metsulfuron at 2.0 oz/a. In the third year, clopyralid at all rates and picloram at 0.4 and 0.6 lb/a were still controlling 95 to 100% of the yellow hawkweed. Picloram at 0.1 lb/a controlled 75% of the hawkweed in the fertilized plots. Grass regrowth in the third year more than doubled (in comparison to the check) in all plots treated with clopyralid, picloram at 0.4 and 0.6 lb/a, and metsulfuron at 2.0 oz/a. The application of nitrogen in the second year did not increase hawkweed or grass dry weights during the third year when compared to the check. In the fourth year, clopyralid and picloram at 0.4 and 0.6 lb/a were still controlling 80 to 100% of the hawkweed. Grass biomass was visually estimated to be about ten times greater in the clopyralid treatments and three times greater in the picloram treatments than in the checks.

Results in the fifth year indicate residual control from clopyralid at all rates was about 80%. Grass biomass was visually estimated to be 4 times greater in the clopyralid treatments than in the checks. Other herbicide treatments did not provide either long-term suppression of hawkweed or increased grass production.

These results indicate at least five years of yellow hawkweed control with clopyralid at rates of 0.5 and 1.0 lb/a and four years control with picloram at rates of 0.4 and 0.6 lb/a. Both the clopyralid and picloram treatments substantially increased the grass yield. (University of Idaho, Dept. of Plant, Soils, and Ent. Sci., Moscow 83843)

Table.
Response of pasture vegetation to sulfonylurea and pyridine herbicides 4 and 5 years after application.

Herbicide	Rate (oz ai/A)	Hawkweed 1989	Hawkweed 1990	Grass Biomass[1] 1989	Grass Biomass[1] 1990
		(%)	(%)	(%)	(%)
Chlorsulfuron	0	100 ns2	100 ns	15 ns	14 ns
	0.5	100	95	14	8
	1	100	98	23	8
	2	100	95	28	13
Clopyralid	0	100 A	100 A	9 B	19 B
	4	20 B	20 B	93 A	90 A
	8	0 C	23 B	100 A	78 A
	16	0 C	21 B	100 A	83 A
DPX-L5300	0	100 ns	100 ns	20 ns	8 ns
	0.5	100	100	14	2
	1	95	100	30	3
	2	93	100	28	6
Metsulfuron	0	100 ns	100 ns	21 ns	26 ns
	0.5	100	95	30	14
	1	100	63	23	36
	2	100	73	33	31
Picloram	0	100 A	100 ns	31 BC	4 ns
	1.6	95 A	100	41 B	30
	6.4	6 C	52	100 A	51
	9.6	0 C	48	100 A	53
Sulfometuron	0	100 ns	100 ns	24 ns	28 ns
	0.5	100	80	22	23
	1	100	52	16	53
	2	100	76	28	30

1 Hawkweed and grass ratings expressed as percent of check.
2 ns = treatment means within herbicides within columns are not statistically different from the check. Means with the same letter are not significantly different at the 5% level of the Duncan's multiple-range test.

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

Grass seedlings were:

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

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

Herbicide treatments were applied in 20 gal/a water carrier with flat-fan nozzles (TeeJet 8002), except for glyphosate treatments, which were applied at 10 gal/a with flat-fan nozzles (TeeJet 8001), from a tractor-mounted plot sprayer operated at 1.7 mph. Application started on June 27, but rain delayed completion until July 1. Grass seedling height was 1 to 3 inches at the time of treatment. Grass height was measured the second week of September in 1989 and the first week of June in 1990. 1989 data are shown in 1990 W.S.W.S Research Progress Report.

1989. Grasses not showing herbicide injury symptoms were Covar sheep fescue, Fawn tall fescue and Oahe intermediate wheatgrass (data not shown). Tolerance to all herbicides except glyphosate was found in seedlings of: Secar bluebunch wheatgrass; Reubens Canada bluegrass, Sherman big bluegrass; Manchar smooth brome; Regar meadow brome; Alta tall fescue; Durar hard Fescue; Paiute orchardgrass; Climax Timothy; Hycrest crested wheatgrass; Ephraim crested wheatgrass; Luna pubescent wheatgrass; Nordan crested wheatgrass; and Sodar streambank wheatgrass.

Grasses surviving glyphosate postemergence treatments at all rates in 1989 include Chewing fescue, Covar sheep fescue, Fawn tall fescue, and Oahe intermediate wheatgrass (data not shown). A slight tolerance to glyphosate at 0.25 lb ai/a, but not at higher rates was detected in Regar brome, Alta tall fescue, Durar hard fescue, and Nordan crested wheatgrass. Height of redtop was reduced 40% by 0.4 oz/a chlorsulfuron and tended to be lower at other rates. Common timothy height was reduced 48% by 0.5 oz/a of chlorsulfuron. CGA-136872 at 0.4 oz ai/a reduced the height of Chewing fescue by 46%.

1990. Reubens Canada bluegrass cover was reduced by about half in the 0.8 oz ai/A triasulfuron plots (Table 1). Glyphosate at 8 oz ai/a or greater reduced cover more than 75% in Reubens Canada bluegrass, Sherman big bluegrass, Manchar smooth brome, Hycrest crested wheatgrass, Luna pubescent wheatgrass, Nordan crested wheatgrass, Oahe intermediate wheatgrass, and Sodar streambank wheatgrass. Grass cover in plots treated with Glyphosate at 4 oz ai/a plots were not different from check. Grass cover by other grass taxa in combination with other herbicides was statistically equivalent to the untreated check.

Less competition with reduced cover caused grasses in plots treated with 8 and 16 oz/a glyphosate to be taller than the checks (Table 2). Less weed pressure in plots treated with either DPX-G8311 or Chlorsulfuron stimulated smooth brome height by about 20 cm. Chewing fescue treated with chlorsulfuron at 0.25 oz/a or more was 24 to 34 cm taller than its check. The heights of other grasses in combination with other herbicides were statistically the same as in the untreated check.

This study validates previously observed tolerance of fescues to the tested herbicides. The results of these studies suggest that seedlings of some taxa are not injured by effective rates of these herbicides, when used for postemergence weed control. It is apparent however, that responses of any grass taxon to these herbicides may not be accurately predicted without confirming field data. (Univ. of Idaho, Dept. of Plant, Soils, and Ent. Sci., Moscow, 83843)

Table 1. Effect of herbicides on grass cover one year after establishment.

Herbicide	Rate	Reubens Canada Blueg.	Shermans Big Blueg.	Manchar Smooth Brome	Regar Meadow Brome	Alta Tall Fescue	Chewing Fescue	Creep. Red Fescue	Covar Sheep Fescue	Durar Hard Fescue	Fawn Tall Fescue	Paiute Orchard	Redtop	Common Timothy	Secar Blueb. Wheatg.	Ephraim Crested Wheatg.	Hycrest Crested Wheatg.	Luna Pubesc. Wheatg.	Nordan Crested Wheatg.	Oahe Interm. Wheatg.	Sodar Streamb. Wheatg.
	(oz ai/A)	(%)																			
Triasulfuron	0	63 A	19	53	12	85	56	74	48	40	81	74	18	63	33	32	76	65	63	63	50
Triasulfuron	0.2	51 A	27	59	21	78	65	71	45	43	81	55	13	58	21	34	69	58	73	76	40
Triasulfuron	0.4	58 A	35	66	25	84	55	64	49	45	89	84	30	65	43	37	75	73	81	70	55
Triasulfuron	0.8	38 B	27	53	33	80	50	68	50	48	85	85	21	63	37	39	75	68	64	73	48
Clopyralid	0	70	45	38	3	88	43	50	21	50	91	88	8	71	19	42	45	78	73	68	55
Clopyralid	3.5	74	45	41	13	86	68	63	24	45	85	83	9	68	14	50	65	68	68	75	51
Clopyralid	7	75	44	56	12	88	68	58	29	53	91	80	9	68	17	50	64	65	70	69	53
Clopyralid	14	81	53	43	12	90	65	56	29	55	95	85	8	65	29	53	65	78	70	86	63
2,4-D	16	70	39	48	9	88	69	58	20	50	90	83	15	68	20	55	70	74	73	74	58
Clop+2,4D	7+16	78	60	60	18	88	73	69	38	43	90	86	26	75	25	55	73	80	78	80	59
DPX-G8311	0	68	45	43	26	84	55	63	24	68	95	63	33	63	33	48	73	74	60	70	53
DPX-G8311	0.3	84	60	55	38	79	60	65	30	58	86	70	35	60	41	65	70	75	71	80	58
DPX-G8311	0.4	70	55	59	41	86	69	71	39	65	93	65	36	68	30	54	81	86	60	85	69
DPX-G8311	0.5	83	73	60	44	90	66	63	38	58	88	85	46	68	40	53	78	88	71	89	55
Chlosulfuron	0	74	30	36	8	88	60	55	19	40	88	74	9	55	14	16	68	73	73	60	30
Chlosulfuron	0.3	75	40	55	8	90	75	60	40	39	93	85	23	70	17	34	70	73	83	74	50
Chlosulfuron	0.4	80	51	48	12	83	74	68	34	48	85	77	31	65	29	30	66	70	78	71	49
Chlosulfuron	0.5	66	33	45	13	85	70	61	40	51	91	79	26	75	28	28	76	75	78	76	40
Picloram	0	68	31	35	13	80	56	50	24	46	85	75	16	70	53	63	64	68	74	48	35
Picloram	4	80	26	41	33	90	45	65	36	69	100	73	28	70	28	53	70	74	79	75	58
Picloram	8	76	33	54	22	83	70	70	35	54	95	83	16	68	26	48	70	74	80	66	61
Picloram	16	76	41	45	20	83	70	60	46	69	94	63	29	68	21	41	65	75	73	65	64
CGA-136872	0	65	36	43	11	83	61	58	30	35	91	80	13	75	36	33	64	71	73	46	51
CGA-136872	0.2	73	15	44	10	78	55	63	29	39	90	74	12	75	29	31	74	63	75	55	49
CGA-136872	0.4	74	35	43	9	85	59	61	34	41	83	76	27	70	38	38	74	78	69	79	58
CGA-136872	0.8	55	22	43	10	80	53	61	20	34	91	84	17	68	35	41	80	73	78	61	61
Glyphosate	0	84 A	45 A	43 A	3	76	53	65	33	48	83 A	75 A	19	70 A	15	31	78 A	55 A	73 A	70 A	41 A
Glyphosate	4	6 B	25 A	36 A	8	86	58	58	34	48	98 A	78 A	4	15 B	18	31	61 A	58 A	74 A	51 A	38 A
Glyphosate	8	4 B	3 B	9 B	4	85	55	48	25	54	88 A	79 A	12	8 B	4	6	12 B	14 B	51 B	4 B	3 B
Glyphosate	16	2 B	2 B	2 B	2	74	64	53	30	45	71 B	50 B	6	6 B	2	4	8 B	2 B	14 C	1 B	2 B

1. Means a without letter are not significantly different from the checks. Any two means having a common letter are not significantly different from each other at the 5 % level of significance, using the Protected Duncan's Test.

Table 2. Effect of herbicides on grass height one year after establishment.

Herbicide	Rate	Reubens Canada Blueg.	Shermans Big Blueg.	Manchar Smooth Brome	Regar Meadow Brome	Alta Tall Fescue	Chewing Fescue	Creep. Red Fescue	Covar Sheep Fescue	Durar Hard Fescue	Fawn Tall Fescue	Paiute Orchard	Redtop	Common Timothy	Secar Blueb. Wheatg.	Ephraim Crested Wheatg.	Hycrest Crested Wheatg.	Luna Pubesc. Wheatg.	Nordan Crested Wheatg.	Oahe Interm. Wheatg.	Sodar Streamb. Wheatg.
	(oz ai/A)	(cm)																			
Triasulfuron	0	23	78	87	81	101	61	68	51	56	82	87	43	66	83	49	61	78	47	64	61
Triasulfuron	0.2	26	77	91	89	95	63	75	53	58	91	86	40	62	75	55	52	65	56	68	60
Triasulfuron	0.4	23	79	96	79	101	69	67	51	61	82	82	35	61	88	53	70	86	49	61	60
Triasulfuron	0.8	28	82	93	87	101	60	70	59	73	96	92	36	66	102	55	65	90	56	70	67
Clopyralid	0	26	82	114	94	106	67	71	55	75	102	100	42	77	94	63	50	96	51	76	76
Clopyralid	3.5	31	84	119	103	102	77	78	62	74	108	110	54	66	103	66	58	94	49	73	78
Clopyralid	7	30	84	113	122	97	84	73	64	81	108	113	62	81	104	67	63	86	57	72	77
Clopyralid	14	32	87	110	118	119	83	80	67	80	108	85	54	87	109	61	68	100	66	90	77
2,4-D	16	27	81	114	110	112	82	70	65	74	108	112	51	88	105	70	67	96	64	86	79
Clop+2,4D	7+16	33	69	110	96	113	93	83	73	66	105	108	56	79	108	65	69	104	65	80	82
DPX-G8311	0	28	83	80 B	111	107	67	66	46	72	96	100	62	79	90	52	60	74	50	68	68
DPX-G8311	0.3	30	88	114 A	113	110	83	65	55	75	115	107	58	87	116	65	68	87	60	83	76
DPX-G8311	0.4	30	88	103 A	126	106	85	74	58	77	115	105	69	90	110	55	70	93	57	76	81
DPX-G8311	0.5	30	85	111 A	129	114	90	73	67	71	110	112	61	98	117	69	62	88	58	77	85
Chlosulfuron	0	25	82	86 B	88	101	52	67	58	70	96	100	50	61	98	48	58	99	54	72	74
Chlosulfuron	0.3	29	79	106 B	121	110	76	80	66	73	107	110	57	76	88	53	68	100	56	80	80
Chlosulfuron	0.4	34	85	111 A	106	105	78	80	71	76	104	99	61	63	92	62	65	103	59	86	86
Chlosulfuron	0.5	34	83	116 B	113	104	86	85	70	75	109	110	55	78	105	72	69	98	63	76	81
Picloram	0	23	85	109	104	103	75	67	66	63	98	102	51	75	98	63	63	87	45	62	77
Picloram	4	29	87	118	129	108	89	82	55	77	85	99	64	83	95	66	74	105	61	82	89
Picloram	8	35	85	117	126	101	84	84	66	74	109	99	46	94	97	56	71	102	56	74	71
Picloram	16	31	90	113	138	110	89	73	64	72	114	108	63	88	84	51	59	108	51	79	73
CGA-136872	0	21	83	69	45	103	50	64	59	58	97	94	40	65	85	51	41	83	58	71	77
CGA-136872	0.2	27	78	81	79	91	62	70	49	52	93	99	46	65	102	53	56	77	53	66	79
CGA-136872	0.4	25	78	87	72	102	53	65	52	55	101	98	37	70	87	47	68	83	64	82	87
CGA-136872	0.8	28	82	91	70	107	76	65	49	60	94	96	47	62	95	53	65	87	56	64	89
Glyphosate	0	24	79	89 B	98	98 B	69	69 B	56	68	93 B	107	36	69	96 A	58	57 B	85	58 B	70 AB	52 B
Glyphosate	4	25	79	113 A	107	128 A	75	81 AB	57	77	128 A	120	51	72	100 A	80	84 A	105	74 AB	82 A	77 A
Glyphosate	8	30	65	108 AB	106	134 A	88	89 A	73	81	125 A	127	50	53	76 A	70	91 A	101	82 A	69 AB	50 B
Glyphosate	16	29	77	64 B	59	127 A	82	82 AB	71	72	125 A	124	32	43	35 B	62	80 A	72	78 A	48 B	62 B

1. Means without a letter are not significantly different from the checks. Any two means having a common letter are not significantly different from each other at the 5 % level of significance, using the Protected Duncan's Test.

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

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

Herbicide treatments were applied to 8 X 160 ft plots across the grass strips in 25 gal/a water carrier, with TeeJet 8002 nozzles at a pressure of 25 psi, from a motorized plot sprayer operated at 1.9 mph. The application date was July 10, 1988. The air temperature was 73F, soil temperature was 93F at the surface, 91F at 2 inches depth, and 73F at 5 inches. The relative humidity was 38% and the sky was clear, 0 to 3 mph west wind. Grass seedling height ranged from 2 to 5 inches. Grass height, chlorosis, and seed head production were measured the first week of August. Internode length and seed head length were measured the third week of August 1988. Height, internode length, and estimated biomass were recorded in late July 1989. Grass cover was visually estimated and prickley lettuce plants (Lactuca seriola L. LACSE) were also counted in each plot in second week of June in 1990.

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

Oahe intermediate wheatgrass (WSWS 1989 Research Progress Report).

1989. Grass stands reduced by glyphosate in 1988 tended to be lower in 1989 (data shown in WSWS 1990 Research Progress Report pp. 111). Exerata redtop had six times more biomass when treated with 0.027 lb ai/a triasulfuron than did the check. Redtop in all clopyralid treatments except the combination of clopyralid and 2,4-D produced three times more shoot biomass. 2,4-D alone reduced redtop by about 50%. Both the combination of 2,4-D and clopyralid and 2,4-D alone increased the biomass of Alta tall fescue by 4 times; of Meckelenburg sheep fescue by 5 times; of common timothy by 3 times; and of Regar meadow brome by 1.6 times, but clopyralid alone did not. CGA-136872 at 0.013 lb ai/a increased Reubens Canada bluegrass biomass 10-fold and Kenblue Kentucky bluegrass treated with chlorsulfuron at 0.023 lb ai/a was increased 6 fold.

1990. Bluebunch X quackgrass cover was significantly increased (about 15%) when treated with 0.125 lb/a clopyralid, and was reduced 66% when treated with 0.5 lb/a glyphosate (data not shown). The cover produced by other grasses treated with herbicides were not statistically different from that the herbicide check. Glyphosate at 0.5 lb/a, however, tended to reduce cover of all grasses except fescues.

A natural prickly lettuce (Lactuca serriola L. (LACSE)) population became the dominant weed species in the third year. Prickly lettuce population densities were functions of a three-way interaction between grass species, grass cover, and herbicide. General linear modeling using least squares determined the fitness and evaluate the importance of the main effect categorical variables (grass and herbicides) and numerical variables (grass cover)(Table). All tested main effects were significant at P =0.0001 with the model R^2 = 0.47 and C.V. was 120.

Without grass cover and herbicides, prickly lettuce populations in this experiment ranged from 379 to 548 per 8 ft by 10 ft plot. As grass cover increased by 1%, prickly lettuce populations decreased 1.82 plants per plot. Some grass species were more competitive than others. Prickly lettuce populations per plot were forecast to be reduced by Oahe intermediate wheatgrass (99 plants per 8 ft by 10 ft plot), Covar sheep fescue (104 plants per plot), Manchar smooth brome (119 plants per plot), Regar meadow brome (127 plants per plot), Logro creeping red fescue (141 plants per plot) and Common timothy (146 plants per plot). Prickly lettuce populations were predicted to be greater in Reubens Canada Bluegrass (153 plants per plot), Exerata redtop (158 plants per plot) and Meckelenburg sheep fescue (180 plants per plot).

The model predicting prickly lettuce populations indicate herbicides significantly influenced the number of prickly lettuce plants per plot. Triasulfuron at either 0.027 and 0.054 lb ai/a was forecast to reduce prickly lettuce populations by about 100 plants per plot (Table). Picloram at 0.5 and 1.0 lb ai/a were predicted to reduce prickly lettuce populations by 96 and 87 plants per plot respectively. Herbicide persistence may explain these differences in part, but the benefit of increased grass cover in herbicide-treated plots can not be discounted. Decreased cover and lack of carryover herbicide residue in the glyphosate treatments was reflected in the prediction a of prickly lettuce increase ranging from 183 to 293 plant per plot.

The results of this study demonstrated that some of these grass taxa in combination with selective herbicides will resist the invasion of prickly lettuce. Many of the seedlings of taxa that showed injury the first year appeared to be normal plants the second and third year. (University of Idaho, Dept. of Plant, Soil, & Ent. Sci., Moscow 83843)

Table.
Predicting prickly lettuce populations three years after grass planting and herbicide application.

$Y_{cd} = u + a(_c) + b(_d) + B^1X^1(_{cd})$ $R^2 = 0.47$
C.V.= 120

Where:
u = Intercept = 273

B^1X^1 = Grass Cover (%) X -1.82

$a(_c)$ = Grass species	
bluebunch x quackgrass	ns
bluegrass, Canada	153
bluegrass, Kentucky	ns
brome, meadow	-127
brome, smooth	-119
fescue, creeping red	-141
fescue, hard	ns
fescue, sheep (Covar)	-104
fescue, sheep (Mecklenburg)	180
fescue, tall (Alta)	ns
fescue, tall (Fawn)	ns
orchard grass	ns
redtop	ns
redtop (Exerata)	158
redtop (Streaker)	ns
timothy, common	-146
wheatgrass, crested	ns
wheatgrass, intermediate	-99
wheatgrass, streambank	ns
check	106

$b(_d)$ = Herbicide Rate	(lb ai/A)	
Triasulfuron	0.000	ns
Triasulfuron	0.013	ns
Triasulfuron	0.027	-109
Triasulfuron	0.054	-104
Clopyralid	0.000	105
Clopyralid	0.220	92
Clopyralid	0.450	64
Clopyralid	0.900	94
2-4,D	1.000	83
Clop+2-4,D	0.45+1	ns
DPX-G8311	0.000	90
DPX-G8311	0.016	ns
DPX-G8311	0.023	ns
DPX-G8311	0.031	ns
Chlorsulfuron	0.000	ns
Chlorsulfuron	0.016	ns
Chlorsulfuron	0.023	ns
Chlorsulfuron	0.031	ns
Glyphosate	0.000	169
Glyphosate	0.125	240
Glyphosate	0.250	183
Glyphosate	0.500	295
Picloram	0.000	ns
Picloram	0.250	-87
Picloram	0.500	0
Picloram	1.000	-96
Primisulfuron	0.000	ns
Primisulfuron	0.013	ns
Primisulfuron	0.027	ns
Primisulfuron	0.054	ns

ns = prediction of Y_{cd} would not significantly change with the addition to the regression equation.

Effects of winter and spring applied herbicides on yellow starthistle density. Callihan, R.H., R.O. Schirman and William J. Price. A rangeland field with yellow starthistle (*Centaurea solstitialis* L. CENSO) was suspected of containing picloram-resistant yellow starthistle. A field evaluation was established to compare the results of four soil persistent herbicides applied in winter and spring at concentrations well above normal use rates. The object was to determine whether the high doses would eliminate the yellow starthistle plants that may survive recommended doses.

Metsulfuron was applied in late fall (13 December 1989) and mid-spring of the following year (10 May 1990) at a rate of 0.08 kg ai/ha (1.1 oz ai/ha). Triclopyr at 5.0 kg ae/ha (4.5 lb ae/ac), picloram 1.2 kg ae/ha (1.1 lb ae/ac) and tebuthiuron 10.8 kg ai/ha (9.6 lb ai/ac) were applied on 13 Dec. 1989 and early spring (19 April 1990). Water with 0.5% non-ionic surfactant 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 four replications. The plots were arranged in a randomized complete block experimental design.

Density counts were taken on 17 July 1990. A 0.75 m^2 (8 ft^2) quadrat was used to sample the plots. All standing live yellow starthistle plants were recorded from two quadrats in each plot, resulting in eight observations for each date that a chemical treatment was applied.

The control plots averaged 131.5 plants/m^2 (Table). The late fall metsulfuron plots averaged 14 plants/m^2 (89% control) while the spring-applied metsulfuron plots averaged 6.4 yellow starthistle plants/m^2 or 95% control. Yellow starthistle control in both the winter and spring triclopyr plots averaged >99% (0.7 plants/m^2 in winter plots and 0.3 plants/m^2 in spring plots). No live yellow starthistle plants were observed in the picloram or tebuthiuron treatments (100% control).

Due to the wide variation of densities in the control plots in comparison to the treated plots, and the large number of observations with zero plant counts (48 out of 72), the data did not fit a normal distribution. A ranking procedure was used to transform the data so that the normality assumption of an analysis of variance could be met. A rank transformation procedure was used in which the data was ordered from the lowest to the highest. Each observation (subplot in this case) was then assigned the appropriate rank score, and equal data values were assigned equal scores.

The mean rank transformed density score from the control treatment (68.5) was significantly higher (P=0.05) than the average rank transformed density scores in all treated plots (see Table). Both the December and May metsulfuron rank transformed densities were significantly higher than the triclopyr, picloram and tebuthiuron rank transformed densities, but no significant differences were detected between the December (50.3) and April (45.9) metsulfuron rank scores.

Even though the April triclopyr treatment produced 99.5% control, its mean rank score (34.7) was significantly higher (meaning significantly less control) than the rank scores of all picloram and tebuthiuron treatments (24.5), which produced 100% control (see Table). Average rank score (31.0) for the densities in plots receiving the December triclopyr application was not significantly different from the picloram and tebuthiuron treatments. (Idaho Agricultural Experiment Station, Moscow 83843)

Table. Effects of late fall and spring applied herbicides on yellow starthistle density in a rangeland population suspected of containing picloram resistant genotypes.

Chemical rate	Month applied	density	Rank-transformed density	Control (density reduction)
		(no/m^2)	(score)*	(%)
Control	---	131.5	68.5 A**	0.0
Metsulfuron	Dec	14.1	50.3 B	89.3
0.08 kg ai/ha	May	6.4	45.9 B	95.1
Triclopyr	Apr	0.7	34.7 C	99.5
5.0 kg ae/ha	Dec	0.3	31.0 C D	99.7
Picloram	Dec	0.0	24.5 D	100.0
1.2 kg ae/ha	Apr	0.0	24.5 D	100.0
Tebuthiuron	Dec	0.0	24.5 D	100.0
10.8 kg ai/ha	Apr	0.0	24.5 D	100.0
LSD (P=0.05)	---	---	8.2	---

* Rank scores were established by ordering each numeric value for each response variable from the lowest to the highest. Then the appropriate number was assigned to each observation (beginning with one for the lowest observation). Density or biomass observations with the same values were given an average score based on the mean of the rank scores they encompassed.

** Means followed by the same letter are not significantly different (P=0.05).

Effects of picloram and dicamba on the survival of yellow starthistle seedlings transplanted from a suspected picloram resistant and a known picloram susceptible population. Callihan, R.H. and R.O. Schirman. Yellow starthistle seedlings (*Centaurea solstitialis* L. CENSO) were transplanted into plastic cups from soil cores (approx. 20 cm diameter and 15 cm deep) removed from semiarid pastures. A single plant was transplanted into each cup. Cores from the susceptible population were dug from a site in northwestern Nez Perce Co., Idaho. The suspected picloram resistant plants came from a rangeland site in Columbia Co., Washington in which recent picloram treatments had failed to satisfactorily control the weed after eight consecutive years of treatment with picloram over all or parts of the field. A screening trial was established using potted plants to compare the survival of the two populations when treated with picloram and dicamba at six rates each.

Transplanting was completed three days after soil cores were collected on 19 April (Columbia Co.) and 20 April (Nez Perce Co.). The plants were small rosettes (2-3 cm tall with 3-7 leaves) when transplanted. The transplants were grown in the cups for six weeks prior to spraying on 6 June 1990. The plants had stems from 15 to 25 cm tall with 8-16 leaves at the base when the herbicides were applied. Dicamba was applied at rates of 0.14, 0.28, 0.56, 1.12 and 2.24 kg ae/ha. Picloram was applied at rates of 0.07, 0.14, 0.28, 0.56 and 1.12 kg ae/ha. A non-sprayed control was also included for each population and chemical. Water with 0.5% non-ionic surfactant was used as a carrier and was applied at a rate of 351 l/ha.

Each chemical rate treatment within a population contained 16 cups (replications) giving 16 test plants per treatment. The cups were arranged in a randomized complete block experimental design containing 16 replications 24 hours after treatments were applied. A susceptible and suspected resistant plant for each chemical rate and population were paired together within each replication thereby imposing a split plot upon the experimental design..

Plant survival was recorded three weeks after spraying. The data were analyzed by chi-square analysis using a categorical modeling procedure (SAS/STAT User's Guide, 1988). The results are shown Tables 1 and 2. Yellow starthistle survival was not significantly different between the two chemicals three weeks after treatment (Table 1). Fifty percent of the yellow starthistle died in both chemical treatments. No significant differences were found in the two way interactions nor in the three way interaction (Chemical*Rate*Population).

The survival differences between the two populations were highly significant (P=0.01) in the 0.14 kg/ha picloram and the 0.14 kg/ha dicamba treatments (Table 2). The suspected resistant population had about three times more live plants than the known susceptible population. Survival in the 0.07 kg/ha picloram and the 0.28 dicamba treatments were significantly different (P=0.05) between the two populations. These results indicate a substantial difference exists between these two populations' ability to survive foliar treatments of picloram and dicamba. (Idaho Agricultural Experiment Station, Moscow 83843)

Table 1. Analysis of variance table for the effects of six rates of picloram and dicamba on yellow starthistle.

Source of variation	Degrees of freedom	Chi-square value	Probability of a higher chi-square
Intercept	1	25.88*	0.0001
Chemical	1	0.08	0.7736
Rate	5	61.85	0.0001
Population	1	36.43	0.0001
Chemical*Rate	5	0.32	0.9973
Chemical*Population	1	0.19	0.6648
Rate*Population	5	2.15	0.8280
Chem.*Rate*Population	5	0.80	0.9768

* The statistical procedure was a CATMOD categorical modeling analysis based on a Chi-square test (SAS/STAT User's Guide, 1988).

Table 2. Effects of picloram and dicamba on yellow starthistle from susceptible and resistant populations.

Rate	Picloram		Dicamba	
	Resistant	Susceptible	Resistant	Susceptible
kg ae/ha	(% dead plants)			
0.00	0	25	0	25
0.07	38*	75*	-	-
0.14	31**	100**	19**	88**
0.28	81	100	44*	100*
0.56	69	100	63	100
1.12	88	100	75	100
2.24	-	-	81	100

*Indicates a significant difference (P=0.05) between the two populations within a single chemical rate.
**Indicates a highly significant difference (P=0.01) between the two populations within a single chemical rate.

Effects of five hormone-type herbicides on the survival of yellow starthistle seedlings from a known susceptible population and a suspected picloram resistant population. Callihan, R.H. and R.O. Schirman. Yellow starthistle seeds (*Centaurea solstitialis* L. CENSO) were planted in 1 quart white polyethylene potting containers. Two seedlots (collected during the fall of 1989) were planted. The first seedlot (from northwestern Nez Perce Co., Idaho) was collected from a population known to be susceptible to picloram. The second seedlot (from Columbia Co., Washington) was collected from a rangeland site in which repeated picloram treatments had failed to control the weed. A screening trial was established to determine whether cross-resistance within a group of five herbicides would be exhibited.

The seedlings were treated at the five to seven leaf stage (14 and 15 June 1990). Picloram and clopyralid were applied at rates of 0.018, 0.035, 0.070, 0.140 and 0.280 kg ae/ha. Dicamba was applied at rates of 0.035, 0.07, 0.140, 0.280 and 0.560 kg ae/ha. Triclopyr and 2,4-D LVE were applied at rates of 0.07, 0.14, 0.28, 0.56 and 1.12 kg ae/ha. A non-sprayed control was also included for each population and chemical. Water with 0.5% non-ionic surfactant was used as a carrier and was applied at a rate of 350.7 l/ha. Forty-eight to 72 hours after spraying, the treated plants in their peat moss-vermiculite plugs were removed intact from the polyethylene containers and transplanted into a cultivated field environment.

Each transplanted plug contained four seedlings and was replicated five times, giving a total of 20 seedlings for each chemical rate within a population. The replications were arranged into a randomized complete block experimental design, when the plugs were transplanted into the field. A susceptible and suspected resistant plug for each chemical rate and population was paired together and transplanted side-by-side within each replication.

Plant survival was recorded four weeks after spraying. Most plants that did not survive died within the first 14 to 21 days. By day 28, a clear distinction could be made between dry, brittle, brown to black colored leaves of dead plants and the succulent, green, flexible leaves of the live plants. The data were analyzed by chi-square analysis using a categorical modelling procedure (SAS/STAT User's Guide, 1988).

The two populations had significantly different numbers of plants surviving picloram treatments at rates of 0.018, 0.035 and 0.07 kg/ha (Table). The susceptible population had significantly higher (P=0.001) mortality in the 0.018, 0.035 and 0.07 kg/ha picloram treatments. The susceptible population had 65% dead at 0.018 kg/ha picloram while the suspected resistant population had 25% dead. The percent of dead plants in the 0.035 kg/ha rate was 65% for the susceptible and 20% for the resistant population. The 0.07 kg/ha rate produced 100% mortality in the susceptible population versus 60% mortality in the suspected resistant population, but at 0.14 and 0.28 kg/ha picloram rates, both populations had 100% mortality.

No differences were detected between the two populations in the clopyralid treatments (Table). The chemical was uniformly effective across all rates with a range of 80% to 100% dead plants in both populations.

The numbers of dead plants in the two populations were significantly different at three dicamba rates (Table). A significantly higher percentage of dead plants were observed in the susceptible population treated with dicamba rates of 0.07 kg/ha (55% vs 10%), 0.14 kg/ha (85% vs 50%) and 0.28 kg/ha (90% vs 55%). Both populations had 100% mortality at 0.56 kg/ha dicamba.

The three highest rates of 2,4-D caused 90% to 100% mortality in both populations (Table), but the 0.07 and 0.014 kg/ha rates produced significantly higher numbers of dead plants in the susceptible population. The susceptible population had 60% dead plants in the 0.07 kg/ha rate and 85% dead plants in the 0.014 kg/ha rate while the suspected resistant population had 30% and 45% dead plants in the two rates respectively.

Mortality in the triclopyr treatments was reversed when compared to the above herbicides in that the suspected resistant population had significantly higher (P=0.001) mortality than the susceptible population in the 0.14 and 0.28 kg/ha treatments. Seventy percent and 95% of the plants were dead in the suspected resistant population sprayed with 0.14 and 0.28 kg/ha rates respectively. The susceptible population had 30% and 65% mortality in the same treatments. The 0.56 and 1.12 kg/ha triclopyr treatments had 100% mortality for both populations. (Idaho Agricultural Experiment Station, Moscow 83843)

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Table. Effects of herbicides on picloram resistant and picloram susceptible yellow starthistle seedlings.

Herbicide Population	Plant Response					
PICLORAM(kg/ha)	0	0.018	0.035	0.07	0.14	0.28
	(% dead)					
susceptible	0	65**	65**	100**	100	100
suspected resistant	0	25**	20**	60**	95	100
CLOPYRALID(kg/ha)	0	0.018	0.035	0.07	0.14	0.28
	(% dead)					
suseptible	0	90	95	95	100	100
suspected resistant	0	80	80	85	100	100
DICAMBA(kg/ha)	0	0.035	0.07	0.14	0.28	0.56
	(% dead)					
susceptible	0	10	55**	85**	90**	100
suspected resistant	0	20	10**	50**	55**	100
2,4-D LVE(kg/ha)	0	0.07	0.14	0.28	0.56	1.12
	(% dead)					
susceptible	0	60**	85**	95	100	100
suspected resistant	0	30**	45**	90	100	100
TRICLOPYR(kg/ha)	0	0.07	0.14	0.28	0.56	1.12
	(% dead)					
susceptible	0	55	30**	65**	100	100
suspected resistant	0	55	70**	95**	100	100

** Indicates significant difference (P=0.0001) between populations within single herbicide rates based on Chi-square analysis using a categorical modeling procedure (SAS/STAT User's Guide, 1988).

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Effects of herbicides on yellow starthistle density and vegetative biomass components of a rangeland yellow starthistle weed community. Northam, F.E. and R.H. Callihan. A field screening trial was established to compare the efficacy of seven herbicides applied to a rangeland weed community dominated by yellow starthistle (*Centaurea solstitialis* L. CENSO). The site was located near the top of Central Grade in northwestern Nezperce Co., Idaho. The following herbicides and rates were applied on 1 May 1990: metsulfuron at 0.014 and 0.042 kg ai/ha, picloram at 0.28 kg ae/ha, imazapyr at 0.28 kg ae/ha, clopyralid at 0.28 kg ae/ha, dicamba at 1.12 kg ae/ha, 2,4-D at 1.12 kg ae/ha and triclopyr at 1.68 kg ae/ha. A non-sprayed control was also included. The treatments were replicated four times and arranged in a randomized complete block experimental design.

Water was used as a carrier and applied at a rate of 52 l/ha with a non-ionic surfactant at a 0.5% v/v ratio. Environmental conditions during spraying included: air temperature 19 C, soil temperature at 5 cm 16 C, relative humidity 48%, wind mostly calm with occasional 5-8 km/hr gusts from the west, moist soil surface, no dew was present and 60% of the soil surface was covered with plant litter from the previous season. The plot area was mowed two weeks prior to spraying to remove a 30-40 cm deep layer of standing litter from the previous growing season. The yellow starthistle plant height ranged from eight to ten cm with four to seven leaves. A few of the annual bromes were beginning to produce inflorescences.

Density and biomass samples were taken on 17 July 1990. Density estimates were made by counting the number of live yellow starthistle plants in a 0.74 m^2 quadrat. The standing vegetative biomass was sampled by clipping a 0.37 m^2 quadrat. The clipped material was dried for 24 hours at 48 C. Each sample was hand separated into yellow starthistle and all other live herbaceous material (both grasses and dicots), then weighed. This gave yellow starthistle and non-yellow starthistle biomass measurements. Total biomass was estimated by adding the two weights.

Yellow starthistle density results are shown in Table 1. The control plots averaged 319 plants/m^2. The least reduction in yellow starthistle density was in the sulfometuron plots, which averaged 18% reduction (262 plants/m^2) in the 0.014 g/ha treatment and 55% reduction (143 plants/m^2) in the 0.042 g/ha treatment. Yellow starthistle density was reduced more than 90% in all other herbicide plots. The triclopyr and 2,4-D LVE plots had yellow starthistle densities of 21 and 11 plants/m^2 respectively (94 and 97% reduction). The remaining treatments had less than 3 yellow starthistle plants/m^2 and reduced density more than 99%.

The density data were transformed by a ranking procedure that placed the observations in numerical order beginning with the smallest. A score (based on the position in the sequence from the lowest to the highest) was assigned to each density value in the data set. The rank transformed scores were used in an analysis of variance. Based on these scores, the control treatment was not significantly different (P=0.05) from the 0.014 g/ha metsulfuron treatment. The score for the 0.042 g/ha metsulfuron treatment (55.4) was significantly less than the control treatment (64.4) and both metsulfuron treatments were significantly greater than all other herbicide treatments. The average rank scores from the four herbicides that reduced yellow starthistle density over 99% (imazapyr, picloram, dicamba and clopyralid) were not significantly different.

Yellow starthistle standing biomass ranged from 115 g/m^2 (metsulfuron at 0.014 kg/ha) to less than 0.1 g/m^2 in the picloram, dicamba and clopyralid plots (Table 1). The 0.014 kg/ha metsulfuron averaged 34% more biomass than the 76 g/m^2 mean of the control plots. Metsulfuron at 0.042 kg/ha yielded 57 g/m^2 of standing yellow starthistle biomass, which was a reduction of 27% below the control. All other herbicide treatments had less than 11 g/m2 or more than 85% biomass reduction. Imazapyr, picloram, dicamba and clopyralid had less than 1.5 g/m^2 of yellow starthistle, which was greater than 98% biomass reduction.

The yellow starthistle biomass observations were transformed according to the rank procedure described for the density data above (Table 1). Based on the rank scores, the control and the two metsulfuron treatments were not significantly different (P=0.05). The average rank scores for all other herbicide treatments were significantly less than the mean scores of the control and metsulfuron plots. Among the four herbicides that reduced yellow starthistle biomass over 98%, (imazapyr, picloram, dicamba and clopyralid) none had significantly different rank scores.

Table 2 shows the non-yellow starthistle biomass results. The control treatment averaged 56 g/m^2 which was less than the dicamba (65 g/m^2) and the 2,4-D LVE (62.7 g/m^2) averages. Non-yellow starthistle biomass in plots treated with clopyralid, metsulfuron at 0.042 kg ai/ha or picloram averaged 53, 47 and 48 g/m^2 respectively, which ranged from 7% to 18% reduction in comparison to the control average. Plots treated with triclopyr or 0.014 kg/ha metsulfuron averaged slightly over 50% less non-yellow starthistle biomass (27 and 26 g/m^2 respectively) than was present in the control plots. Imazapyr averaged only 14 g/m^2 or 76% less than the control treatment.

Based on analysis of variance of the rank transformed non-yellow starthistle biomass data (Table 2), no significant differences were detected between the control treatment rank score (48.4) and the following herbicide treatments' rank scores: dicamba (46.9), 2,4-D LVE (44.1), clopyralid (44.1), and 0.042 kg/ha metsulfuron (41.3). Even though the picloram rank score (37.0) was significantly different from that of the control, it was not significantly different from scores for biomass from plots treated with dicamba, 2,4-D LVE, clopyralid or 0.042 kg/ha metsulfuron. The rank scores of biomass from the treatments with the two lowest non-yellow starthistle biomass averages (metsulfuron at 0.014 and imazapyr) were not significantly different from each other (24.1 and 15.4 respectively), but they were significantly less than all other treatments except 0.014 kg/ha metsulfuron and triclopyr; these two were not significantly different from each other.

The total standing biomass depended on the treatment effect on yellow starthistle biomass (Table 2). Those treatments that did not significantly reduce yellow starthistle density or standing biomass resulted in the highest total biomass (control-132 g/m^2, metsulfuron at 0.014 kg/ha-141.5 g/m^2 and metsulfuron at 0.042 g/ha-102 g/m^2). The average rank transformed scores from these four treatments were not significantly different (Table 2). These data show that controlling yellow starthistle decreases forage production on heavily infested sites because there is no seed material from perennial grasses to replace the weed biomass. Long term control of yellow starthistle will require revegetation efforts also.

The imazapyr plots averaged 15 g/m^2 of total standing vegetative biomass (Table 2) which was an 89% reduction in biomass when compared to the control. The mean rank transformed total for total biomass score from the imazapyr plots was significantly lower than the rank scores of any other treatments. The sharp decline of vegetative material in the imazapyr plots would be expected since this treatment is a general purpose herbicide that tends to be non-selective in this circumstance. (Idaho Agricultural Experiment Station, Moscow 83843).

Table 1. Effects of herbicides on rangeland yellow starthistle density and biomass.

Herbicide Rate	Yellow Starthistle Density decrease*	density	rank	Yellow Starthistle Biomass decrease	biomass	rank
	(%)	(no/m^2)	(score)*	(%)	(g/m^2)	(score)*
CONTROL	0.0	318.7	64.4 A**	0.0	76.0	63.0 A**
Metsulfuron 0.014 kg ai/ha	17.9	261.8	61.2 AB	0.0	115.1	61.0 A
Metsulfuron 0.042 kg ai/ha	55.4	142.7	55.4 B	26.8	55.6	56.6 A
Triclopyr 1.68 kg ai/ha	93.5	20.7	40.7 C	85.7	10.8	38.5 B
2,4-D LVE 1.12 kg ai/ha	96.7	10.6	28.3 D	96.8	2.4	27.4 C
Imazapyr 0.14 kg ai/ha	99.1	2.9	21.9 DE	98.3	1.3	24.1 CD
Picloram 0.28 kg ai/ha	99.2	2.4	23.6 DE	99.9	<0.1	20.8 CD
Dicamba 1.12 kg ai/ha	99.9	0.2	17.6 E	100.0	0.0	18.5 D
Clopyralid 0.28 kg ai/ha	100.0	0.0	15.5 E	100.0	0.0	18.5 D
LSD (P=0.05)	--	--	8.9	--	--	7.0

* Percent reduction compared to the control plots.

** Rank scores were established by ordering each numeric value for each response variable from the lowest to the highest. Then the appropriate number was assigned to each observation (beginning with one for the lowest observation). Density or biomass observations with the same values were given an average score based on the mean rank of the scores they encompassed.

*** Means followed by the same letter were not significantly different (P=0.05).

Table 2. Effects of herbicides on the biomass of non-yellow starthistle and total vegetation components in yellow starthistle infested rangeland.

Herbicide Rate	Decrease*	Biomass	Rank Transformation
	(%)	(g/m^2)	(score)
NON-YELLOW STARTHISTLE BIOMASS			
CONTROL	0.0	56.4	48.4 A
Dicamba 1.12 kg ae/ha	0.0	65.3	46.9 AB
2,4-D LVE 1.12 kg ae/ha	0.0	62.7	44.1 AB
Clopyralid 0.28 kg ae/ha	6.6	52.7	44.1 AB
Metsulfuron 0.042 kg ai/ha	17.6	46.6	41.3 AB
Picloram 0.28 kg ae/ha	14.2	48.4	37.0 BC
Triclopyr 1.68 kg ae/ha	51.4	27.4	27.1 CD
Metsulfuron 0.014 kg ai/ha	53.2	26.4	24.1 DE
Imazapyr 0.14 kg ae/ha	76.1	13.5	15.4 E
LSD (P=0.05)	--	--	10.8
TOTAL VEGETATIVE BIOMASS			
CONTROL	0.0	132.4	60.1 A
Metsulfuron 0.014 kg ai/ha	0.0	141.5	54.1 A
Metsulfuron 0.042 kg ai/ha	22.8	102.2	51.4 A
Dicamba 1.12 kg ae/ha	49.3	65.3	35.3 B
2,4-D LVE 1.12 kg ae/ha	50.8	65.1	34.9 B
Clopyralid 0.28 kg ae/ha	60.3	52.6	31.1 BC
Picloram 0.28 kg ae/ha	63.4	48.4	27.0 BC
Triclopyr 1.68 kg ae/ha	70.9	38.5	24.3 C
Imazapyr 0.14 kg ae/ha	88.8	14.8	10.4 D
LSD (P=0.05)	--	--	9.1

* Percent reduction compared to the control plots.

Control of common tansy in pasture. Miller, T.W. and R.H. Callihan. A common weed in north central Idaho is common tansy (*Tanacetum vulgare* L.). Control by herbicides is possible, and is often the only practical method of control of this aromatic perennial.

A pasture near Potlatch, Idaho, heavily infested with tansy, was selected for the study. The field was burned on April 19 to eliminate seed stalks from previous years. Plots measured 20 x 20 ft and treatments were arranged in a randomized complete block design and replicated four times. Treatments were applied May 25 in a carrier volume of 20 gal water/a with a CO_2-powered backpack sprayer. The tansy plants were approximately 8 to 12 inches in height at the time of spraying and were beginning to form flower stalks. Weed control percentage was based on weed density (100% = no weeds), and was estimated to the nearest 5% on July 31. Data were analyzed using analysis of variance procedure, and means were separated using Fisher's least significant difference test (P=0.05).

Three treatments resulted in excellent control of tansy 68 days after application: picloram, metsulfuron, and dicamba + 2,4-D (99, 98, and 92% control, respectively). These treatments were not statistically different in their level of weed control. The clopyralid + 2,4-D treatment was not as effective as the other 3 treatments (65% control).

Grass response to all treatments was excellent (data not shown). This rapid grass growth may delay re-infestation of tansy into sprayed plots, although periodic re-application of herbicides will likely be necessary. Plots will be re-evaluated during the spring of 1991 to determine longevity of control and need for retreatment. (University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Percent control of common tansy in pasture by selected herbicides in northern Idaho (1990).

Treatment	Rate	Brand Name	Percent Control
	(ai or ae/a)		
Picloram	0.25 lb	Tordon 22K	99
Metsulfuron	0.3 oz	Ally	98
Dicamba + 2,4-D	0.5 lb + 1.44 lbs	Weedmaster	92
Clopyralid + 2,4-D	0.19 lb + 1 lb	Stinger + 2,4-D	65
Check	-	-	0
lsd (0.05)			13
c.v.			12

Survey and removal of matgrass plants in an eradication program. R.H. Callihan and L. Puchalski. An infestation of matgrass *(Nardus stricta* L.*)* is located in approximately 60 acres of a wet mountain meadow habitat four miles north of Bovill, Idaho. This is the only known occurrence of this alien species in Idaho. Scattered, disjunct colonies of this grass have spread into wet meadow and forest habitats adjacent to the main infestation. The University of Idaho and the U.S. Forest Service are continuing a research based integrated pest management plan to eradicate this invader from the Clearwater National Forest. Consistent annual application of this plan is necessary for the eradication of this infestation. One component of the plan is the detection and elimination of matgrass colonies.

Surveys for disjunct colonies were conducted in the autumn of 1986, 1987, 1988, 1989, and 1990. Colonies were defined as individual matgrass plants, or clumps of matgrass plants separated by no more than six feet. The number of disjunct colonies located during the surveys were 36 in 1986, 22 in 1987, 28 in 1988, 41 in 1989, and 40 in 1990. Removal of the colonies began in 1987, with a total of 167 disjunct colonies removed since then.

A total of 567 acres were surveyed in 1988, 636 acres in 1989, and 130 in 1990. The 1990 survey included 70 acres adjacent to the meadows where the infestation is centered. The most significant discovery of the 1990 survey was a single colony located on a feeder drainage into Feather Creek. It was approximately 200 yards further north than plants previously found. The linear distance from the northern-most to the southern-most colony found so far is 1.76 miles. The linear distance from the eastern-most to western-most disjuncts found so far is approximately one mile.

The main meadow infestation was surveyed for the first time in 1990. Previous surveys concentrated on locating disjunct colonies outside of the main infestation. The 1990 survey focused primarily on the meadow infestation and areas adjacent to it. Approximately 2800 established plants were removed from the originally infested meadows. This represented about 1/4 of the number of plants treated by spot spraying the meadows with glyphosate in 1989. It was noted that progressively fewer plants were found per unit area as one moves away from the central portion of the meadow where the original infestation was located.

Eight new colonies were found south of Potlatch Creek, resulting in a total of 25 colonies removed from the area south of Potlatch Creek since 1987. The five years of survey outside of the original meadow infestation have confirmed that the main body of the infestation remains north of the west fork of Potlatch Creek. The number of new disjuncts found in 1990 indicates that surveys for disjuncts should continue for several more growing seasons. The newly found colony at the northern end of the survey area and the colonies found at the southern end indicate that future surveys should continue searching meadows and forest land further north and south of the main infestation. Meadow areas east of State Highway Three need to be surveyed since four colonies have been found within 50 meters of the highway during previous surveys.

Visual detection of matgrass in a sward is the most critical and difficult factor in the eradication program. The ability to detect and remove matgrass has improved over the five years as indicated by the increase in numbers found each year. Disjunct colonies are expected to be discovered in the survey area for three to four more years, but the number of disjunct colonies is expected to decrease substantially during that time. Annual surveys will need to continue for several years to ensure disjunct removal is accomplished before this portion of the IPM eradication program is completed. (Idaho Agricultural Experiment Station, Moscow 83843)

Herbicide screening trial in a yellow starthistle population suspected of containing picloram-resistant genotypes. Callihan, R. H., R. O. Schirman and William J. Price. Normally 0.28 kg/ha picloram provides effective chemical control of yellow starthistle (*Centaurea solstitialis* L. CENSO) on Pacific Northwest rangeland, but a population in one repeatedly treated field has not been effectively controlled by this treatment. A screening trial was established in that field to compare the efficacy of seven herbicides on that yellow starthistle population.

Picloram at 0.28, 0.56 and 0.84 kg ae/ha and triclopyr at 1.68 kg ae/ha were applied on 19 April 1990 to yellow starthistle plants 2-3 cm tall with 3-7 leaves per rosette. The following treatments were applied on 10 May 1990: clopyralid at 0.28 and 0.56 kg ae/ha, metsulfuron at 0.014 and 0.042 kg ai/ha, imazapyr at 0.14 kg ae/ha, 2,4-D low volatile ester at 1.12 kg ae/ha and dicamba at 1.12 kg ae/ha. A non-sprayed control was also included. The treatments were replicated four times and arranged in a randomized complete block experimental design. Water was used as a carrier at 51.9 l/ha with 0.5% (v/v) non-ionic surfactant.

The density and standing biomass of yellow starthistle were sampled on 17 July 1990. Densities were estimated by counting the number of live yellow starthistle plants in a 0.74 m^2 (8 ft^2) quadrat. The standing yellow starthistle biomass was estimated by clipping all live starthistle plants in a 0.37 m^2 (4 ft^2) quadrat. The clipped material was dried 24 hours at 48 C (120 F) and then weighed. Two subsamples were taken from each plot, giving eight observations for each treatment from the four replicates.

Yellow starthistle density and biomass from the April picloram plots are shown in the table. The average yellow starthistle density ranged from 86 plants/m^2 in the control plots to none in plots treated with 0.84 kg/ha picloram. Plots treated with 0.28 kg/ha picloram averaged 17 plants/m^2 which was an 81% reduction in yellow starthistle density. The densities in the plots treated with 0.56 and 0.84 kg/ha were reduced 98% and 100% respectively. All herbicide treatments reduced yellow starthistle density to less than 75% of the control. Both clopyralid rates, metsulfuron at 0.014 kg ai/ha and the April picloram at 0.28 kg ae/ha provided less than 90% control. The densities were 21 plants/m^2 for clopyralid at 0.28 kg ae/ac, 17 plants/m^2 for the April 0.28 kg ae/ha picloram, 15 plants/m^2 for clopyralid at 0.56 kg ae/ha and 12 plants/m^2 for metsulfuron at 0.014 kg ai/ha.

Triclopyr at 1.68 kg ae/ha resulted in 7 yellow starthistle plants/m^2, which was a 93% reduction in density. All other treatments reduced density more than 95%. Imazapyr at 0.14 kg ae/ha (4.0 plants/m^2), May picloram at 0.28 kg ae/ha (2.1 plants/m^2), 2,4-D at 1.12 kg ae/ha (1.7 plants/m^2) and April picloram at 0.56 kg ae/ha (1.3 plants/m^2) ranged from 96% to 99% control. Three treatments produced over 99% control; these were 0.042 kg ai/ha metsulfuron (0.7 plants/m^2), 1.12 kg/ha dicamba, and 0.84 kg ae/ha picloram (0 plants/m^2 or 100% control).

Because of the range of yellow starthistle density and biomass values among treatments, plus the number of subsamples with zero values (55 out of 104), the data did not fit a normal distribution. A rank transformation was used to adjust the frequency distribution of the subsamples so that a valid analysis of variance could be calculated. The lowest value was transformed to a value of one, the second lowest value was transformed to 2 and so on to the highest value which was transformed to the number of observations in the data set (in this case the subplot with the highest density count was transformed to 104). Observations with equal values were assigned a rank score that was the average of the rank scores they encompassed. For example, the first 55 density observations were zeros. These values were all assigned the score of

28 (1 + 2 + 3 ... + 55 ÷ 55). The rank transformed values were used in the analysis of variance. The analysis of variance was conducted separately on the biomass data from the April picloram treatments.

The mean rank transformed density score from the control treatment (99.9) was significantly higher (P = 0.05) than the average rank transformed density scores in all treated plots (see Table). The herbicide treatments that produced less than 90% yellow starthistle control (clopyralid at 0.28 and 0.56 kg ae/ha, April picloram at 0.28 kg ae/ha and metsulfuron at 0.014 kg ai/ha) had rank scores that were significantly higher than the rank transformed densities of the remaining herbicide treatments.

Six treatments reduced the yellow starthistle stands by 98% or more. The rank scores of those treatments were not significantly different (2,4-D LVE-28.1, April picloram at 0.56 kg ae/ha-34.0, imazapyr-33.1, dicamba-32.1, metsulfuron at 0.042 kg ai/ha-31.8 and April picloram at 0.84 kg ae/ha).

The 0.28 kg/ha picloram treatment applied in April was distinctly inferior to the 0.56 and 0.84 kg/ha picloram treatment applied at that time. In most yellow starthistle infestations, 0.28 kg/ha picloram provides over 90% reduction in density and biomass, and 0.56 kg/ha provides 100% control. Investigation of the 6% yellow starthistle that escaped the 0.56 kg/ha rate is underway. (Idaho Agricultural Experiment Station, Moscow 83843)

Table. Effects of herbicides on yellow starthistle density and biomass.

Herbicide rate	Month applied	Control (percent reduction) Biomass	Control (percent reduction) Density	Yellow starthistle Biomass	Yellow starthistle Density	Rank transformation Biomass	Rank transformation Density
		(%)	(%)	(g/m^2)	(No./m^2)	(score)*	(score)*
Control	---	0.0	0.0	34.8	85.8	26.9 A	99.9 A**
Clopyralid 0.28 kg ae/ha	May	---	78.2	---	20.6	---	77.8 B
Clopyralid 0.56 kg ae/ha	May	---	84.3	---	14.9	---	77.1 B
Picloram 0.28 kg ae/ha	April	63.0	82.5	12.9	16.6	21.3 B	76.4 B
Metsulfuron 0.014 kg ai/ha	May	---	88.5	---	10.9	---	63.8 C
Triclopyr 1.68 kg ae/ha	April	---	92.9	---	6.7	---	48.6 D
Picloram 0.28 kg ae/ha	May	---	97.6	---	2.2	---	41.9 DE
2,4-D LVE 1.12 kg ae/ha	May	---	98.0	---	1.7	---	38.1 DEF
Picloram 0.56 kg ae/ha	April	94.0	98.6	2.0	1.3	9.9 C	34.0 EF
Imazapyr 0.14 kg ae/ha	May	---	98.8	---	1.0	---	33.1 EF
Dicamba 1.12 kg ae/ha	May	---	99.6	---	0.3	---	32.1 EF
Metsulfuron 0.042 kg ai/ha	May	---	99.8	---	0.2	---	31.8 EF
Picloram 0.84 kg ae/ha	April	100.0	100.0	0.0	0.0	8.0 C	28.0 F
LSD (P = 0.05)		---	---	---	---	3.7	12.0

* Rank scores were established by ordering each numeric value for each response variable from the lowest to the highest. Then the appropriate number was assigned to each observation (beginning with one for the lowest observation). Density or biomass observations with the same values were given an average score based on the mean of the rank scores they encompassed.

** Means followed by the same letter were not significantly different (P=0.05).

Timing of herbicide applications for control of larkspurs. Ralphs, M.H., J.O. Evans and S.A. Dewey. Larkspur species pose a significant threat of poisoning to cattle on mountain rangelands. Duncecap and tall larkspur are long-lived perennial species that resprout from the crown and roots, and are difficult to kill. Previous research identified herbicides that are active against these two species. The objective of this research was to determine the optimum time of application.

Picloram and triclopyr (1.1, 2.2 and 4.5 kg ae ha^{-1}), glyphosate (0.5, 1.1 and 2.2 kg ai ha^{-1}) and metsulfuron (.035, .070 and .140 kg ai ha^{-1}) were applied in the late vegetative, bud, and flower growth stage of duncecap larkspur at Oakley, ID, and tall larkspur at Manti, UT in 1988 and 1989. Larkspur density and cover of associated species was measured one year later.

Picloram was equally effective in controlling duncecap larkspur over all growth stages. The 1.1 kg ha^{-1} rate controlled more than 70% of all larkspur plants and the 2.2 kg ha^{-1} rate gave near total control. Tall larkspur was controlled at the 1.1 kg ha^{-1} rate (> 84% of plants killed) in the bud and flower stages, but the 2.2 kg ha^{-1} rate was required to kill more than 80% of the plants in the vegetative stage. Picloram offers the advantage of being equally effective during most of the growing season. This is important because access to these high elevation areas is difficult early in the summer. Picloram is selective to broadleaf forbs, and grass cover increased at both locations at rates of 1.1 and 2.2 kg ha^{-1}.

Metsulfuron is also selective to broadleaf forbs and allowed grass to increase. Unlike picloram, metsulfuron appears to be very sensitive to timing, and must be applied during the vegetative stage. Efficacy declines dramatically as larkspur matures to the bud and flower stage. The low rate of metsulfuron (35 g ha^{-1}) killed more than 88% of duncecap larkspur plants. Tall larkspur may require 70 to 140 g ha^{-1} for total control.

Glyphosate is also sensitive to timing. It is least effective in the flower stage. It is non-selective and cannot be recommended for broadcast application. Annual forbs and weedy perennials appear to be reinvading these plots at the exclusion of desirable grasses. Glyphosate can be selectively applied as a spot spray, but the concentration should be equivalent to the 2.2 kg ha^{-1} rate. Lower rates did not consistently give acceptable control in either the vegetative or bud stage.

The two species of larkspur responded differently to triclopyr. Duncecap larkspur was most susceptible to triclopyr in the vegetative stage. The 4.5 kg ha^{-1} rate killed more than 86% of the plants. Tall larkspur was most susceptible in the flower stage where the 4.5 kg ha^{-1} rate killed more than 87% of the plants. Triclopyr is selective and appears to stimulate desirable grasses. (USDA/ARS Poisonous Plant Research Laboratory, Logan, UT 84321)

Control of prickly rose in subarctic spruce forests. Cole, E.C. and M. Newton. On floodplain sites in northern latitudes, prickly rose can become the dominant vegetation after logging. This study examined the efficacy of different herbicides for conifer release sites occupied by prickly rose. The study area was logged approximately four years ago. Dominant vegetation included prickly rose, willow, and green alder with an understory of bluejoint grass, horsetail, fireweed, bunchberry, and sedge. Parts of the area were planted with plug white spruce in 1986. Natural regeneration of spruce was also occurring sporadically.

Treatment Procedures: All treatments were completely randomized, with three replications per treatment. Plot size is 20 by 54.45 feet (0.025 acre). Applications were made May 24 and August 23, 1989.

Herbicides were applied with a backpack sprayer equipped with a single adjustable cone nozzle and using the "waving wand" technique. Volume per acre was 10 gallons, except for the hexazinone plots. These plots were applied at 20 gallons per acre, due to the low solubility of the hexazinone powder. To insure proper dosage, delivery rate of the sprayer was determined, and applications were made in two timed passes (4 passes for the liquid hexazinone) in opposite directions.

Results: May treatments were evaluated in August 1989 and all treatments were evaluated in August 1990 for percent crown reduction and percent stem dieback for individual rose shrubs. Injury to spruce seedlings was also rated based on a six-point scale: 0--no injury; 1--minor injury to foliage; 2--injury to buds; 3--minor top dieback; 4--severe top dieback and loss of foliage; and 5--dead.

Rose Shrubs: For crown reduction, all herbicide treatments were significantly different from the untreated plots (Table 1). The best treatments in terms of crown reduction were imazapyr at 0.25 lb/a (90 percent 1989 and 78 percent 1990) and both rates of glyphosate (91 and 88 percent). These treatments were not significantly different from hexazinone at 2.0 lbs/a (80 percent 1989 and 78 percent 1990). The triclopyr ester treatments caused the greatest stem dieback (96 percent for 1.0 lb/a and 88 percent for 1.5 lbs/a), and they resulted in approximately 70 percent net crown reduction the first year and 45 to 55 percent the second year. Some shrubs were killed in these plots, but those that were not killed were resprouting vigorously. Although the imazapyr treatment resulted in only 44 percent stem dieback, few of the shrubs were resprouting, and by the second growing season, stem dieback had increased to 78 percent. Recovery of rose was greatest in the triclopyr ester treatments.

Spruce Injury: Injury to spruce was minor in most of the treatments (Table 2), although all treatments, including the untreated controls, had a high percentage of seedlings injured. Only the treatments with sulfometuron caused severe injury to spruce. Severe injury included top dieback, significant loss of foliage, and even mortality. In the other treatments, injury was limited to minor injury to foliage or buds. Since seedlings in the untreated controls appeared injured, factors other than the herbicide treatments probably caused some injury. Injury caused by frost, winter desiccation, or other environmental factors could not be distinguished from slight herbicide injury.

Conclusions: Imazapyr at 0.25 lb/a and glyphosate at 0.75 and 1.12 lb/a offered the best control of individual rose shrubs. Treatments with sulfometuron caused severe injury to approximately 5 percent of the spruce seedlings. Most of the May treatments had similar crown reduction and stem dieback over the two growing seasons. Stem dieback increased with the imazapyr treatment, and recovery was greatest with the triclopyr ester treatments. (Department of Forest Science, Oregon State University, Corvallis, OR 97331-5705)

Table 1 Crown reduction and stem dieback of rose

Treatment	Rate ae/Acre	1989 Crown Reduction	1989 Stem Dieback	1990 Crown Reduction	1990 Stem Dieback
		(%)			
2,4-D	2 lbs	46 d[1]	26 de	49 b	21 ef
Sulfometuron	1.5 oz	48 d	30 cd	49 b	32 def
Sulfometuron plus 2,4-D	1.5 oz + 2 lbs	69 bc	53 b	49 b	29 def
Glyphosate	0.75 lb			91 a	45 bcd
	1.12 lbs			88 a	36 cde
Hexazinone	1.5 lbs	60 cd	23 de	50 b	36 cde
	2.0 lbs	80 ab	32 cd	78 a	65 ab
Imazapyr	0.25 lb	90 a	44 bc	78 a	78 a
Triclopyr ester	1.0 lb	71 bc	96 a	54 b	58 abc
	1.5 lbs	72 bc	88 a	45 b	63 ab
Untreated		17 e	8 e	26 c	10 f

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

Table 2 Spruce injury

Treatment	Rate ae/Acre	1989 Injury Rating	1990 Injury Rating
2,4-D	2 lbs	0.7 abc[1]	0.21 c
Sulfometuron	1.5 oz	1.3 a	1.00 ab
Sulfometuron plus 2,4-D	1.5 oz + 2 lbs	1.1 ab	1.21 a
Glyphosate	0.75 lb		0.44 bc
	1.12 lbs		0.15 c
Hexazinone	1.5 lbs	0.3 c	0.44 bc
	2.0 lbs	0.2 c	0.12 c
Imazapyr	0.25 lb	0.5 bc	0.58 bc
Triclopyr ester	1.0 lb	0.4 c	0.31 c
	1.5 lbs	0.4 c	0.10 c
Untreated		0.4 c	0.52 bc

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

Herbicide stem injection treatments for controlling paper birch in high latitude forests. Cole, E.C. and M. Newton. Paper birch and white spruce are common associates in northern latitude forests. Although birch has some value as a commercial species, it can also grow in densities that compete with white spruce. This study examined various stem injection treatments for thinning paper birch in mixed stands. The study site was located approximately fifteen miles west of Fairbanks, Alaska. Paper birch was the dominant species within the stand. White spruce and quaking aspen were also present. Dominant trees were spruces greater than 100 years old. Birches ranged from 7 to 21 inches diameter at breast height and up to 80 feet tall.

Treatment Procedures: All treatments included fifteen sample trees in three groups of five trees. Treatments were randomly assigned to each group of five trees. Herbicide concentration is given in percent concentration of liquid herbicide product in water. Formulations are shown in Table 1. Stems were treated on May 22 and 23 and August 21 to 23, 1989.

Herbicide application was made by cutting the trees with a hatchet for a typical "hack." One hack was made for each 2 inches of diameter at breast height. One millimeter of chemical solution was applied by syringe into each hack within one minute of cutting. In addition, one treatment included hacking with no addition of chemical, to determine if hacking had an effect on tree vigor. For the May treatments, some chemical was lost from the injection cuts due to the efflux of sap from the hacks.

Results: All trees were evaluated for percent crown reduction in June, 1990. In addition to crown reduction, foliage vigor was rated, and sprouting was noted. Vigor was rated on the following scale: 1--healthy; 2--slight foliage injury; 3--wilting of foliage; 4--foliage present, but expansion not complete ("littleleaf" symptoms); 5--no foliage, but live buds still present; and 6--crown dead. Sprouting was rated by the following scale: 1--healthy sprouts; 2--sprouts present, but foliage exhibiting symptoms of injury; 3--no sprouting, tree living; and 4--no sprouting, tree dead. Data were analyzed using analysis of variance and multiple comparisons among means.

Crown reduction of birch varied by chemical and by month of application (Table 2). Only the imazapyr and glyphosate treatments were effective, and the glyphosate treatments were not effective in May. This was probably due to the high degree of sap flow causing the herbicide to be "washed" out of the tree before translocation. These trees showed evidence of this "outflush" of chemical, including necrotic tissue and brown stains on bark surfaces below the hacks. This was also true for the other May treatments. The other herbicides and the hack only treatment ranged from 0 to 30 percent crown reduction.

The glyphosate treatments varied in efficacy by month of application, but not by percent solution (Table 2). Crown reduction in August was 61 percent with the 25 percent concentration and 54 percent with the 50 percent concentration. Results on individual trees were highly variable, ranging from 20 to 100 percent crown reduction.

The imazapyr treatments varied by month of application and by percent solution; the interaction was significant. In May, the 50 percent concentration caused significantly greater crown reduction than the 25 percent concentration. Trees may be susceptible at this time, but since some of the chemical was washed out by sap, this precludes a definitive test. A test just after the cessation of positive sap pressure would resolve this question. Based on the August treatments, concentrations less than 12.5 percent (and retained in the tree) will probably be effective during the late spring and summer.

In August, the range of imazapyr concentrations used did not produce significantly different results, with crown reduction for all being greater than 98 percent. Variability with the August treatments was low, with crown reduction ranging from 95 to 100 percent. Some mortality occurred at the 25 and 50 percent concentrations with this product. With the 50 percent concentration, there was also some evidence of "flashback" injury to surrounding vegetation; one untreated tree was exhibiting injury symptoms and was most likely grafted to a treated tree.

Foliage vigor was directly tied to response to treatments. Some of the treatments with little crown reduction did show signs of foliage injury (Table 3). However, foliage is expected to recover, except where the rating is greater than 3. In this regard, we may anticipate further decline in vigor and some mortality in the August glyphosate treatments.

No correlations could be found between sprouting and treatment or between sprouting and month of application.

Conclusions: In general, treatments were not effective in May due to the high degree of washing out of chemical by sap. Although imazapyr showed some efficacy in May, greater crown reduction occurred in August and at lower concentrations. Glyphosate treatments in August resulted in greater than 50 percent crown reduction, but results were variable. Imazapyr treatments in August resulted in greater than 98 percent crown reduction, regardless of concentration, and some mortality was occurring at the higher concentrations. Lower concentrations would probably be adequate. Testing in smaller stems should evaluate concentrations down to 3 percent or lower. (Department of Forest Science, Oregon State University, Corvallis, OR 97331-5705)

Table 1 Treatments for Bonanza Creek stem injection

Treatment	ae/Gal Formulation	% Solution	Month
Glyphosate	4 lbs	25, 50	May, Aug
Imazapyr	4 lbs	12.5, 25, 50	May, Aug
Triclopyr amine	3 lbs	25, 50	May, Aug
2,4-D amine	4 lbs	50, 100	May, Aug
Hack only			May, Aug
Untreated control			

Table 2 Crown reduction for birch

Treatment	Concentration	Month	Crown Reduction	
	(%)		(%)	
2,4-D amine	50	May	2	h[1]
	100		5	gh
	50	Aug	10	fgh
	100		10	fgh
Glyphosate	25	May	3	h
	50		10	fgh
	25	Aug	61	bc
	50		54	bcd
Imazapyr	12.5	May	45	cde
	25		31	def
	50		71	b
	12.5	Aug	98	a
	25		99	a
	50		100	a
Triclopyr amine	25	May	9	fgh
	50		0	h
	25	Aug	13	fgh
	50		28	efg
Hack only		May	4	h
		Aug	4	h
Untreated			6	gh

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

Table 3 Foliage vigor and sprouting ratings for birch

Treatment	Concentration	Month	Foliage Rating	Vigor Sprouting Rating
	(%)			
2,4-D amine	50	May	1.3 fgh[1]	2.5 a
	100		1.0 h	2.4 a
	50	Aug	1.4 fgh	2.2 a
	100		2.4 efg	2.5 a
Glyphosate	25	May	1.1 gh	2.9 a
	50		1.3 fgh	2.2 a
	25	Aug	4.1 bc	2.7 a
	50		3.7 cd	2.6 a
Imazapyr	12.5	May	3.2 cde	2.7 a
	25		3.3 cde	2.3 a
	50		4.2 abc	3.1 a
	12.5	Aug	4.2 abc	2.7 a
	25		5.3 ab	2.9 a
	50		5.5 a	3.3 a
Triclopyr amine	25	May	1.4 fgh	2.5 a
	50		1.4 fgh	2.5 a
	25	Aug	2.5 def	2.3 a
	50		1.9 fgh	2.7 a
Hack only		May	1.0 h	2.5 a
		Aug	1.6 fgh	2.6 a
Untreated			1.4 fgh	2.6 a

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

Grass control treatments for reforestation of subarctic spruce forests. Cole, E.C. and M. Newton. Grass competition can cause serious regeneration problems in northern latitude forests. This study examined conifer release treatments for controlling bluejoint grass. The study site was located approximately fifteen miles west of Fairbanks, Alaska on a unit which was part of an 8500-acre burn in 1983. After burning, the site was dominated by bluejoint grass and horsetail. Fireweed, phacelia, bunchberry, and prickly rose were also present in lesser quantities. Parts of the area were cleared with a skidder, and these areas were planted with plug white spruce three years prior to treatment.

Treatment Procedures: All treatments were completely randomized, with three replications per treatment. Plot size was 20 by 54.45 feet (0.025 acre). Applications were made May 23 and August 21, 1989.

Liquid herbicides were applied with a backpack sprayer equipped with a single adjustable cone nozzle and using the "waving wand" technique. Volume per acre was 10 gallons, except for the liquid hexazinone plots. These plots were applied at 20 gallons per acre, due to the low solubility of the hexazinone powder. To insure proper dosage, delivery rate of the sprayer was determined, and applications were made in two timed passes (4 passes for the liquid hexazinone) in opposite directions.

Granular herbicides were applied with a "whirlybird" fertilizer spreader. Due to the low volume of herbicide material applied to each plot, herbicides were diluted with fertilizers, which were selected based upon similar particle size. 34-0-0 ammonium nitrate was used for granular hexazinone and 0-0-60 potassium chloride for the granular imazapyr.

Hand scalping was done by using hazel hoes and hoedads. An area was cleared 1.5 feet on each side of 10 seedlings per scalping plot.

Results: May treatments were evaluated in August 1989 and August treatments were evaluated in August 1990, so that evaluations were based on one growing season after application. In addition, the imazapyr, hand scalping, and untreated plots were evaluated in August 1990 for second-year results. Spruce injury was also evaluated on these plots on a six-point scale: 0--no visible injury; 1--slight injury to foliage; 2--injury to buds; 3--slight top dieback; 4--top dieback and major loss of foliage; and 5--dead. Each plot was ocularly rated for percent cover by vegetation type.

Total Cover: Total cover ranged from 12 (granular hexazinone at 2 lbs/a) to 89 percent (untreated) (Table 1). All treatments which resulted in less than 42 percent cover were not significantly different from the untreated plots. These treatments included granular and liquid hexazinone at 2 lbs/a, (12 and 21 percent), liquid imazapyr at 0.5 and 0.75 lb/a (31 and 29 percent), sulfometuron at 1.5 oz/a (39 percent), glyphosate at 1.12 lbs/a (33 percent) and hand scalping (41 percent).

Grass Cover: Grass cover ranged from 0.1 to 60 percent, with glyphosate at 1.12 lbs/a resulting in the lowest grass cover and atrazine at 4 lbs/a the highest (Table 1). Liquid imazapyr at 0.5 and 0.75 lb/a (1 and 2 percent grass cover) and granular hexazinone at 2 lbs/a (4 percent) reduced grass cover substantially. Three other treatments, hand scalping (7 percent), granular imazapyr at 1.5 lbs/a (7 percent), and liquid hexazinone at 2 lbs/a (9 percent), had less than 10 percent grass cover.

Horsetail Cover: Two treatments, liquid and granular hexazinone at 2 lbs/a, resulted in less than 5 percent horsetail cover (Table 2). Cover for both was 3 percent. Cover for the remaining treatments ranged from 12 to 42 percent, with some treatments having greater horsetail cover than the untreated plots.

Fireweed Cover: Fireweed cover for almost all treatments was less than 10 percent (Table 2). The two glyphosate treatments averaged less than one percent fireweed cover.

Second-year Results: Cover in the untreated plots and the imazapyr treatments after the second-growing season was less than after the first growing season, while cover in the hand scalping plots increased. Total cover in the imazapyr treatments was 16 percent or less, 67 percent in the untreated plots, and 55 percent in the hand scalping plots. Differences among treatments were primarily due to continued control of grass and horsetail in the imazapyr treatments. Spruce injury was also significantly greater in the imazapyr plots. Injury to buds had occurred on some seedlings, and all seedlings exhibited poor growth.

Conclusions: Overall, the treatment with the lowest cover after one growing season was granular hexazinone at 2 lbs/a, with 12 percent cover. This treatment was successful in reducing cover in the three dominant vegetation types (grass, horsetail, and fireweed) and without causing significant injury to spruce seedlings. Liquid hexazinone at 2 lbs/a and liquid imazapyr at 0.75 lb/a resulted in less than 30 percent total cover after one growing season. Although some of the treatments were successful in reducing grass cover, horsetail cover remained relatively high. This resulted in a species shift, and only a partial reduction of total cover. The imazapyr treatments resulted in excellent control through the second growing season. However, these treatments caused injury to spruce and recovery was uncertain. (Department of Forest Science, Oregon State University, Corvallis, OR 97331-5705)

Table 1 Total and grass cover

Treatment	Rate ae/Acre	% Cover Total		Grass	
Atrazine	4 lbs	81	ab[1]	60	a
Atrazine + 2,4-D	4 lbs+2 lbs	60	abcde	37	ab
Fluazifop	0.4 lb	78	abc	27	ab
Glyphosate	0.75 lb	47	abcdef	32	ab
	1.12 lbs	33	cdef	0.1	b
Hand Scalp		41	bcdef	7	b
Granular hexazinone	2 lbs	12	f	4	b
Liquid hexazinone	1 lb	64	abcde	39	ab
	1.5 lbs	61	abcde	32	ab
	2 lbs	21	ef	9	ab
Granular imazapyr	0.75 lb	71	abcd	35	ab
	1.5 lbs	54	abcdef	7	ab
Liquid imazapyr	0.5 lb	31	cdef	1	b
	0.75 lb	29	def	2	b
Sulfometuron	1.125 oz	58	abcdef	18	ab
	1.5 oz	39	bcdef	12	b
	2.25 oz	44	abcdef	22	ab
Untreated		89	a	42	ab

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

Table 2 Horsetail (EQSP) and fireweed (EPAN) cover

Treatment	Rate ae/Acre	% Cover EQSP	EPAN
Atrazine	4 lbs	15 ab[1]	4 b
Atrazine + 2,4-D	4 lbs+2 lbs	13 ab	6 ab
Fluazifop	0.4 lb	42 a	4 b
Glyphosate	0.75 lb	15 ab	0.2 b
	1.12 lbs	32 ab	0.4 b
Hand Scalp		22 ab	6 ab
Granular hexazinone	2 lbs	3 b	3 b
Liquid hexazinone	1 lb	12 ab	10 ab
	1.5 lbs	18 ab	8 ab
	2 lbs	3 b	7 ab
Granular imazapyr	0.75 lb	30 ab	4 b
	1.5 lbs	38 a	2 b
Liquid imazapyr	0.5 lb	22 ab	7 ab
	0.75 lb	20 ab	5 ab
Sulfometuron	1.125 oz	30 ab	5 ab
	1.5 oz	18 ab	6 ab
	2.25 oz	17 ab	2 b
Untreated		28 ab	15 a

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

Conifer release treatments for aspen control in subarctic spruce forests. Cole, E.C. and M. Newton. Quaking aspen is a common competitor in naturally and artificially regenerated stands of white spruce in the northern latitudes. This study compared various conifer release treatments for controlling aspen suckers.

The study site was located approximately fifteen miles west of Fairbanks, Alaska on a unit which had been part of an 8500-acre burn in 1983. After burning, the site was dominated by suckering aspen with an understory of bluejoint grass, horsetail, fireweed, phacelia, bunchberry, and prickly rose. Aspen suckers were four to eight feet tall at the time of treatment. Parts of the area were planted with plug white spruce three years prior to treatments.

Treatment Procedures: All treatments were completely randomized, with three replications per treatment. Plot size was 20 by 54.45 feet (0.025 acre). Plots were treated May 23 and August 21, 1989 Herbicides were applied with a backpack sprayer equipped with a single adjustable cone nozzle and using the "waving wand" technique. Volume per acre was ten gallons, except for the liquid hexazinone plots. These plots were applied at 20 gpa, due to the low solubility of the powder formulation. To insure proper dosage, delivery rate of the sprayer was determined, and applications were made in two timed passes (4 passes for the liquid hexazinone plots) in opposite directions. Manual release treatments were done using a chainsaw and by cutting aspen approximately six inches above the ground line. Due to a malfunction in the chainsaw, some aspen in the May treatments were cut with a pocket knife.

Results: Plots were evaluated in August 1990. Crown reduction and stem dieback were ocularly rated for ten randomly-selected aspen in each replication. Spruce injury was rated on a six-point scale: 0--no injury; 1--minor injury to foliage; 2--injury to buds; 3--slight top dieback; 4--major top dieback and loss of crown; and 5--dead.

The greatest percent crown reduction and stem dieback occurred with the glyphosate + imazapyr mixtures and with the glyphosate treatments (Table 1). In the glyphosate + imazapyr mixtures, most of the aspen had some live cambium, but buds appeared severely injured and recovery is not expected. The glyphosate alone treatments had slight suckering, especially with the low rate.

With the imazapyr treatments, rate was more important than time of application. Control was good with the high rate (74 to 78 percent crown reduction and 46 to 48 percent stem dieback), and less effective as the rate decreased.

The triclopyr ester at 1.5 lbs treatment gave moderate control (59 percent crown reduction and 45 percent stem dieback). The remaining herbicide treatments resulted in fair to poor control, with less than 45 percent crown reduction.

The manual release treatments gave good one-season control, but aspen were recovering. The difference between the May and August treatments appeared to be due to the difference in recovery time, two growing seasons for the May treatment and one for the August treatment. At the end of the first growing season, the May treatment had similar crown reduction to the August treatment.

Overall, spruce injury was minor (Table 2). Chlorosis or yellowing of foliage and stunting were the most common injuries. Injury was greatest with sulfometuron treatments and high rate (0.6 lb) of imazapyr. Spruce in these treatments had yellow, stunted foliage and poor growth. Results from another study indicate that these seedlings will show poor growth for at least two years. In the other treatments, seedlings were recovering and had good growth.

Conclusions: Several treatments showed promise for controlling aspen in young conifer stands. Glyphosate and glyphosate + imazapyr mixtures gave excellent control, with aspen in some treatments exhibiting little capacity for recovery. Manual release also gave good first growing season control, but aspen were resprouting vigorously in the second growing season. (Department of Forest Science, Oregon State University, Corvallis, OR 97331-5705)

Table 1 Crown reduction and stem dieback for quaking aspen

Treatment	Rate	Month	Net Crown Reduction		Stem Dieback	
	(ae/acre)		-----(%)-----			
2,4-D	2 lbs	May	25	hij[1]	15	efg[1]
2,4-D + sulfometuron	2 lbs+1.5 oz	May	31	hi	19	efg
Glyphosate	0.75 lb	Aug	82	abc	52	bcd
	1.12 lbs	Aug	93	abc	61	bc
Manual		May	29	hij	100	a
		Aug	72	cde	100	a
Hexazinone	2 lbs	May	42	fgh	34	de
Imazapyr	0.4 lb	May	27	hij	10	fg
	0.6 lb	May	78	bcd	48	bcd
	0.125 lb	Aug	21	ij	5	g
	0.25 lb	Aug	34	ghi	11	fg
	0.4 lb	Aug	53	efg	32	def
	0.6 lb	Aug	74	bcd	46	cd
Glyphosate + imazapyr	0.75+.125 lb	Aug	94	ab	69	b
	0.75+.25 lb	Aug	100	a	97	a
	0.75+0.4 lb	Aug	100	a	93	a
Sulfometuron	1.5 oz	May	22	hij	16	efg
Triclopyr ester	1 lb	May	20	ij	12	efg
	1.5 lb	May	59	def	45	cd
Triclopyr ester + sulfometuron	1 lb+1.5 oz	May	17	ij	10	fg
Untreated			9	j	1	g

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

Table 2 Spruce injury

Treatment	Rate	Month	Injury Rating	
	(ae/acre)			
2,4-D	2 lbs	May	0.21	ef[1]
2,4-D + sulfometuron	2 lbs+1.5 oz	May	1.33	ab
Glyphosate	0.75 lb	Aug	0.62	bcdef
	1.12 lbs	Aug	0.94	bcd
Manual		May	0.39	def
		Aug	0.59	cdef
Hexazinone	2 lbs	May	0.06	f
Imazapyr	0.4 lb	May	0.65	bcdef
	0.6 lb	May	1.71	a
	0.125 lb	Aug	---	
	0.25 lb	Aug	---	
	0.4 lb	Aug	0.81	bcde
	0.6 lb	Aug	1.29	abc
Glyphosate + imazapyr	0.75+.125 lb	Aug	---	
	0.75+.25 lb	Aug	---	
	0.75+0.4 lb	Aug	---	
Sulfometuron	1.5 oz	May	1.24	abc
Triclopyr ester	1 lb	May	0.31	def
	1.5 lb	May	0.79	bcde
Triclopyr ester + sulfometuron	1 lb+1.5 oz	May	1.27	abc
Untreated			0.63	bcdef

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

Picloram applied with various spray additives and 2,4-D for leafy spurge control. Lym, Rodney G., and Frank A. Manthey. Previous research at North Dakota State University has shown that less than 30% of the picloram applied to leafy spurge is absorbed and approximately 5% reaches the roots. Picloram still remains the most effective herbicide for leafy spurge control and when applied with 2,4-D provides better control than picloram applied alone. The increase in control is due to decreased picloram metabolism not increased absorption or translocation. Thus, a likely approach for increased picloram efficiency for leafy spurge control is by increasing absorption and thereby increasing the amount of picloram translocated to the roots. The purpose of this experiment was to evaluate various additives applied with picloram and picloram plus 2,4-D for increased leafy spurge control compared to the herbicides applied alone.

The first experiment was established on June 5 and 13, 1989 at Chaffee and Dickinson, ND, respectively. The second experiment was established only at Chaffee on the same date. There was a dense stand of leafy spurge in the full flower to early seed-set growth stages at both locations. The weather was overcast with 70 F and 56% relative humidity at Chaffee and clear, 61 F and 65% relative humidity at Dickinson. 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 fertilizer solutions ammonium sulfate, urea, and a commercial formulation of fertilizer plus surfactant equivalent to 15-3-3-2 (N-P-K-S) by weight plus 17% nonionic surfactant (Irhance); a sulfuric acid buffer (SCI-40); a soybean oil formulated with Atplus 300F emulsifier 90:10 (v/v); the commercial surfactants, X-77, LI-700, Silwett L-77, and Triton CS7; and the industrial surfactants, Emulphor ON877 (polyoxyethylated fatty alcohol), Gafac RA-600 and Gafac RS-710 (both are free acids of a complex organic phosphate ester), Igepal CO530 (ethoxylated nonylphenol), Mapeg 200 MOT (PEG 200 monotallate), Mapeg 400 MOT (PEG 400 monotallate), Mapeg 400 DO (PEG 400 dioleate) and Mapeg 400 MO (PEG 400 monooleate).

Leafy spurge control increased or tended to increase when picloram at 0.25 but not 0.5 lb/A was applied with an additive compared to picloram alone at both locations (Table 1). Leafy spurge control with picloram at 0.25 lb/A alone was 37% averaged over both locations 3 months after treatment (MAT) compared to 60% when applied with a spray additive. All spray additives except Silwett L-77 decreased or tended to decrease leafy spurge control when applied with picloram at 0.5 lb/A compared to the herbicide applied alone. No treatment provided satisfactory leafy spurge control 12 MAT.

In the second experiment, leafy spurge control tended to increase when picloram at 0.25 lb/A was applied with Mapeg 400 MOT, Gafac RA-600 and LI-700 3 MAT (Table 2). Control averaged over all picloram plus additive treatments was 57% compared to 41% when the herbicide was applied alone. Control was similar regardless of treatment 12 MAT. In general leafy spurge control tended to decrease when picloram plus 2,4-D was applied with an additive compared to the herbicides alone except when picloram plus 2,4-D at 0.25 plus 1 lb/A was applied with Triton CS7 which averaged 71% 3 MAT compared to 52% when the herbicides were applied alone. Picloram plus 2,4-D plus Mapeg 400 MO averaged

68% leafy spurge control and was the only treatment that provided increased control compared to the herbicides applied alone (41%) 12 MAT.

The third experiment evaluated selected additives applied with picloram or picloram plus 2,4-D for leafy spurge control in the fall. The experiment was established near Hunter, ND on September 13, 1989 in a dense leafy spurge stand when the plants were in the fall regrowth stage. Plot design and size and application procedure were similar to previous experiments. The weather was clear, 70 F with 33% relative humidity. Leafy spurge control was similar regardless of treatment when additives were applied with picloram or picloram plus 2,4-D in the fall (Table 3). Control averaged 96 and 25% 9 and 12 MAT, respectively.

In general, leafy spurge control was occasionally increased when a spray additive was applied with picloram at 0.25, but not at 0.5 lb/A compared to the herbicide alone. All additives, except Triton CS7 and Mapeg 400 MO decreased leafy spurge control when applied with picloram plus 2,4-D in the spring. Control with picloram or picloram plus 2,4-D applied in the fall was not influenced by any additive evaluated. The additives that did increase short-term leafy spurge 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. (Published with approval of the Agric. Exp. Stn. North Dakota State Univ., Fargo).

Table 1. Picloram applied with various additives for leafy spurge control in June 1989 at two locations in North Dakota (Lym and Manthey).

		Location/evaluation date				
		Chaffee		Dickinson		Mean
Treatment	Rate	Sept 89	June 90	Sept 89	June 90	3 MAT[a]
	— lb/A —	% control				
Picloram + Mapeg 200 MOT	0.25+1 qt	57	30	74	3	66
Picloram + Gafac RA-600	0.25+0.5%	64	37	65	3	65
Picloram + Emulphur ON 877	0.25+0.5%	53	43	47	0	50
Picloram + X-77 + AMSU[b]	0.25+0.25%+2.5	52	33	58	3	55
Picloram + Silwett L-77	0.25+0.5%	55	31	75	8	65
Picloram + Mapeg 200 MOT	0.5+0.5%	49	19	72	0	61
Picloram + Gafac RA-600	0.5+0.5%	49	41	65	3	57
Picloram + Emulphur ON 877	0.5+0.5%	50	25	56	0	53
Picloram + X-77 + AMSU[b]	0.5+0.25%+2.5	53	36	65	4	59
Picloram + Silwett L-77	0.5+0.5%	58	41	89	14	74
Picloram	0.25	44	32	29	3	37
Picloram	0.5	67	54	74	18	71
LSD (0.05)		16	NS	16	8	12

[a]Months after treatment
[b]Ammonium sulfate 2.5 lb N/A.

Table 2. Picloram and picloram plus 2,4-D applied with various additives for leafy spurge control in June 1989 near Chaffee, North Dakota (Lym and Manthey).

		Herbicide/rate (lb/A)/evaluation date			
		Picloram 0.25		Picloram + 2,4-D 0.25+1	
Additive	Rate/A	Sept 89	June 90	Sept 89	June 90
		% control			
Mapeg 200 MOT	1 qt	46	41	36	53
Mapeg 400 MOT	1 qt	55	51	37	60
Mapeg 400 DO	1 qt	51	53	40	50
Mapeg 400 MO	0.5%	47	52	40	68
Soybean oil+Atplus 300 F	1 qt + 1%	47	48	42	50
SCI-40	1%	28	32	23	40
Gafac RS-710	0.5%	37	48	27	41
Gafac RA-600	0.5%	57	95	15	33
Emulphor ON 877	0.5%	47	63	33	49
Igepal CO-530	0.5%	37	49	43	55
X-77 + urea	0.25% + 2.5 lb	45	42	28	33
LI-700	1 qt	60	81	56	61
Triton CS7	0.5%	43	65	71	55
Silwett L-77	0.25%	39	41	63	53
Inhance	1 qt	47	59	51	44
None	..	41	34	52	41
Picloram (alone)	0.5 lb	57	59	40	71
LSD (0.05)		23	NS	29	25

Table 3. Picloram and picloram plus 2,4-D applied with various additives in September 1989 near Hunter, North Dakota (Lym and Manthey).

		Herbicide/rate (lb/A)/evaluation date			
		Picloram 0.5		Picloram + 2,4-D 0.5+1	
Additive	Rate/A	June 90	Aug 90	June 90	Aug 90
		% control			
Mapeg 400 MOT	1 qt	92	10	..	..
Mapeg 400 DO	1 qt	..	..	99	41
Gafac RA-600	0.5%	92	13	..	..
Emulphor ON 877	0.5%	96	19	..	..
Igepal CO-530	0.5%	..	..	96	29
LI-700	1 qt	97	32	97	24
Triton CS7	0.5%	..	..	97	22
Silwett L-77	0.25%	92	15	98	38
Inhance	1 qt	94	22	96	26
None	..	96	25	97	34
LSD (0.05)		NS	NS	NS	NS

Leafy spurge control with combinations of auxin herbicides applied for 3 years. Lym, Rodney G., and Calvin G. Messersmith. Picloram remains the most effective herbicide for leafy spurge control. However, due to cost or environmental concerns it is often advantageous to tank-mix picloram with other herbicides, as single or annual treatments for leafy spurge control. The purpose of these experiments was to evaluate annual applications of picloram applied with dicamba and various 2,4-D formulations for leafy spurge control.

The experiments were established in 1986 on June 11 or Sept 15 near Dickinson, on June 18 or Sept 3 near Valley City, and on August 28 on the Sheyenne National Grasslands. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. Retreatments were applied annually in the spring or fall through 1988. 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 regardless of the 2,4-D formulation applied with picloram plus dicamba in the spring (Table). Control averaged across all treatments and both locations was 70% in the fall of 1988 (data not shown) but declined to 53% 1 yr after the third application [36 months after the first treatment (MAT)]. This is similar to the commonly used treatment picloram plus 2,4-D at 0.25 plus 1 lb/A which averaged 60% or more based on long-term observations, 12 months after the last retreatment was applied in a 3 yr annual application program.

Fall application of picloram applied with dicamba and 2,4-D provided much better long-term control than the same treatments applied in the spring (Table). Control averaged across all treatments and location was 66 and 43% 12 and 24 months after the third treatment. Leafy spurge control with picloram at 0.5 lb/A averaged 59% 1 yr following the third fall application, but improved to 81% when picloram at 0.5 lb/A was applied with dicamba at 2 lb/A. The 80% or better leafy spurge control is similar to a 3 yr annual application of dicamba at 2 lb/A alone or picloram plus 2,4-D at 0.5 plus 1 lb/A based on previous research conducted at North Dakota State University. Leafy spurge control with picloram plus dicamba was not improved by adding 2,4-D regardless of the 2,4-D formulation.

In general, leafy spurge control was similar with all 2,4-D formulations in combination with picloram and dicamba. Picloram applied with dicamba provided better leafy spurge control than picloram applied alone as a fall treatment but is more expensive than the commonly used treatment, picloram plus 2,4-D. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo, 58105)

Table. Leafy spurge control with picloram plus dicamba and various formulations of 2,4-D applied annually from 1986 to 1988 averaged over three locations (Lym and Messersmith).

Application date and treatment	Rate	Control/months after first treatment[a] 12	24	36	45	48
	lb/A	%				
Spring						
2,4-D mixed amine[b] + dicamba + picloram	2 + 1 + 0.25	5	17	53	..	..
2,4-D mixed amine[b] + dicamba + picloram	2 + 0.5 + 0.25	18	22	56	..	..
2,4-D mixed amine[b] + dicamba + picloram	1 + 0.12 + 0.5	6	13	46	..	..
2,4-D alkanolamine+ dicamba + picloram	2 + 1 + 0.25	7	22	62	..	..
Dicamba + picloram	1 + 0.25	8	26	49	..	..
LSD (0.05)		NS	NS	NS		
Fall						
2,4-D mixed amine[b] + dicamba + picloram	2 + 1 + 0.25	24	26	45	43	29
2,4-D alkanolamine+ dicamba + picloram	2 + 1 + 0.25	37	42	53	54	31
2,4-D mixed amine[b] + dicamba + picloram	4 + 2 + 0.5	51	56	86	79	57
2,4-D ester[c] + 2,4-DP + dicamba + picloram	2 + 2 + 0.5 + 0.25	18	22	46	43	35
2,4-D ester[c] + 2,4-DP + dicamba + picloram	2 + 2 + 0.5 + 0.5	44	50	79	75	60
2,4-D alkanolamine + dicamba + picloram	4 + 2 + 0.5	33	50	79	72	54
Dicamba + picloram	2 + 0.5	40	49	81	77	52
Picloram	0.5	27	32	59	53	29
LSD (0.05)		NS	11	14	15	17

[a]Final treatment applied 24 months after the first treatment.
[b]Mixed amine salts of 2,4-D (2:1 v/v dimethylamine:diethanolamine)-EH 736.
[c]2,4-D isooctyl ester:2,4-DP butoxyethanol ester:dicamba (4:4:1 v/v/v)-EH 680.

Fluroxypyr formulations for leafy spurge control. Lym, Rodney G., and Calvin G. Messersmith. Fluroxypyr is a pyridine carboxylic acid herbicide similar to picloram but with less soil residual. Previous research conducted at North Dakota State University has shown fluroxypyr provides short-term leafy spurge control. The methyl heptyl ester evaluated in that study may have caused a rapid kill of the leafy spurge topgrowth resulting in poor herbicide translocation to the roots. The purpose of this study was to evaluate the triisopropyl and diisopropyl amine formulations of fluroxypyr for leafy spurge control.

The experiment was established on June 13 near Dickinson and June 15, 1989 near Hunter, ND. Leafy spurge was dense at both locations and in the late-flower to seed set growth stages at treatment. 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 at both locations. The sky was clear at Dickinson with 62 F air temperature and 50% relative humidity while it was partly cloudy at Hunter, 80 F and 28% relative humidity. Evaluations were based on visible percent stand reduction as compared to the control.

		Location/evaluation date			
		Hunter		Dickinson	
Treatment	Rate	29 Aug 89	29 May 90	20 Sept 89	16 June 90
	lb/A	% control			
Fluroxypyr triisopropyl amine	0.25	9	0	13	3
Fluroxypyr triisopropyl amine	0.5	15	4	32	4
Fluroxypyr triisopropyl amine	1	20	3	52	0
Fluroxypyr diisopropyl amine	0.25	6	0	9	1
Fluroxypyr diisopropyl amine	0.5	19	0	21	1
Fluroxypyr diisopropyl amine	1	17	0	61	0
Fluroxypyr methyl heptyl ester	0.5	59	3	70	7
Fluroxypyr methyl heptyl ester	1	59	8	64	3
Fluroxypyr triisopropyl amine + picloram	0.25 + 0.25	57	18	73	8
Fluroxypyr triisopropyl amine + picloram	0.5 + 0.25	53	3	69	21
Fluroxypyr methyl heptyl ester + picloram	0.5 + 0.25	64	23	88	12
Picloram	0.25	42	2	59	14
Picloram	0.5	53	13	72	45
Picloram + 2,4-D	0.25 + 1	51	13	71	3
LSD (0.05)		20	11	23	16

The fluroxypyr ester formulation provided better leafy spurge control than either amine formulation (Table). Fluroxypyr ester provided an average of 63% leafy spurge control 2 to 3 months after application compared to only 22% when fluroxypyr amine was applied, averaged over all application rates and both locations. Leafy spurge control was similar when picloram was applied alone or with fluroxypyr amine or ester. The commonly used annual treatment picloram plus 2,4-D at 0.25 plus 1 lb/A provided similar control to the best fluroxypyr and fluroxypyr plus picloram treatments at both locations. No treatment provided satisfactory control 12 months after treatment. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105)

Sulfometuron applied alone or with auxin herbicides followed by picloram retreatments for leafy spurge control. Lym, Rodney G., and Calvin G. Messersmith. Previous research at North Dakota State University has shown that sulfometuron provides better leafy spurge control when applied in mid-summer or fall compared to spring treatments. However, sulfometuron applied annually has caused severe grass injury and should not be used as a retreatment. The purpose of these experiments was to evaluate initial treatments of sulfometuron alone and followed by annual retreatments with picloram in the fall, and in combination with auxin herbicides applied from mid-July to mid-September for leafy spurge control.

All herbicides were applied with a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. All plots were 10 by 30 ft in a randomized complete block design. The sulfometuron experiment establishment dates in 1986 and leafy spurge growth stages were: July 22 and August 27 near Chaffee, ND, at the mature seed and fall regrowth stages, respectively; September 3 near Valley City, ND, well branched and in the fall regrowth stage; and September 15 near Dickinson, ND, in the fall regrowth stage with most leaves chlorotic or bright red. As leafy spurge control declined, a retreatment of picloram at 4 oz/A was applied 12 months after the original treatment as a split-block treatment to the back one-third of each plot at Chaffee and Dickinson and at 8 oz/A at Valley City. Evaluations were based on visible percent stand reduction as compared to the control.

Sulfometuron plus auxin herbicide treatments applied in July near Chaffee provided 82 to 100% top growth control 1 month after treatment (MAT) (Table 1). Sulfometuron alone did not provide satisfactory leafy spurge control. When evaluated in May 1987, grass injury tended to increase as the sulfometuron rate increased and was higher when sulfometuron was applied with picloram or dicamba compared to sulfometuron alone. When evaluated in August 1987, control was similar whether sulfometuron was applied alone or with an auxin herbicide prior to the picloram retreatment (62%). Control decreased rapidly and no treatment provided satisfactory leafy spurge control in 1988.

Leafy spurge control tended to be better when sulfometuron plus an auxin herbicide was applied in August or September (Table 2) compared to July (Table 1). However, grass injury also was higher. Long-term leafy spurge control tended to be higher as the sulfometuron rate increased up to 2 oz/A. The dicamba and 2,4-D rate had little affect on control over the ranges evaluated, but control tended to increase as the picloram application rate increased. Long-term control was much higher at Valley City compared to the other two locations. The best treatment for long-term control at Valley City was sulfometuron plus picloram at 2 plus 16 oz/A which averaged 80% 22 MAT compared to 32% control with picloram at 16 oz/A alone. Retreatment with picloram at 4 or 8 oz/A increased leafy spurge control at Chaffee and Valley City but not at Dickinson. Leafy spurge control averaged 81% when sulfometuron had been applied at 1 or 2 oz/A, averaged over all auxin herbicide combinations, followed by two annual picloram retreatments which was 20% higher than control with picloram alone. Control declined gradually and averaged 31% in August 1990, 24 months after the last retreatment. Thus, sulfometuron may be useful as the initial treatment in a long term management program provided some grass injury is acceptable. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table 1. Leafy spurge control by sulfometuron plus auxin herbicides applied in July at Chaffee, ND (Lym and Messersmith).

		Evaluation date								
		Aug 86	May 87		Aug 87		May 88		Aug 88	
Treatment	Rate	Control	Control	Grass injury	Control	Retreatment[a]	Control	Retreatment[a]	Control	Retreatment[a]
	oz/A	%								
Sulfometuron+picloram	0.5 + 8	100	40	11	15	52	6	16	0	10
Sulfometuron+dicamba	0.5 + 16	83	5	0	7	54	10	16	7	6
Sulfometuron+2,4-D	1 + 8	97	18	3	8	53	10	43	1	19
Sulfometuron+picloram	1 + 8	99	60	20	16	54	10	27	6	13
Sulfometuron+dicamba	1 + 16	82	47	11	14	76	4	28	0	6
Sulfometuron+picloram	2 + 32	99	97	30	60	66	53	65	38	35
Sulfometuron+dicamba	2 + 130	100	96	49	59	69	26	37	11	15
Sulfometuron	1	31	18	10	7	66	6	41	1	9
Sulfometuron	2	13	16	15	8	72	0	33	3	19
Control	0	0	0	0	0	48	0	26	0	11
LSD(0.05)		15	32	21	22	NS	NS	NS	NS	24

[a] Picloram at 4 oz/A applied as a split-block treatment to the back one-third of each plot on June 29, 1987.

Table 2. Sulfometuron plus auxin herbicides applied in August or September followed by a picloram retreatment for leafy spurge control (Lym and Messersmith).

		Evaluation date									
		May 87		Aug 87		June 88		Sept 88	June 89	Sept 89	Aug 90
Treatment	Rate	Control	Grass injury	Control	Grass injury	Control	Retreatment	Retreatment		Retreatment	Retreatment
	oz/A	%									
Chaffee											
Sulfometuron+picloram	0.5+8	89	35	15	..	5	78	11	..	..	..
Sulfometuron+dicamba	0.5+16	68	8	16	..	13	72	10	..	..	..
Sulfometuron+2,4-D	1+8	35	83	1	..	0	44	11	..	..	..
Sulfometuron+picloram	1+8	95	46	32	..	8	67	16	..	..	..
Sulfometuron+dicamba	1+16	81	36	17	..	5	78	11	..	..	..
Sulfometuron+picloram	2+32	94	56	70	..	29	68	12	..	..	..
Sulfometuron+dicamba	2+128	95	53	56	..	8	78	16	..	..	..
Fosamine	64	43	15	9	..	3	78	16	..	..	..
Fosamine	96	56	13	20	..	6	70	12	..	..	..
Control	..	0	0	0	..	0	63	10	..	..	..
LSD (0.05)		29	19	28		NS	NS	NS			
Dickinson											
Sulfometuron+2,4-D	0.5+16	55	61	23	33	0	3	..	..	..	..
Sulfometuron+picloram	0.5+12	97	71	67	26	1	25	..	..	..	..
Sulfometuron+2,4-D	2+16	75	73	26	33	1	16	..	..	..	..
Sulfometuron+2,4-D	2+32	78	70	29	33	4	14	..	..	..	..
Sulfometuron+picloram	2+8	95	89	83	60	11	14	..	..	..	..
Sulfometuron+picloram	2+12	99	94	90	80	8	36	..	..	..	..
Sulfometuron+picloram	2+16	99	98	93	91	20	39	..	..	..	..
LSD (0.05)		20	29	22	24	NS	NS				
Valley City											
Sulfometuron+2,4-D	0.5+16	41	0	11	0	6	96	20	92	33	5
Sulfometuron+2,4-D	0.5+32	57	0	9	0	1	91	19	89	62	5
Sulfometuron+picloram	0.5+8	96	7	39	0	3	98	43	95	65	13
Sulfometuron+picloram	0.5+12	98	3	68	0	15	99	36	98	76	31
Sulfometuron+picloram	0.5+16	99	4	81	0	16	99	51	99	63	35
Sulfometuron+2,4-D	1+16	90	5	26	0	5	94	29	93	64	24
Sulfometuron+2,4-D	1+32	93	6	41	0	8	99	34	96	81	38
Sulfometuron+picloram	1+8	99	8	85	0	36	97	37	99	81	58
Sulfometuron+picloram	1+12	99	6	88	0	34	96	53	97	78	59
Sulfometuron+picloram	1+16	99	8	86	0	45	99	43	99	86	51
Sulfometuron+2,4-D	2+16	97	34	68	4	10	99	57	98	80	43
Sulfometuron+2,4-D	2+32	99	29	73	14	13	98	52	97	93	40
Sulfometuron+picloram	2+8	99	49	97	20	52	100	68	98	78	31
Sulfometuron+picloram	2+12	99	41	95	0	45	100	75	98	87	65
Sulfometuron+picloram	2+16	99	37	98	20	80	99	65	93	82	48
Picloram	16	99	0	63	0	32	97	25	98	61	12
Control		..	..	..	..	0	98	29	94	58	3
LSD (0.05)		12	22	22	20	22	7	38	6	32	35

[a]Picloram at 4 oz/A applied as a split-block treatment to the back one-third of each plot in Aug 1987 at Chaffee and Dickinson and at 8 oz/A in Aug 1987 and September 1988 at Valley City.

Leafy spurge control with sulfometuron and/or picloram plus 2,4-D in a 3 year 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 in North Dakota, Chaffee and Valley City in the east and Dickinson in the west. 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. Spring treatments were applied the first week of June and fall treatments the first or second week of September in 1988 and the 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. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 9 by 30 ft at Chaffee and Dickinson and 10 by 30 ft at Valley City and each treatment was replicated four times in a randomized complete block design at all sites. Evaluations were based on percent stand reduction as compared to the control. The initial grass stand at Dickinson was too sparse to allow evaluation of grass injury and was abandoned following the June 1990 evaluation.

Leafy spurge control, averaged across all spring treatments increased from 18 to 49% 12 and 24 months after the first treatment (MAT), respectively (Table). The best leafy spurge control (60%) was provided by the combination treatments of picloram plus 2,4-D at 4 plus 16 oz/A in 1988 followed by the same treatment in 1989 or sulfometuron plus picloram at 1.25 plus 4 oz/A in 1989; or sulfometuron plus 2,4-D at 1.25 plus 16 oz/A in 1988 followed by picloram plus 2,4-D at 4 plus 16 oz/A in 1989. Grass injury averaged only 6% when picloram plus 2,4-D was applied in 1989 compared to 14% with sulfometuron plus 2,4-D and 29% with sulfometuron plus picloram. Leafy spurge control improved to 66 and 81% in August 1990 averaged over all treatments at Valley City and Chaffee, respectively, following the third spring treatment.

Leafy spurge control with sulfometuron plus picloram at 1.25 plus 4 oz/A applied for 2 consecutive yr averaged 80% but grass injury averaged 86% (Table). Sulfometuron applied with 2,4-D at 1.25 plus 4 oz/A averaged 49 and 89% leafy spurge control and grass injury, respectively, following two consecutive annual treatments. Picloram plus 2,4-D fall applied for 2 consecutive yr averaged only 7% leafy spurge control, but control increased to 38 and 62% when sulfometuron plus 2,4-D or sulfometuron plus picloram was applied the second yr rather than picloram plus 2,4-D. However, grass injury also increased and averaged 56%.

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 combination treatments were best when fall applied. However, grass injury was severe when sulfometuron was applied in the fall. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Table. Long-term leafy spurge control and grass injury from sulfometuron, picloram, and 2,4-D in pastures (Lym and Messersmith).

				Location and evaluation date									Mean[a]			
				Chaffee				Valley City				Dickinson				
1988 and 1990				June 90		Aug 90		June 90		Aug 90		June 90	12 MAT		24 MAT	
Date applied and treatment	Rate	1989 Treatment	Rate	Con trol	Grass inj	Con trol	Grass inj	Con trol	Grass inj	Con trol	Grass inj	Con trol	Con trol	Grass inj	Con trol	Grass inj
	- oz/A -		- oz/A -	%												
Spring																
Sulfometuron+picloram	1.25+4	Sulfometuron+picloram	1.25+4	32	8	63	3	67	39	47	26	11	18	12	37	23
Sulfometuron+picloram	1.25+4	Picloram+2,4-D	4+16	56	11	80	0	70	9	34	10	12	18	11	46	10
Sulfometuron+2,4-D	1.25+16	Sulfometuron+2,4-D	1.25+16	44	19	82	3	25	10	82	38	15	21	16	28	14
Sulfometuron+2,4-D	1.25+16	Picloram+2,4-0	4+16	61	3	90	0	78	10	89	6	32	28	9	57	7
Picloram+2,4-0	4+16	Picloram+2,4-D	4+16	79	0	87	0	75	3	91	10	14	13	0	56	2
Picloram+2,4-D	4+16	Sulfometuron+picloram	1.25+4	73	14	85	0	80	14	37	20	34	17	0	67	55
Picloram+2,4-D	4+16	Sulfometuron+2,4-D	1.25+16	63	7	80	2	51	35	85	32	35	11	0	49	21
LSD (0.05)													NS	7	12	16
Fall																
Sulfometuron+picloram	1.25+4	Sulfometuron+picloram	1.25+4	99	98	80	94	100	95	80	77	98	46	70	80	86
Sulfometuron+picloram	1.25+4	Picloram+2,4-D	4+16	89	83	38	80	99	58	46	33	58	52	76	42	56
Sulfometuron+2,4-D	1.25+16	Sulfometuron+2,4-D	1.25+16	97	98	61	92	95	97	81	86	98	31	80	49	89
Sulfometuron+2,4-D	1.25+16	Picloram+2,4-D	4+16	74	91	16	58	96	92	4	44	56	25	89	10	51
Picloram+2,4-D	4+16	Picloram+2,4-D	4+16	55	12	9	4	98	4	5	1	19	10	3	7	3
Picloram+2,4-D	4+16	Sulfometuron+picloram	1.25+4	90	57	39	24	100	99	85	73	96	6	0	62	48
Picloram+2,4-D	4+16	Sulfometuron+2,4-D	1.25+16	90	71	47	45	93	99	29	83	93	2	0	38	64
LSD (0.05)				26	21	26	20	19	24	20	30	17	12	7	16	19

[a] Mean 12 or 24 months after the first treatment.

Control of western snowberry with various herbicides. Ferrell, M.A. Western snowberry is a shrub that invades pastureland, crowding out more desirable forage. Research was conducted near Aladin, Wyoming on an unimproved pasture to compare the efficacy of various herbicides on western snowberry. Plots were 10 by 20 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi June 7, 1989 (air temp. 66 F, soil temp. 0 inch 93 F, 2 inch 85 F, 4 inch 80 F, relative humidity 62%). Glyphosate at 0.375 lb ae/a was applied June 7, July 14, and August 8. The soil was classified as sandy loam (65% sand, 17% silt, and 18% clay) with 2.0% organic matter and a 7.3 pH. Visual weed control evaluations were made June 7, 1990, one year following treatment. Western snowberry was in full leaf and 15 to 20 inches high. Infestations were heavy thoughout the experimental area.

Western snowberry control in 1990 was 100% with all rates of metsulfuron and chlorsulfuron. Other treatments showing 95% or better control were the three split applications of glyphosate at 0.375 lb ae/a and fosamine at 24.0 lb ai/a. The split treatments of glyphosate resulted in 60 percent grass damage one year after application. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1629.)

Western snowberry control

Treatment[1]	Rate ai/a	Percent control[2]	% grass damage[2]
glyphosate[3]	1.125 lb	95	60
fosamine	6.0 lb	13	0
fosamine	12.0 lb	82	0
fosamine	24.0 lb	96	0
metsulfuron + X-77	0.3 oz	100	0
metsulfuron + X-77	0.6 oz	100	0
metsulfuron + X-77	1.2 oz	100	0
chlorsulfuron + X-77	0.4 oz	100	0
chlorsulfuron + X-77	0.8 oz	100	0
chlorsulfuron + X-77	2.2 oz	100	0
check		0	0
LSD (O.05)		12	9
CV		9	96

[1]Treatments applied June 7, 1989 and X-77 applied at 0.5% v/v.
[2]Visual evaluations June 7, 1990.
[3]Glyphosate treatment was split into three 0.375 lb applications: June 7, July 14, and August 8, 1989.

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 on the control of leafy spurge. Retreatments will be light rates of picloram or picloram/2,4-D tankmixes and will be 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). 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. Infestations were heavy throughout the experimental area. Visual weed control evaluations were made June 6, 1990.

Treatments of picloram at 1.25 lb ai/a and greater gave 80% or better control and did not require retreatment in 1990. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1630.)

Leafy spurge control

Treatment[1]	Rate (lb ai/a)	Percent control[2]
picloram	0.25	30
picloram	0.5	47
picloram	0.75	63
picloram	1.0	74
picloram	1.25	84
picloram	1.5	89
picloram	1.75	93
picloram	2.0	97
picloram + 2,4-D amine	0.25 + 1.0	35
(LSD 0.05)		10
(CV)		10

[1]Treatments applied May 24, 1989.
[2]Visual evaluations June 6, 1990.

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). Retreatments were applied July 6, 1988 in the same manner as the original treatments (air temp. 93 F, soil temp. 0 inch 110 F, 1 inch 95 F, relative humidity 38%, wind south at 3 to 5 mph, sky partly cloudy). The soil was classified as 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, and June 6, 1990.

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 2.0 lb ai/a continues to be the only original treatment maintaining 80% or better shoot control in 1990. Plots with less than 80% control were retreated again June 6, 1990. Retreatments will be applied as needed to maintain or attain 80% leafy spurge shoot control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1631.)

Leafy spurge control

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

[1]Original treatments applied May 28, 1987. Retreatments applied July 6,1988 and June 6, 1989.
[2]Visual evaluations June 8, 1988, May 25, 1989 and June 6, 1990.

The control of leafy spurge (*Euphorbia esula* L.) by the interaction of herbicides and perennial grasses. M.A. Ferrell, T.D. Whitson, D.W. Koch, and A.E. Gade. Plant competition has long been recognized as an important method of weed control. This experiment was established near Sundance, WY to evaluate the effects of eleven perennial grass species on leafy spurge. Two applications of glyphosate at 0.75 lb ai/A were broadcast with a truck-mounted sprayer delivering 15 gpa at 35 psi before seeding grasses in 1986. The first application was June 2, 1986. (Temperature: air 69F, soil surface, 65F, 1 inch 64, 2 inch 63F, 4 inch 63F. Relative humidity: 58%. Wind: calm) and the second application was July 1, 1986. (Temperature: air 85F, soil surface, 85F, 1 inch 84, 2 inch 81F, 4 inch 80F. Relative humidity: 40%. Wind: 2 to 3 mph from the west). Soils were classified as a slit loam (22% sand, 58% silt, 20% clay) with 1.8% organic matter and 6.3 pH. Pendimethalin at 2.0 and fluroxypyr at 0.5 lb ai/A were applied postemergent May 16, 1988 with a tractor mounted sprayer delivering 20 gpa at 35 psi. (Temperature: air 73F, 1 inch 68F, 2 inch 67F, 4 inch 64F. Relative humidity: 64%. Wind: 2 to 3 mph from the northwest). Plots (60 by 90 ft) were arranged in a split plot design with four replications. One half of the plot was tilled and the other half left untilled. Plots were tilled with a rototiller on August 12, 1986 and grasses were seeded with a John Deere powertill drill on August 12, 1986. Evaluations on percent grass stand, percent leafy spurge control, and pounds of air dry grass per acre have been taken yearly since 1988.

Grass stands were 70% or better in 1990 with pubescent wheatgrass (Luna), intermediate wheatgrass (Oahe), big bluegrass (Sherman), Russian wildrye (Bozoisky), hybrid wheatgrass (RS1), crested wheatgrass (Ephraim), and smooth bromegrass (Manchar) in rototilled plots and Sherman and Luna in the no-till plots. Leafy spurge control was 80% or greater with Bozoisky, Luna, Sherman, RS1, western wheatgrass (Rosana), Ephraim, and Oahe in rototilled plots; however, none of the grasses in the no-till plots had maintained adequate control. Grass yields releated clearly to grass stand and leafy spurge control and were considerably better in the rototilled compared to the no-till plots. Grass production exceeded 900 pounds with Luna, Sherman, RS1, and Oahe in the rototilled plots. Grass yields exceeded 700 pounds with Luna, Sherman and Oahe in the no-till plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1632.)

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

	Percent Grass Stand[2]						Percent Leafy Spurge Control						Pounds of Air Dry Grass per Acre					
	Rototilled			No-till			Rototilled			No-till			Rototilled			No-till		
Grass Species (Variety)[1]	88	89	90	88	89	90	88	89	90	88	89	90	88	89	90	88	89	90
Pubescent wheatgrass (Luna)	90	90	94	70	71	74	97	93	93	84	72	75	497	2074	1102	274	1062	727
Crested wheatgrass (Ephraim)	83	86	84	55	14	14	95	90	87	79	56	45	474	1434	836	218	413	466
Mountain rye	18	11	1	5	4	0	79	50	49	58	31	20	368	436	793[4]	224	119	483[4]
Big bluegrass (Sherman)	74	88	89	79	83	80	96	91	90	89	78	65	594	2297	922	336	2118	762
Hybrid wheatgrass (RS1)	74	85	85	13	10	6	94	89	88	60	33	15	518	2886	1281	142	619	382
Smooth bromegrass (Manchar)	80	80	78	18	23	16	92	79	78	68	40	25	294	1263	639	152	605	171
Intermediate wheatgrass (Oahe)	71	91	93	16	53	48	97	91	86	68	51	46	652	3173	1235	152	2053	734
Bluebunch wheatgrass (Secar)	64	64	58	15	2	3	83	76	65	64	35	24	194	968	871	128	169	282
Western wheatgrass (Rosana)	76	58	61	26	19	18	91	88	88	65	48	34	464	1348	729	174	387	284
Russian wildrye (Bozoisky)	83	90	88	30	10	13	97	93	93	63	44	41	552	1283	564	160	220	229
Thickspike wheatgrass (Critana)	81	61	64	29	15	20	94	78	78	70	29	36	484	1587	695	210	690	449
least significant difference at 0.05[3]	13	21	23	13	21	23	16	18	21	16	18	21	151	630	335	151	630	335

[1]Grasses seeded August 12, 1986.
[2]Evaluations made September 14, 1988; August 8, 1989; and September 13, 1990.
[3]Comparison of variety means is valid between rototilled and no-till within the same year and column.
[4]Mountain rye production was 0 pounds of air dry grass per acre for 1990 for rototilled and no-till. Production values are for blue grass/intermediate wheatgrass mix which invaded the plot.

Silver sagebrush control on rangeland following yearly sequential applications of various herbicides. Whitson, T.D., D.A. Reynolds and R. Cox. Silver sagebrush (Artemisia cana Pursh) is a resprouting species therefore a single herbicide treatment, burning or mowing without successive treatments will not effectively control this species. This experiment was initiated to determine if successive repeated treatments would be effective in control of silver sagebrush on rangeland. The experimental site was located on an area that had been burned in October, 1987. Herbicides were applied to plots 10 by 27 ft. arranged in a randomized complete block design with four replications. The soil was a loamy sand (87% sand, 8% silt and 5% clay) with 1.8% organic matter and a 5.6 pH. Herbicides were applied to S. sagebrush regrowth 8 to 10 inches tall on June 24, 1988. Application conditions were: temperature: air 85F, soil surface 90F, 1 inch 100F, 2 inches 103F and 4 inches 85F with 35% relative humidity and calm winds. Herbicide treatments were reapplied July 6, 1989. Application conditions were: temperature: 82F, soil surface 64F, 1 inch 60F, 2inches 75F and 4 inches 70F with 32% relative humidity and calm winds. Evaluations were made August 8, 1990. Silver sagebrush control was 84% in areas treated with the combination tricolpyr plus 2,4-D (LVE) at 1.0+.5 lb ae/A. Areas treated with tebuthiuron at 0.75 lb ai/A and the combination of tebuthiuron plus 2,4-D (LVE) at 0.5+2.0 lb ae/A controlled 72% of the S. sagebrush, while 2,4-D (LVE) used alone at 2.0 lb ae/A controlled 71% of the silver sagebrush. Therefore, when a burn must be followed by two herbicide applications and complete control of silver sagebrush is not obtained it is unlikely that treatments will be economically feasible.

Silver sagebrush control with various herbicides.

Herbicide[1]	Appl. Rate (lb. ai/A)	% Control[2]
Fluroxypyr	0.5	15
Fluroxypyr	1.0	48
Fluroxypyr	2.0	74
Triclopyr	0.5	34
Triclopyr	1.0	50
Triclopyr	2.0	64
2,4-D + Triclopyr	0.5 + 1.0	59
2,4-D + Triclopyr	1.0 + 2.0	84
Metsulfuron + LI700	0.062 + 0.25%	23
Chlorsulfuron + LI700	0.062 + 0.25%	0
2,4-D	2.0	71
Tebuthiuron	0.5	61
Tebuthiuron	0.75	72
PPG 1259	0.5	37
Fluroxypyr + Triclopyr	0.5 + 1.0	39
2,4-D + Tebuthiuron	2.0 + 0.5	72
Chlorsulfuron + 2,4-D	0.062 + 2.0	62
Check	------	0
(LSD 0.05)		25
(CV)		37

[1]Herbicides were applied 6/24/88 and 7/6/89.
[2]Evaluations were made 8/8/90.

Tolerance of ten perennial grasses to glyphosate, sulfosate and 2,4-D. Whitson, T.D. and J.G. Lauer. Glyphosate and sulfosate and their combinations with 2,4-D are normally considered non-selective herbicides. In two leafy spurge control studies conducted at the University of Wyoming in 1986 and 1987 perennial grasses exhibited good tolerance to glyphosate.

Studies were established near Powell, Wyoming on 10 perennial grass species that were seeded April 15, 1987. Plots were 10 by 55 ft. arranged in a randomized complete block with three replications. The soil was sandy clay loam (47% sand, 27% silt, and 26% clay) with 1.6% organic matter and a 7.9 pH. Herbicides were applied postemergence on April 11, 1990 (relative humidity 85%, wind 1-2 mph SE, air temperature 50F, soil surface 51F, 1 inch 52F, 2 inches 55F, and 4 inches 60F), grasses up to 3 inches tall and June 1, 1990 (relative humidity 50%, wind 2-3 mph SW, air temperature 60F, soil surface 61F, 1 inch 63F, 2 inches 60F and 4 inches 60F), grasses were 10 to 12 inches tall with seedhead emergence beginning on wildrye species.

Bozoisky Russian wildrye had significant growth suppression with all applications of glyphosate and sulfosate. Mountain bromegrass was suppressed with June applications of glyphosate at .38 lb ai/A, sulfosate at .62 lb ai/A and combinations of glyphosate + 2,4-D at .22+.44 and .33+.66 lb ai/A. Streambank wheatgrass was suppressed with April applications of glyphosate at .5 and June applications at .38 lb ai/A and June applications of sulfosate at .62 lb ai/A and combinations of glyphosate+2,4-D at .22+.44 and .33+.66 lb ai/A. Slender wheatgrass was suppressed with all treatments applied in June and with sulfosate at .62 lb ai/A applied in April. Western wheatgrass was suppressed with all treatments made in June. Synthetic A Russian wildrye was suppressed with all glyphosate applications and sulfosate at .62 lb ai/A in April and all treatments applied in June. Basin wildrye and thickspike wheatgrass were suppressed with all treatments applied in June. Hycrest crested wheatgrass was suppressed with glyphosate at 0.5 lb ai/A in April and in all June treatments except with sulfosate at 0.5 lb ai/A. Smooth bromegrass was suppressed with April applications of glyphosate at .5 lb ai/A and sulfosate at 0.62 lb ai/A and with all June treatments except sulfosate at 0.5 lb ai/A. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Tolerance of ten perennial grasses to glyphosate, sulfosate and 2,4-D.

Herbicide (lb ai/A) (Appl. Date)	BRWR[1]	MBG	SBWG	SWG	WWG	SARWR	BWR	TSWG	HCWG	SBG
	(Average % Suppression[2])									
Glyphosate (0.375) (4/11/90)	70	8	13	8	15	30	0	7	13	3
Glyphosate (0.5) (4/11/90)	83	13	25	13	16	78	2	7	30	22
Glyphosate (0.62) (4/11/90)	85	15	13	13	10	70	5	8	18	12
Sulfosate (0.5) (4/11/90)	47	3	7	12	7	10	3	7	10	3
Sulfosate (0.62) (4/11/90)	57	12	10	20	12	50	10	10	17	17
2,4-D (0.25) (6/1/90)	0	0	0	0	0	0	0	0	0	0
Glyphosate + 2,4-D(A) (0.22 + 0.44) (6/1/90)	33	58	23	57	32	33	53	38	28	30
Glyphosate + 2,4-D(A) (0.32 + 0.65) (6/1/90)	48	78	35	83	43	52	82	40	38	32
Glyphosate (0.38) (6/1/90)	85	75	55	87	57	77	82	57	47	45
Sulfosate (0.5) (6/1/90)	52	10	10	40	20	30	30	20	23	13
Sulfosate (0.62) (6/1/90)	42	67	30	73	25	53	73	30	40	35
Check	0	0	0	0	0	0	0	0	0	0
(LSD 0.05)	18	23	19	18	19	24	19	20	26	17
(CV)	19	42	48	27	45	31	36	52	58	49

[1]Grass variety codes: BRWR = Bozoisky Russian wildrye; MBG = Mountain bromegrass; SBWG = Streambank wheatgrass; SWG = Slender wheatgrass; WWG = Western wheatgrass; SARWR = Syn. A Russian wildrye; BWR = Basin wildrye; TSWG = Thickspike wheatgrass; HCWG = Hycrest Crested wheatgrass; SBG = Smooth bromegrass.

[2]Evaluations made July 20, 1990.

Control of Russian knapweed with various herbicides applied at three growth stages. Whitson, T.D., J,L. Baker, R.D. Cunningham and T.E. Heald. Russian knapweed (Centaurea repens L.) is a very competitive perennial weed which is widely distributed across the western United States. Various herbicides were applied near Riverton, Wyoming at three Russian knapweed 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 loam 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.

Russian knapweed control was 100% with all picloram treatments alone or in combination with 2,4-D, clopyralid at 0.375 lb ai/A alone or in combination with 2,4-D (LVE) at 1.0 lb ae/A. All clopyralid and clopyralid combinations were significantly more effective when applied after the bloom stage and after defoliation by frost. Dicamba and dicamba combinations were much more effective when applied after frost. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Russian knapweed control with three application timings.

Herbicide	Rate lb ai/A	Application Date[2] 5/18/89 (% cont)	7/7/89 (% cont)	10/9/89 (% cont)	avg. % contrl
Picloram	0.375	100[1]	100	100	100
Picloram	0.50	100	100	100	100
Picloram	0.635	100	100	100	100
Picloram + 2,4-D (LVE)	0.375 + 1.0	100	100	100	100
Picloram + 2,4-D (LVE)	0.5 + 1.0	100	100	100	100
Picloram + 2,4-D (LVE)	0.635 +	100	100	100	100
Clopyralid + 2,4-D	0.188 + 1.0	76	100	100	92
Clopyralid + 2,4-D	0.25 + 1.33	81	100	100	94
Dicamba + 2,4-D (LVE)	1.0 + 2.0	42	74	100	72
Dicamba + 2,4-D (LVE)	2.0 + 2.0	34	59	100	64
2,4-D (LVE)	2.0	15	0	13	9
Dicamba	2.0	38	36	100	58
Dicamba	4.0	76	93	100	90
Dicamba + Picloram	0.5 + 0.125	93	100	100	98
Dicamba + Triclopyr	0.5 + 0.25	16	6	98	40
Dicamba + Fluroxypyr	0.5 + 0.5	8	15	93	39
Dicamba + Clopyralid	0.5 + 0.125	73	93	100	89
Clopyralid	0.188	80	99	100	93
Clopyralid	0.25	98	100	100	99
Clopyralid	0.375	99	100	100	100
Clopyralid + 2,4-D (LVE) + Picloram	0.188 + 1.0 + 0.25	100	100	100	100
Clopyralid + L-77	0.188 + 0.25%	72	93	100	88
Picloram + L-77	0.375 + 0.25%	100	100	100	100
Check	-------	0	0	0	0
(LSD 0.05)		21	11	8	
(CV)		21	10	6	

[1]Evaluations made June 4, 1990.
[2]When times of application were compared, significant differences were found; October was best, then July, followed by May.

Common sagewort (Artemisia campetris (L.) control with various herbicides. Whitson, T.D. and A.E. Gade. Common sagewort, a highly competitive biennial rangeland species, is often considered an invading species in northeast Wyoming. A common sagewort infestation near Sundance, Wyoming was treated with various herbicides, June 6, 1989 on a silt loam soil (48% sand, 28% silt and 24% clay) with a 2.5% organic matter and a 7.4 pH. Application information, temperature: air 70F, surface 62F, 1 inch 62F, 2 inches 55F and 4 inches 60F, with relative humidity of 80% and wind NW 1 to 2 mph, while green sagewort was in the vegetative stage 6 to 10 inches tall. Treatment areas 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were applied broadcast with a CO_2 pressurized six-nozzle knapsack unit delivering 30 gpa at 45 psi. Counts of green sagewort were made before treatment and at evaluation to calculate percent of control. Those treatments controlling greater than 94% of common sagewort one year after aplication included: metsulfuron at 0.062 lb ai/A, tebuthivron at 0.5 lb ai/A and the combinations of tebuthivron + 2,4-D (LVE) at 0.062+2.0 lb ai/A (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Common sagewort control with application of various herbicides.

Herbicide[1]	Appl. Rate (lb. ai/A)	% Control by Evaluation Date 8/8/89	8/28/90
Fluroxypyr	0.5	33	70
Fluroxypyr	1.0	78	93
Fluroxypyr	2.0	85	89
Triclopyr	0.5	8	53
Triclopyr	1.0	16	72
Triclopyr	2.0	61	83
Triclopyr + 2,4-D (LVE)	0.5 + 1.0	37	86
Triclopyr + 2,4-D (LVE)	1.0 + 2.0	58	91
Metsulfuron + LI700	0.062 + 0.25%	76	98
Chlorsulfuron + LI700	0.062 + 0.25%	43	94
2,4-D (LVE)	2.0	53	94
Tebuthiuron	0.5	1	90
Tebuthiuron	0.75	0	78
Clopyralid + 2,4-D	0.19 + 1.0	39	81
Fluroxypyr + Triclopyr	0.5 + 1.0	70	84
Tebuthiuron + 2,4-D (LVE)	0.5 + 2.0	46	95
Chlorsulfuron + 2,4-D (LVE)	0.062 + 2.0	78	97
Check	------	0	0
(LSD 0.05)		23	19
(CV)		37	16

[1]Herbicides were applied 6/7/89.

Gray rabbitbrush control at two growth stages with various herbicides. Whitson, T.D. and D.A. Reynolds. Herbicide treatments for gray rabbitbrush (Chrysothamnus nauseosus (Pall. ex Pursh) Britt. control treatments have often resulted in poor control. Two studies were initiated to determine the control efficacy of various herbicides on two growth stages of gray rabbitbrush, near Saratoga, Wyoming. Treatments were applied to 10 by 27 ft. plots arranged in a randomized complete block with four replications. Herbicides were applied with a pressurized knapsack unit delivering 30 gpa at 45 psi. Application information: May 19, 1989, temperature: air 45F, soil surface 62F, 1 inch 62F, 2 inches 55F and 4 inches 60F with 64% relative humidity and west winds 2-3 mph. Gray rabbitbrush was in early leaf development. July 6, 1989 temperature: air 82F, soil surface 64F, 1 inch 60F, 2 inches 75F and 4 inches 70F, with 32% relative humidity and calm winds. Gray rabbitbrush was in the full leaf stage prior to bud. The soil was a sand (90% sand, 5% silt and 5% clay) with 1.4% organic matter and a 7.0 pH. Evaluations were made August 20, 1990. The greatest control was with the July application of 2,4-D at 4.0 lb ai/A and the combination of 2,4-D plus triclopyr at 1.0+0.5 lb ai/A, 45 and 44% control, respectively. Ineffective control was obtained with all 18 herbicide treatments tested at either the May or July application. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Gray rabbitbrush control with two application timings of various herbicides.

Herbicide	Appl. Rate (lb. ai/A)	Application Date 5/19/89	7/6/89
		(% Control)[1]	
2,4-D + Picloram	2.0 0.5	38	38
2,4-D	4.0	23	45
Dicamba	3.0	8	13
Dicamba	4.0	14	19
Picloram + Silwet	0.25 + 0.25%	30	18
Picloram	0.25	19	27
Picloram	0.5	11	17
Picloram	0.75	16	11
Clopyralid	0.29	0	13
Clopyralid	0.38	15	17
2,4-D + Clopyralid	1.51 + 0.29	16	4
2,4-D + Clopyralid + Silwet	1.51 + 0.29 + 0.25%	18	35
2,4-D + Clopyralid	2.0 0.38	20	16
2,4-D + Clopyralid + Picloram	1.51 + 0.29 + 0.25	36	10
2,4-D + Clopyralid + Picloram	2.0 + 0.38 + 0.25	18	37
2,4-D + Triclopyr	1.0 + 0.5	9	18
2,4-D + Triclopyr + Picloram	1.0 + 0.5 + 0.25	34	44
2,4-D + Triclopyr + Silwet	1.0 + 0.5 + 0.25%	28	38
Check	------	0	0
(LSD 0.05)		24	22
(CV)		92	70

[1]Evaluations were made 8/20/90.

Seaside arrowgrass control with various herbicides applied at two growth stages. Whitson, T.D. and W.R. Tatman. Seaside arrowgrass (*Triglochin maritima* L.) commonly grows in mountain meadows in the western United States. It contains hydrocyanic acid, especially under stressed conditions, which is highly poisonous to livestock. These studies were established near Laramie, Wyoming to determine the effectiveness of chlorsulfuron, metsulfuron and 2,4-D for control of seaside arrowgrass. Herbicides were applied at two growth stages to determine proper application timing. 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. The soil was a sandy loam (61% sand, 13% silt and 26% clay) with 6.6% organic matter and a pH of 7.9. Application information on August 23, 1988 when seaside arrowgrass was in late bloom, temperature: air 73F, surface 74F, 1 inch 74F, 2 inches 70F and 4 inches 65F with 36% relative humidity and 1 to 2 mph west winds. Application information on June 21, 1989 when seaside arrowgrass was in the 6 to 10 leaf stage, temperature: air 82F, surface 63F, 1 inch 61F, 2 inches 62F and 4 inches 63F with 28% relative humidity and east winds 3 to 6 mph.

Chlorsulfuron applied at rates of 0.025 lb ai/A controlled 86% of seaside arrowgrass when applied at late bloom and 96% when applied at the 6 to 10 leaf stage. Control increased to 100% when rates were applied at .057 lb ai/A in both studies. Metsulfuron at 0.0315 lb ai/A and above controlled above 98% of seaside arrowgrass in both studies. A lower application rates of 0.016 was applied only to the 6 to 10 leaf stage and controlled 95% of the seaside arrowgrass. 2,4-D(LVE) at 4 and 6 lb ai/A did not provide effective control at either date of application. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Arrowgrass control with June and August applications of various herbicides.

Herbicide	Appl. Rate (lb. ai/A)	Avg. % Ctrl.[1] Application Date 6/21/89	8/23/88
Chlorsulfuron (Telar) + X-77	0.0063 + 0.25%	64	79
Chlorsulfuron + X-77	0.0125 + 0.25%	76	86
Chlorsulfuron + X-77	0.0183 + 0.25%	81	98
Chlorsulfuron + X-77	0.025 + 0.25%	96	86
Chlorsulfuron + X-77	0.0315 + 0.25%	91	89
Chlorsulfuron + X-77	0.0378 + 0.25%	95	100
Chlorsulfuron + X-77	0.0441 + 0.25%	98	90
Chlorsulfuron + X-77	0.0504 + 0.25%	100	98
Chlorsulfuron + X-77	0.0567 + 0.25%	100	100
Chlorsulfuron + X-77	0.063 + 0.25%	98	100
Chlorsulfuron + X-77	0.0945 + 0.25%	100	100
Chlorsulfuron + X-77	0.126 + 0.25%	100	100
Metsulfuron (Escort) + X-77	0.0157 + 0.25%	95	-- *
Metsulfuron + X-77	0.0315 + 0.25%	99	98
Metsulfuron + X-77	0.063 + 0.25%	100	98
Metsulfuron + X-77	0.125 + 0.25%	-- *	100
2,4-D (LVE)	4.0	65	43
2,4-D (LVE)	6.0	63	60
Check	------	0	0
(LSD 0.05)		11	17
(CV)		9	14

[1]Evaluations were made 8/21/90.
*Treatments not applied at this date.

Control of downy brome at two locations with various herbicides. Whitson, T.D., A.E. Gade, J.E. Barnard and Chad Reid. Downy brome (Bromus tectorum L.) has become one of the most rapidly spreading rangeland weeds in the western United States. It is highly competitive with perennial rangeland grasses because of its early spring growth habit. Atrazine was used in the past for downy brome control but was not selected for reregistration in 1990. Because downy brome emergence is dependent on fall and winter moisture it is difficult to predict when a preemergence herbicide should be applied, therefore postemergence herbicides were selected for these experiments in Niobrara and Crook Counties in Wyoming. Treatments were applied to 10 by 27 ft. plots arranged in a randomized complete block design with four replications. Herbicides were applied with a pressurized knapsack unit delivering 30 gpa at 45 psi. Application information in Niobrara County, May 2, 1990(temperature: air 62F, soil surface 50F, 1 inch 52F, 2 inches 50F and 4 inches 49F with 45% relative humidity and a south wind 1-2 mph). The soil was loamy sand (84% sand, 8% silt and 8% clay) with 1.0% organic matter and a 6.9 pH. Crook County application information: June 17, 1990, temperature: air 70F, soil surface 68F, 1 inch 68F, 2 inches 70F and 4 inches 72F with a relative humidity of 60% and NE wind 1-2 mph. The soil was a loam (48% sand, 28% silt and 24% clay) with 2.5% organic matter and a 7.4 pH. Downy brome was in the 2 to 3 leaf stage in Niobrara and 3 to 5 leaf stage in Crook County at the time of application. Evaluations were made July 9, 1990 in Niobrara and August 28, 1990 in Crook County. All rates of quizalofop provided excellent control of downy brome but damage to perennial grass species was unacceptable with all rates but the 0.12 lb ai/A rate. Applications of glyphosate in Niobrara County at 0.5 to 0.75 lb ai/A controlled 70 to 79% downy brome with minor perennial grass damage. In Crook County glyphosate applied at 0.6 and .75 lb ai/A controlled 78 to 89% of downy brome respectively with less than 10% perennial grass damage. Paraquat at 0.75 lb ai/A controlled 82 and 85% of the downy brome in Niobrara and Crook County, respectively, with no perennial grass damage. Sulfusate at 0.5 lb ai/A controlled 85 and 73% of the downy brome in Niobrara and Crook County, respectively with less than 5% perennial grass suppression. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071)

Comparison of herbicide treatments at two locations for control of downy brome.

		% Control[1]	
		Location	
Herbicide[2]	Rate lb ai/A	Niobrara Co.	Crook Co.
quizalofop + COC	0.12 + 1.7%	98	100
quizalofop + COC	0.25 + 1.7%	99	100
quizalofop + COC	0.38 + 1.7%	100	100
quizalofop + COC	0.5 + 1.7%	100	100
glyphosate	0.25	18	31
glyphosate	0.38	26	43
glyphosate	0.5	70	59
glyphosate	0.6	71	78
glyphosate	0.75	79	89
paraquat + X-77	0.25 + 0.25%	3	36
paraquat + X-77	0.38 + 0.25%	15	30
paraquat + X-77	0.5 + 0.25%	76	75
paraquat + X-77	0.75 + 0.25%	82	85
sulfusate + X-77	0.25 + 0.5%	0	53
sulfusate + X-77	0.38 + 0.5%	55	46
sulfusate + X-77	0.5 + 0.5%	85	73
sulfusate + X-77	0.38 + 0.25%	46	36
Check	------------	0	0
(LSD 0.05)		23	25
(CV)		28	27

[1]Evaluations were made 7/9/90 for Niobrara County and 8/28/90 for Crook County.
[2]Herbicides were applied 5/2/90 at Niobrara County and 6/17/90 at Crook County.

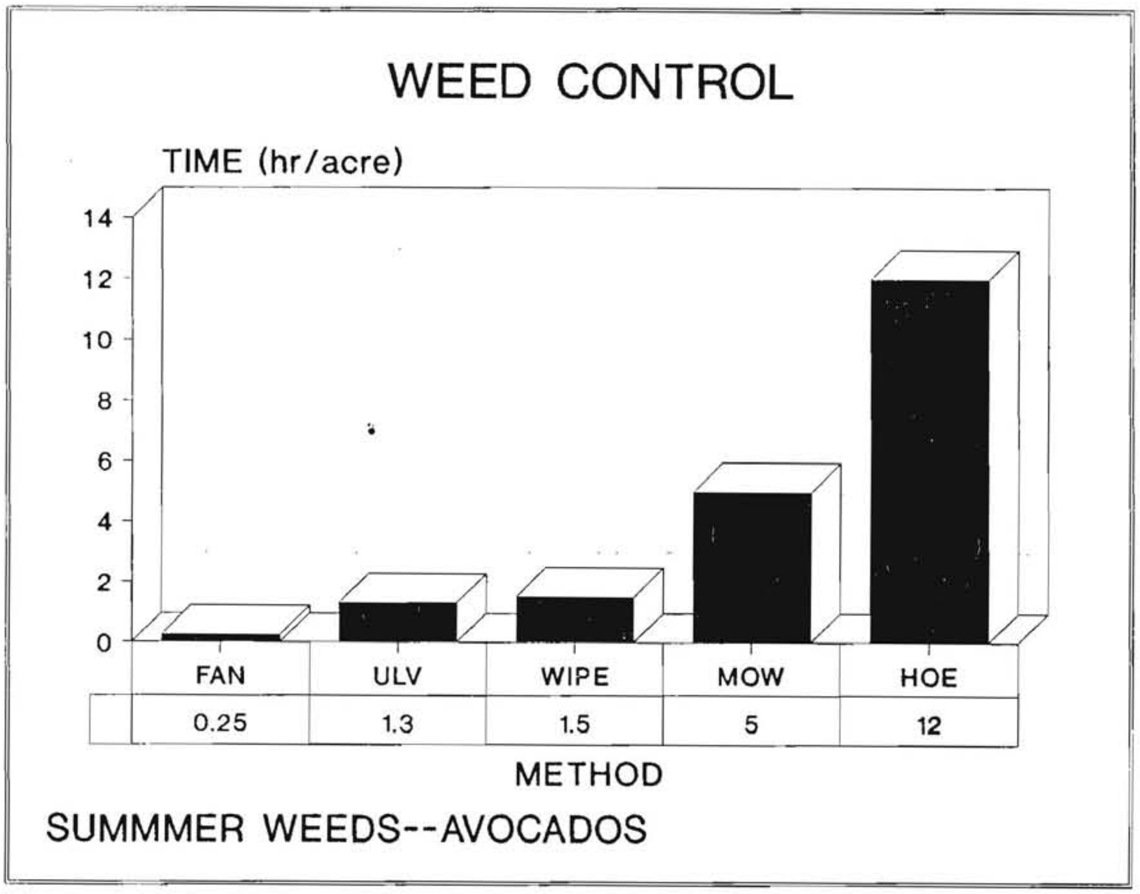
PROJECT 2

WEEDS OF HORTICULTURAL CROPS

DAVID ZAMORA - CHAIRPERSON

BOB MULLEN - CHAIRPERSON - ELECT

Time required for weed control in avocado orchards. Jordan, L. S. and J. L. Jordan. Weed control in many young avocado orchards is easy and necessary; as the trees get older and close in over the row-middles weeds become more isolated and difficult to control. Movement of equipment can be difficult in older orchards. Tests were run on time-effeciency comparisons of hand hoeing, hand mowing (weed-eater), with herbicide applications with a herbicide wick-weed-wiper, ultra-low-volume (ULV) controlled-droplet-applicator (Herbi) and a three-nozzle flat-fan backpack sprayers. Once-over weed control for equivalent areas required times 12 h for hand hoeing, 5h for hand mowing with the weed-eater, 1.5 h with the wick-weed-wiper, 1.3 h with the ULV sprayer, and 0.25 h with the flat-fan backpack sprayer. There was a broad range of time required in different orchards due to the nonuniformity of weed stands and heights in different plots. However, the relative amount of time required for each method of control remained the same. (Department of Botany and Plant Sciences, University of California, Riverside CA 92521)



Number and weight of European brown snails infesting Valencia orange orchards. Jordan, L.S. and J.L. Jordan. Counts were made of European brown snails (*Helix aspera* Miller) infesting Valencia orange orchards, in Riverside, California, with: 1) furrow irrigation, spurge and dallisgrass in the furrows; 2) sprinkler irrigation and infestation with dallisgrass, bermudagrass, and rescuegrass; and, 3) sprinkler irrigation and infestation with prostrate spurge and *Euphorbia serpens* HBK. Snails were collected, counted, and pooled from 6 AM to 9:30 AM, in May 1990, in the following regions: 1) a square meter directly outside of skirt, western side of tree; 2) a square meter directly inside skirt, western side of tree; 3) the square meter directly around trunk base; and, 4) on the lowest 40 cm of tree (trunk and branches). Snails were collected from eight trees in each irrigation/vegetation mix. Snails, pooled from each tree area, were then counted, weighed and discarded. An observation 24 h later indicated that snails were largely absent from the lower 40 cm of the tree trunks, indicating little migration and/or the existence of separate snail populations (one in weed vegetation, the other in the canopy). No difference in either snail count or snail weight existed for snails collected where grass infestations predominated. Where spurge was predominate, snail counts per tree and weights were greater. (Department of Botany and Plant Sciences, University of California, Riverside CA 92521)

Mean and standard deviations of
number and weight of European brown snails

Predominant vegetation	Type irrigation	Number per tree	Weight (g)
Dallisgrass and spurge	Furrow	43.5 ± 12.3	5.59 ± 0.16
Dallisgrass, bermudagrass, and rescuegrass	Sprinkler	40.8 ± 18.3	5.66 ± 0.25
Spurge	sprinkler	112.5 ± 41.7	6.84 ± 0.29

<u>Differential response of pea lines to clomazone</u>. Boydston, R.A. and J.M. Kraft. Twenty-two pea lines were tested for tolerance to clomazone in greenhouse tests. Peas were planted into silt loam soil treated with clomazone at 0.5 or 1.0 ppmw of dry soil and were ranked for chlorosis and stunting at 3 weeks after planting. The experiment was a completely randomized design with four replications and was repeated. Pea lines varied considerably in the amount of chlorosis caused by clomazone. Min 108, 166159, and 86-2236-ARS were classified as very susceptible to clomazone injury. Gen 05981, Rogers Brothers "Genie," and WR1167-ARS were classified as the most tolerant to clomazone and only slight chlorosis was present in these lines at both clomazone concentrations tested. (USDA-ARS, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350)

Injury to greenhouse-grown peas planted in soil treated with clomazone at Prosser, Washington

Pea line	Visual injury rating at 3 weeks after seeding[1] Clomazone rate (ppmw) 0.5	1.0
86-2236-ARS	3.4	4.6
166159 (PIA)[2]	3.1	4.6
Minn 108 (Univ. of Minnesota breeding line)	2.9	4.2
257593 (PIA)	2.6	4.1
74-410-2-ARS	2.6	3.9
Sluis and Groot "Skinado"	2.0	3.7
140165 (PIA)	2.1	3.7
Brotherton "FR-775"	1.9	3.5
Brotherton "Freezer 741"	1.2	3.2
Cebeco "Tara"	1.3	2.9
892010-ARS	1.0	2.7
Asgrow "Flair"	1.8	2.6
Asgrow "Stampede"	0.3	2.5
RR-1178-ARS	0.9	2.2
74SN5-ARS	1.4	2.2
180693 (PIA)	0.3	2.1
Asgrow "Bolero"	0.9	2.0
79-2022-ARS	0.7	2.0
Asgrow "Venus"	0.3	1.8
Gen 05981 (New York State release)	0.3	1.4
Rogers Brothers "Genie"	0.4	1.3
WR1167-ARS	0.2	1.3

[1]Visual rating scale where 1 = slight chlorosis on lower leaves; 3 = plant half chlorotic; and 5 = all chlorotic and dead.
[2]PIA = Plant Introduction Accession

Preemergence herbicides on three cool season turf cultivars. Cudney, D.W., V.A. Gibeault, and J.S. Reints. A preemergence herbicide trial was established across three turf cultivars which had been established for eight months on a sandy loam soil with approximately 0.75 percent organic matter. The turf cultivars were Kentucky bluegrass (blend), tall fescue (Bonsai), and perennial rye (Manhattan II).

Herbicide treatments were applied as granular applications or as spray applications (30 gallon spray volume per acre with a constant pressure CO_2 backpack sprayer) depending on their formulation. Two applications have been made thus far (7/16/90 and 10/11-90). The herbicide treatments consisted of dithiopyr at 0.5 lbs ai/A, isoxaben at 0.5 and 1.0 lbs ai/A, oxadiazon at 2.0 and 4.0 lbs ai/A, isoxaben plus oryzalin at 0.5 plus 1.5 lbs ai/A, bensulide at 10 lbs ai/A, pendimethalin at 2.0 lbs ai/A, benefin plus trifluralin at 1.33 plus 0.67 lbs ai/A, and an untreated control.

There were no phytotoxic symptoms evident to the turf cultivars subsequent to the herbicide treatments. A stand density rating was made on 10/11/90 just prior to the second treatment. Of the three cultivars, Kentucky bluegrass was most affected with the combinations containing trifluralin or oryzalin causing significant reduction in stand. Isoxaben plus oryzalin had a slight effect on perennial rye and tall fescue was unaffected by herbicide treatment.

Preemergence herbicides on three cool season turf cultivars at Riverside, California

Herbicide	lbs/ai/A	10/11/90 ----stand density rating[1]----- Tall Fescue	Perennial Rye	Kentucky Bluegrass
dithiopyr	0.5	0.3	1.2	0.3
isoxaben + oryzalin	0.5 + 1.5	0.3	2.3	4.3
oxadiazon	2.0	0.3	1.5	0.3
oxadiazon	4.0	0.0	1.3	0.3
isoxaben	0.5	0.3	1.3	0.3
isoxaben	1.0	0.3	1.3	0.3
bensulide	10.0	0.0	1.9	0.5
pendimethalin	2.0	0.3	1.0	0.3
benefin + trifluralin	1.33 + 0.67	0.0	1.0	2.0
control	---	0.0	0.8	0.3
LSD 0.05		0.4	0.4	0.4

[1]0 = no effect 10 = no surviving turf species

<u>Herbicide and sray volume effects on bermudagrass control</u>. Orloff, S.B. and D.W. Cudney. Glyphosate and sulfosate have been shown to be excellent herbicides for noncrop weed control. Methods of application and spray volumes have varied from as little as one gallon per acre to as much as 200 gallons per acre. The following trial was established to measure the effect of spray method and volume on bermudagrass control.

The trial was conducted in the Antelope Valley located in the high desert of Southern California. Plots were established at the tail end of a flood-irrigated alfalfa field to well established rapidly growing bermudagrass. Spray volumes of 2, 20, and 100 gallons per acre were evaluated. The two gallon spray volume was applied with a hand-held spinning disc control droplet applicator. Both the 20 and 100 gallon spray volume were applied with a constant pressure CO_2 backpack sprayer with 8002 flat fan Tee Jet nozzles. A nonionic surfactant was added at 0.5% v/v to the 100 gallon per acre spray volume treatments. The plots measured 6 by 20 feet and were replicated four times. The plots were applied on 8/3/90 and evaluated two weeks and two months after application.

Bermudagrass control increased with increasing rate, regardless of spray volume. There were no consistent differences between the three spray volumes, however, the two gallon per acre spray volume tended to be more effective with glyphosate.

Herbicide and Spray Volume Effects on Bermudagrass

Treatment	Rate lb/a	Spray Volume (gal/a)	Control[1] 8/16/90 Bermudagrass	10/8/90 Bermudagrass
glyphosate	1	2	6.0	7.3
	2	2	7.7	8.0
	4	2	9.4	9.5
	1	20	5.8	4.4
	2	20	8.4	7.5
	4	20	7.9	9.1
	1	100	4.5	3.0
	2	100	6.8	6.1
	4	100	8.9	9.3
sulfosate	1	2	3.8	2.8
	2	2	5.8	6.0
	4	2	8.1	7.8
	1	20	4.5	3.5
	2	20	4.3	3.5
	4	20	6.6	8.4
	1	100	4.5	3.5
	2	100	5.8	4.8
	4	100	8.0	8.4
Check			0.0	0.0
LSD 0.05			1.4	1.8

[1]Control 0 = no control 10 = all weeds killed

Postemergence weed control in cabbage with pyridate. McReynolds, R.B. and D.D. Hemphill. Infestations of nightshade weed species in cole crops are a serious problem in Western Oregon. Field trials with pyridate wettable powder (WP) and emulsifiable concentrate formulations were conducted to evaluate their effectiveness in controlling nightshade and other broadleaf weeds in commercial cabbage plantings.

Three trials were established in direct seeded cabbage fields heavily infested with nightshade, shepherd's purse, wild radish and groundsel. Weed densities were as follows: nightshade, 94/meter square (sq); shepherd's purse, 62/meter sq; groundsel, 45/meter sq; and radish, 5/meter sq. The trials were in randomized complete block design with four replications. Preplant-incorporated trifluralin was applied to all trials. Treatments were applied with a CO_2 backpack sprayer equipped with four 8002 flat fan nozzles, spaced at 14 inches, using 241 kPa pressure. Carrier volume was 466 l/ha. The herbicides were applied to all trials when most of the weeds and crop had four to six true leaves.

In two trials only the EC formulation was used. The trials were not harvested, but were visually rated for weed control and phytotoxicity. Replicate size was 1.1 by 6.1 meters. The herbicides were applied on May 21, 1990 and plots were evaluated ten days later.

In the third trial, both formulations were applied to compare their phytotoxic effects on yield. Treatments were applied on August 23, 1990 and plots evaluated 11 days later. Replicate size was 2.0 by 6.1 meters. The plot was harvested 57 days later on October 19, 1990.

Both formulations of pyridate provided good control of the target weeds with control improving as the rate increased. Large weeds (5 to 6 leaves) escaped control more at the low rate than at the intermediate and high rates. Timing applications for the 2 to 4 leaf stage appeared to be more critical for effective control at the low rate. This could impose a significant limitation in Western Oregon where spring rains can delay applications until weeds are larger. The intermediate and high rates would allow for greater versatility in timing applications while still providing effective control.

Phytotoxicity was observed as yellowing on plant leaves in all trials and at all rates. However, its effect was not statistically significant when treatment yields were compared with the hand-weeded control. All rates, except the 1.8 EC, significantly improved total yield compared to the weedy check. Average head weight was significantly greater at the 0.45 and 0.90 WP rates than in the hand weeded control. (North Willamette Research and Extension Center, Oregon State University, 15210 NE Miley Road, Aurora, OR 97002)

Pyridate weed control and phytotoxicity in cabbage, Western Oregon[1]

Rate	% Weed control				Phytotoxicity[2]
	Nightshade	Groundsel	Wild radish	Shepherd's purse	%
0.45 EC	80	30	50	55	3
0.90 EC	88	51	65	70	8
1.8 EC	95	80	95	92	16
0.45 WP	90	-	95	75	2
0.90 WP	97	-	93	96	6
1.8 WP	100	-	97	98	9
Check	0	0	0	0	0

[1]Results for EC formulation, average of three trials. Results for WP from one trial
[2]% of total leaf-area/plot

Pyridate effect on cabbage yield, Western Oregon

Rate (lb ai/acre)	Total yield (kg/plot)	Average head weight (kg)
Weedy Check	10.5	0.680
Hand Weeded Check	14.8	0.813
0.45 WP	18.3	1.033
0.90 WP	16.9	1.070
1.8 WP	15.1	0.850
0.90 EC	16.9	0.955
1.8 EC	13.7	0.757
LSD (0.05)	3.9	0.186

Oxyfluorfen herbicide for caneburning in Marion and evergreen blackberries. Kaufman, Diane and R. D. William. The removal of early primocane growth and lower foliage from fruiting canes enhances production of machine harvested trailing blackberries. The recent loss of dinoseb has necessitated the search for alternatives. This research was conducted in a commercial field in the Portland area to evaluate the effectiveness of oxyfluorfen (Goal) for caneburning in 'Marion' and evergreen blackberries.

Each experiment was randomized in a complete block design with four replications. Plots were three ft wide by 24 ft long and consisted of four 'Marion' plants (six foot spacing) or three evergreen plants (eight foot spacing).

Treatments were applied with a CO_2 pressured backpack sprayer, mounted with a single 8004 nozzle and set at 35 psi.

Goal was applied at rates of two, three, four or five pints of material per broadcast acre; one, two or three times at approximately three week intervals.

Most applications were based on 50 gals of water per acre and 0.25% surfactant on a volume basis, however, efficacy with 100 gals of water or addition of a crop oil was also evaluated.

Visual evaluations of control of lower fruiting laterals and suppression of primocanes were recorded on May, 11, 1990 and June 4, 1990 (Tables 1 and 2), based on a ten point scale with 0 representing no control and ten representing perfect control. A single application of Goal at two or four pints per acre resulted in inadequate primocane control by early June in both 'Marions' and evergreens. Lower rates of Goal were much more effective on evergreen blackberries. However, 'Marions' were suppressed (a rating of 7.0) by four or five pints applied twice with a surfactant or two pints applied twice with crop oil.

Regrowth of primocanes later in the spring is another area of concern among caneberry growers. Primocane growth of 'Marions' and evergreen blackberries was evaluated on June 21, 1990 and July 11, 1990. Though slowed somewhat by Goal, primocane growth was adequate in all treatments by July 11, 1990. However, plants sprayed three times with Goal displayed dramatically delayed primocane growth in terms of both height and primocane number. The third application was made on June 4, 1990 and primocane growth was inhibited in both blackberry varieties through June 21, 1990. By the end of June, primocane regrowth was normal, although a third application could result in inadequate primocane growth in plantings which are only marginally vigorous. (Extension Service, Oregon State University, Corvallis, OR 97331)

Table 1. Visual ratings of fruiting lateral control and primocane suppression, in evergreen blackberries, recorded within three and six weeks of earliest Goal applications, Clackamas County, Oregon.

Goal treatments and timing	May 11, 1990 Fruiting cane	May 11, 1990 Primocane	June 4, 1990 Fruiting cane	June 4, 1990 Primocane
pints (p) application times (t) surfactant (Surf) gallons (g)				
Control	0	0	0	0
2p, 1t, 50g, Surf 1/ April 20, 1990 2/	8.8	8.6	5.0	5.2
2p, 2t, 50g, Surf April 20 and/or May 18, 1990	8.5	8.6	9.0	8.8
2p, 2t, 50g, Crop Oil 3/	9.0	8.6	9.0	9.1
2p, 2t, 100g, Surf	9.4	8.6	9.0	8.5
3p, 3t, 50g, Surf, April 20, May 18, and June 4, 1990	8.9	8.8	8.0	7.5
4p, 1t, 50g, Surf April 20, 1990	9.1	9.0	6.0	6.0
4p, 2t, 50g, Surf	8.8	9.1	9.0	9.1
5p, 2t, 50g, Surf	9.0	9.3	9.0	9.3

1/ 0.25% volume - Activator 90 or Unifilm 90.

2/ Average primocane height on April 20, 1990: Evergreens, 6 to 18 inches; Marions, 4 to 16 inches. Average fruiting lateral length on April 20, 1990: evergreens, 4 to 10 inches; Marions 8 to 12 inches.

3/ Crop Oil: 0.25% Mor-Act.

Table 2. Visual ratings of fruiting lateral control and primocane suppression, in Marion blackberries, recorded within three and six weeks of earliest Goal applications, Clackamas County, Oregon.

Goal treatments and timing	May 11, 1990 Fruiting cane	May 11, 1990 Primocane	June 4, 1990 Primocane
pints (p) application times (t) surfactant (Surf) gallons (g)			
Control	0	0	0
2p, 1t, 50g, Surf 1/ April 20, 1990 2/	5.6	6.6	3.8
2p, 2t, 50g, Surf April 20 and/or May 11, 1990	6.3	6.1	6.2
2p, 2t, 50g, Crop Oil 3/	7.2	7.2	7.1
2p, 2t, 100g, Surf	6.3	6.5	6.1
3p, 3t, 50g, Surf, April 20, May 11, and June 4, 1990	6.5	6.8	6.5
4p, 1t, 50g, Surf	6.6	7.1	5.1
4p, 2t, 50g, Surf April 20, and May 11, 1990	6.6	7.4	7.4
5p, 2t, 50g, Surf	7.1	7.6	7.5

1/ 0.25% volume - Activator 90 or Unifilm 90.

2/ Average primocane height on April 20, 1990: evergreens, 6 to 18 inches; Marions, 4 to 16 inches. Average fruiting lateral length on April 20, 1990: evergreens, 4 to 10 inches; Marions 8 to 12 inches.

3/ Crop Oil: 0.25% Mor-Act.

EPTC phytotoxicity evaluation in carrots. Bell. C. E., H. M. Kempen, H. A. Agamalian. EPTC is being evaluated as a possible herbicide for control of purple nutsedge in carrots in California. This research was conducted to evaluate the phytotoxic potential of EPTC as affected by rate and time of application before planting. The experiment was done at the University of California Imperial Valley Research and Extension Center.

Experimental design was a split plot, with application timing the main plot factor and EPTC rate as the subplot factor. There were four replications. Plot size was two beds (1m wide each) by 9.1m long. EPTC was applied to dry soil and incorporated with a PTO-driven rototiller at 10cm depth. Herbicide applications were made eight weeks, four weeks, one week, and one day before sowing. Applications were at 122 l/ha spray volume at 138 kPa pressure with 8003LP flat fan nozzles. Carrots were sown and irrigated with sprinklers on October 26, 1989. Visual evaluation of crop phytotoxicity and weed control was made on December 21, 1989. Weeds present were London rocket, nettleleaf goosefoot, and sowthistle. Carrot number at harvest and yield were taken on March 29, 1990. Sample size was 1m of each bed per plot.

Analysis of variance of harvest data indicated that neither application timing nor the interaction of timing and herbicide rate had a significant effect on carrot yield or number. Herbicide rate did significantly effect yield (P<.00), but not number. Therefore, data were pooled for all application timing for mean separation. (See table) Visual evaluations were also similar for the four application timings. EPTC injury symptoms (distortion of newest leaves) were apparent on crop and weeds at the highest dose. (University of California Cooperative Extension, Holtville, Bakersfield, and Salinas, CA).

EPTC phytotoxicity and weed control in carrots
in the Imperial Valley, California

EPTC Rate	Weed Control	Phytotoxicity[a]	Harvest data	
	%		number	kg.
0	0	0	83	5.88 a
3	53	1	83.7	6.02 a
6	82	5	74.3	4.94 b

Numbers in columns followed by the same letter are not significantly different at .05 level according to Duncan's Multiple Range Test.
[a] 0=No crop injury, 10 = all plants dead

Weed control with metham soil drench. Bell, C. E. Melons are sown into a clear polyethylene plastic covered trench for early spring harvest in the lower Colorado River desert. Weeds in these trenches can be much worse then outside because of the greater heat and moisture. Some weeds, such as common purslane and junglerice, will germinate in these trenches during January. A trial was conducted to evaluate metham as a soil drench before crop sowing. This research was on the University of California Imperial Valley Research and Extension Center, Holtville, CA.

The experiment was a Randomized Complete Block Design with four replications. Plots were one trench, (55cm wide) by 6m long. Metham rate was 468 l/ha in all treatments. Drench volume was 1936 l/ha in treatment 1, 3882 l/ha in treatment 2, and 7764 l/ha in treatment 3. Treatment 4 was an untreated control. Trenches were preirrigated 10 days before application. The spray boom was attached to a bicycle-wheel sprayer. The boom consisted of two rows of four, in-line 8008 flat fan nozzles arranged perpendicular to the sides of the trench. Treatments 1 and 2 were applied on one pass along the trench, treatment 3 required two passes over the same plot. Metham application was on November 6, 1989. Cantaloupe, cv 'Topmark' was sown on November 20 into the bottom of the trench. The trench was covered with clear plastic (25 um polyethylene) and irrigated on November 21, 1990. Visual evaluation of plots was conducted on February 21, 1990.

For the three weeds present, there was no apparent relationship between drench volume and percent control (see Table). All treatments were better then the untreated control. There was no visually apparent effect of any treatment on cantaloupe vigor or injury. (University of California Cooperative Extension, Holtville, CA 92250).

Weed control with metham as affected by drench volume in the Imperial Valley of California

Drench volume	SONOL[2]	ECHCO[2]	POROL[2]
l/ha		- % -	
1936	100	99.4	99.4
3882	100	96.0	72.7
7764	100	99.4	95.2
Untreated control	0	0	0

[1]Metham at 468 l/ha in all treated plots

[2]SONOL = annual sowthistle, ECHCO = junglerice, POROL = common purslane

Purple nutsedge control in carrots. Bell, C. E., H. M. Kempen, H. S. Agamalian. Purple nutsedge is an increasingly serious problem in carrots in California. Herbicides currently registered in carrots do not adequately control purple nutsedge. Two herbicides, EPTC and noflurazon, were evaluated for efficacy and carrot phytotoxicity.

Two experiments with the same treatments were conducted in adjacent purple nutsedge infested carrot fields. The experiments were both a Latin Square Design with four rows, columns, and treatments. Plot size was 3.9m by 15.2m. Application was at 122 l/ha of spray volume at 138 kPa pressure with 8003LP flat fan nozzles. Application was preplant and incorporated by disc to a depth of 15 cm. Application in experiment 1 was on September 2, 1989 and on September 19, 1989 in experiment 2. Carrots were sown in experiment 1 on September 12 and on September 25 in experiment 2. Carrots stand count was from one meter of one seed line for two beds per plot. Carrot height was the average of four measures per plot. These data were taken on October 24 in experiment 1 and on November 16 in experiment 2. Purple nutsedge count per one meter of two beds and visual evaluation of purple nutsedge was made on November 16 in experiment 2. Purple nutsedge populations in experiment 1 were too low for evaluation. Carrot number at harvest and yield per one meter of two beds were taken on February 13, 1990 in experiment 1 and on March 20, 1990 in experiment 2.

EPTC did not adequately control purple nutsedge in experiment 2. Norflurazon did appear to control purple nutsedge, but there was no significant difference in count data. Neither herbicide had any significant effect on carrot stand, height, number at harvest, and yield, with the exception of norflurazon on height in experiment 2. In norflurazon treated plots, several plants had white (chlorotic) leaves when stand counts were taken. At harvest, most carrot roots in norflurazon treated plots lacked carotinoid pigments. (University of California Cooperative Extension, Holtville, Bakersfield, and Salinas, CA).

Carrots quantitative parameters and purple nutsedge control in the Imperial Valley, Califorania

Herbicide	Rate	Carrot data				Purple Nutsedge	
	kg ai/ha	stand count	Height (cm)	No. at Harvest	yield (kg)	count %	Control %
Experiment 1							
EPTC	3.36	161.8	14.5	305.5	18.4ab	-	-
EPTC	6.72	143.8	12.3	274.8	17.3 b	-	-
norflurazon	2.24	160.5	14.1	297.5	17.8ab	-	-
Untreated control		160.5	14.3	319.8	18.9a	-	-
		n.s.	n.s.	n.s.	p=.05		
Experiment 2							
EPTC	3.36	166.8	11.7 y	348.5	21.4	6.0	7
EPTC	6.72	168.5	11.8 y	351.5	21.7	5.0	27
Norflurazon	2.24	162.8	9.3 z	321.8	20.9	3.3	96
Untreated control		152.5	11.7 y	343.5	22.6	5.3	0
		n.s.	P=.01	n.s.	n.s.	n.s.	

Numbers in columns followed by the same letter at not significantly different a probability levels shown according to Duncan's Multiple Range Test.

Weed control in watermelon planted through clear polyethlene mulch. Bell C. E. and F. L. Laemmlen. A watermelon production system, utilizing clear polyethylene mulch and tunnel, drip irrigation, and transplants, is used to achieve early spring harvest in the lower Colorado Desert by some growers. The system requires a high level of weed control in order to gain the desired benefits. This experiment was conducted on a commercial watermelon field near Brawley, California.

The experiment was a Randomized Complete Block Design with four replications. Plots were three beds (1.5m wide each) by 36.5m long. There were three treatments along with an untreated control. Treatment 1 was methyl bromide gas injected into beds to a depth of 30 cm at 91 kg/ha and immediately covered with clear 25m polyethylene mulch.

Treatment 2 was metham applied through the drip irrigation system into pre-irrigated, mulched, beds over five hours at 468 l/ha. Treatment 3 was bensulide sprayed on the bed surface at 6.7 kg ai/ha in 159 l/ha spray volume at 138 kPa pressure using 8002LP flat fan nozzles. Beds in treatment 3 were immediately covered with mulch. The untreated control was also covered with mulch. Treatments and mulching was on January 24, 1990. Watermelons were planted as small transplants on February 2, 1990. All plots were covered with a clear polyethylene tunnel 80 cm wide and approximately 60 cm tall. Visual evaluation of weed control and crop vigor were made on April 2, 1990. Harvest data (number and yield of marketable watermelons) were made on three days (May 14, May 22, and June 1, 1990).

The best weed control, highest crop vigor, and yield were obtained with the methyl bromide treatment. Metham and bensulide appeared to control weeds better and produce more vigorous watermelon plants then the untreated control, but did not produce higher yield. (University of California, Cooperative Extension, Holtville, CA 92250).

Weed control and watermelon yield in a plastic mulch production system in the Imperial Valley, California

Treatment	Weed control (%)		Vigor [a]	Watermelon yield[b]	
	AMAAL[c]	CHEMU[c]		kg/plot	number
1. Methylbromide	99.6	99.6	8.2	23.0y	119.8y
2. metham	2.0	24.0	4.4	11.5 z	68.4 z
3. bensulide	17.5	46.0	5.0	7.8 z	48.9 z
4. Untreated control	0	0	3.8	12.8 z	75.7yz

a = 10 = most vigorous, 0 = no growth
b = sample size was 12.2 m of center bed of each plot
c = AMAAL = tumble pigweed, CHEMU = nettleleaf goosefoot
Numbers in columns followed by the same letter are not significantly different at the .05 level according to Duncan's Multiple Range Test.

PROJECT 3

WEEDS OF AGRONOMIC CROPS

PAT FUERST - CHAIRPERSON

RICK ARNOLD - CHAIRPERSON - ELECT

Dodder control in alfalfa with trifluralin granules. Bell, C. E., D. W. Cudney, J. M. Richardson, and J. D. Helmer. Dodder is a widespread parasitic weed in alfalfa in California. Trifluralin granules were evaluated for dodder control in the Imperial Valley near El Centro, California.

Experimental design was a randomized complete block with three replications. Plots were 47.5 m long by 30 m wide. Trifluralin 10 percent granules were applied at 2.24 kg ai/ha by a tractor pulled granular spreader. Treatments were: one application on March 9, 1990, after the first hay harvest; application after the first harvest and on April 21 after the second harvest; and one application after the first harvest and after the third harvest on May 25. The field was irrigated one day following each application. Footfall counts and number of colonies per plot were recorded on June 21. For footfall counts, three people took 33 steps in line in each plot and counted the number of times they stepped on dodder. For number of colonies, each person counted the number of colonies in a section 3.3 m by 29 m in each plot. Data in the Table are combined totals for person and replication.

All three trifluralin treatments controlled dodder very successfully compared to the untreated control. Dodder colonies were observed in the untreated plots on May 25. (University of California Cooperative Extension, Holtville and Riverside, Dow Elanco Co. Hesperia and Fresno, CA respectively).

Dodder control with 10% trifluralin granules
in the Imperial Valley, California

Trifluralin timing	Footfall counts[1]	# of colonies[2]
2.24 kg ai/ha/application		
After first harvest only	0	3
After first and second harvest	18	3
After first and third harvest	0	9
Untreated control	143	166

[1] = number of encounters per 99 steps per plot, total of 3 replications

[2] = colonies observed per 3.3 m by 29 m portion of each plot, total of 3 replications.

Weed Control in bed planted alfalfa. Bell, C. E. and C. E. Engle. In the Imperial Valley of California, about 10,000 ha of alfalfa is planted on raised beds for hay production. As opposed to flat planted alfalfa, this method leaves almost one half the field, the furrows, unplanted. These furrows can become very weedy. This research was conducted to evaluate four herbicides and combinations for weed control in furrows.

The experiment was conducted in a second year bedded alfalfa field at the University of California Imperial Valley Research and Extension Center near Holtville, CA. Experimental design was a ramdomized complete block with four replications. Plots were 2 beds (1 m each) by 6.1 m. Each plot was from the center of the outside beds and included two furrows. Treatments 1 and 2 were applied in 374 l/ha spray solution, using a 8003E flat fan nozzle at 276 kPa pressure. Granular treatments (3-7) were applied by hand using a "salt shaker". Treatments were made on April 13, 1990 to cultivated furrows and irrigated the following day. Visual evaluation of junglerice control were made 46 and 80 days after treatment (DAT).

There were chlorotic plants in the clomazone treatments, otherwise there was no injury. Most treatments controlled junglerice for 46 DAT. At 80 DAT, control by the metribuzin treatments had diminished. (University of California Cooperative Extension, Holtville, CA 92250 and Mobay Corporation, Fallbrook, CA 92028).

Junglerice control in bed planted alfalfa
in the Imperial Valley, California

Herbicide	Formulation	Rate	Junglerice control (%)	
		kg ai/ha	46 DAT	80 DAT
metribuzin	75DF[a]	.75	95	69
metribuzin	75DF	1.5	88	69
trifluralin/metribuzin	10/2G[b]	2.24/.45	99	98
pendimethalin	10G	2.24	98	93
clomazone	5G	.84	85	86
trifluralin	10G	2.24	96	95
Untreated control			0	0

[a] 75% dry flowable formulation
[b] G = granular, number = %

Annual grass control in established alfalfa hay with selective grass herbicides. Vargas, Ron. A fourth year stand of Pioneer Brand 5929 alfalfa, infested with both yellow and green foxtail (Setaria glauca (L.) Beauv. and Setaria virdidis (L.) Beauv.), mouse barley (Hordeum leporinum Link) and cultivated oats (Avena spp.) was divided into plots 20 ft. by 30 ft. and replicated four times in a randomized complete block design. The herbicides were applied on May 22, 1990 with a CO_2 plot sprayer calibrated at 30 psi delivering 20 gallons per acre. All treatments contained a crop oil surfactant at 1 quart per acre. At the time of application the grasses were in the 2 to 4 leaf stage and 2 to 6 inches tall. Alfalfa had 3 to 12 inches of growth.

An evaluation on June 12, 1990, 20 DAT, indicated effective control of all grass species with clethodim at the .188 lb ai/a rate. The .094 lb ai/a rate of clethodim provided poor control of Setaria spp. and Hordeum leporinum. Sethoxydim was exhibiting 70 to 80 percent control of all the grass species. Fluazifop-P-butyl provided acceptable control of Avena spp. and Hordeum leporinum but only 25 percent control of Setaria spp.

Annual Grass Control in Established Alfalfa

Herbicide	Rate	Percent Control - 6/12/90 - 20 DAT*		
	(lb ai/A)	Setaria spp	Avena spp	Hordeum leporinum
clethodim	0.094	65	75	67
clethodim	0.125	75	85	77
clethodim	0.188	77	90	87
sethoxydim	0.30	75	77	70
sethoxydim	0.40	70	80	72
fluazifop-P-butyl	0.188	25	77	80
fluazifop-P-butyl	0.25	25	82	75
Control		0	0	0

*Average of four replications

The interactions of broadleaf and grass herbicides in seedling alfalfa. Orloff, S.B. and D.W. Cudney. Both broadleaf and grass herbicides are sometimes needed for broad spectrum postemergence weed control in seedling alfalfa. It would be more efficient and economical to apply them as tank mixes whenever possible. A concern related to tank mixes is possible antagonism and a resultant loss of control or crop injury when two herbicides are mixed. A trial was initiated in Lancaster, California to study possible antagonistic reactions. The plots were applied with a constant pressure CO_2 backpack sprayer with a spray volume of 20 gallons per acre utilizing 8002 flat fan Tee Jet nozzles. Each plot was 10 by 20 feet in size and was replicated four times. There were two treatment methods: (1) applying both herbicides as a tank mix or (2) applying a first herbicide and following it two days later with the second herbicide. The herbicides tested were imazethapyr (0.063 lb/a), 2,4-DB (0.5), sethoxydim (0.28), and clethodim (0.13). All tank mix applications and the first of the separate applications were made on 11/20/89. The second application of the separate treatments was made on 11/22/90. The alfalfa was in the three to five leaf stage. Annual bluegrass had three to five leaves; foxtail was three to seven inches in diameter and tillering; shepherd's purse and filaree were two to four inches in diameter; tansy mustard was one to two inches in diameter.

Weed control ratings were made on 12/8/90 and 4/11/90. None of the herbicides or herbicide tank mixes caused significant alfalfa phytotoxicity. Only herbicide treatments containing clethodim had an appreciable initial effect on annual bluegrass. Clethodim was also superior to sethoxydim in foxtail barley control. Early foxtail barley, filaree, and shepherd's purse ratings showed no difference between tank mixes and separate applications. Evaluations made four months after application indicated no difference in tansy mustard control between tank mix applications and separate applications. Foxtail barley control diminished when sethoxydim was tank mixed with imazethapyr, however, all other tank mixes were equivalent to the separate applications. It is evident from this trial that tank mixes should be thoroughly tested before used, as a reduction in efficacy is possible.

The interactions of broadleaf and grass herbicides in seedling alfalfa at Lancaster, California.

Treatment[2]		Alfalfa (12/8/89)	Annual Bluegrass (12/8/89)	Foxtail Barley (12/8/89)	Shepherd's Purse (12/8/89)	Filaree (12/8/89)	Tansy Mustard (4/11/90)	Foxtail Barley (4/11/90)
		Weed Control Ratings[1]						
imazethapyr + 0	S	0.3	0.3	1.5	3.8	5.0	8.8	3.0
imaz. + sethox	TM	0.8	1.0	5.0	5.5	7.5	6.3	3.
imaz. + clethodim	TM	0.5	4.3	6.3	5.0	6.5	8.8	9.8
imaz. + sethox.	S	1.0	1.8	4.3	5.5	7.3	8.5	8.3
imaz. + clethodim	S	0.8	3.8	6.0	4.0	6.8	6.1	9.6
2,4-DB + 0	S	1.5	0.5	0.0	4.5	5.8	9.8	1.0
2,4-DB + sethox.	TM	1.3	1.3	5.8	3.5	6.3	9.3	9.3
2,4-DB + cleth.	TM	1.5	4.8	6.8	5.8	6.3	9.9	10.0
2,4-DB + sethox.	S	1.0	0.8	4.8	4.0	6.5	9.9	8.8
2,4-DB + cleth.	S	1.8	4.5	6.0	4.5	5.0	10.0	10.0
0 + sethox.	S	0.8	0.8	4.3	1.3	0.0	0.0	6.3
0 + cleth.	S	0.0	4.0	6.3	1.0	0.8	2.0	10.0
imazethapyr	S	1.0	1.3	2.8	4.8	7.0	10.0	3.5
check		0.0	0.3	0.0	1.5	0.0	6.3	0.0
LSD 0.05		0.8	1.3	1.4	2.1	2.2	3.2	2.4

[1]Weed control ratings: 0 = no control 10 = all weeds dead

[2]S = Separate TM = Tank mixed

Crop oil concentrate (Dash) added at 1 qt/A to all treatments with sethoxydim or clethodim.

Non ionic surfactant (Triton 98) added to imazethapyr alone at .25%

Volunteer oat control in fall-planted seedling alfalfa. Orloff, S.B. and D.W. Cudney. In the high desert of Southern California, cereal crops grown for hay are commonly rotated with alfalfa. When fields are replanted to alfalfa, volunteer cereals and other annual grasses can compete severely with the young alfalfa. Pronamide has been the standard treatment on sprinkler-irrigated fields, where the herbicide can be uniformly incorporated to a shallow depth. However, pronamide is not used in flood-irrigated fields, as shallow incorporation is more difficult. In these fields, sethoxydim is the standard treatment.

Trials were established in two high desert valleys, Lucerne Valley and the Antelope Valley, to compare the efficacy of sethoxydim and pronamide under flood irrigated conditions. The herbicides were applied using a CO_2 pressurized backpack sprayer at a spray volume of 20 gallons per acre with 8002 flat fan TeeJet nozzles. The plots measured 20 by 20 feet and were replicated four times. In the first trial, pronamide treatments were applied on 10/1/89 just prior to a four inch flood irrigation. Sethoxydim treatments were made on 10/6/89. The alfalfa was in the three to five trifoliate leaf stage and the volunteer oats were four to six inches in height and in the early tillering stage.

Sethoxydim controlled volunteer oats, while pronamide did not provide adequate control (table 1). A possible explanation for the lack of control with pronamide may be that the pronamide remained suspended in the four to six inch oat foliage and did not reach the soil where it could affect oat growth.

A second trial was established on smaller grassy weeds (foxtail barley), where the pronamide could make better contact with the soil surface. All treatments were made on 11/22/90 and a four inch flood irrigation occurred two days after application. The plots were the same size and the herbicides were applied in the same manner as the previous trial. Both the alfalfa and the weeds were in a younger growth stage at the time of application; the alfalfa had two to three trifoliate leaves and the foxtail barley was in the early tillering stage, prostrate, and was two to three inches in diameter.

Pronamide controlled foxtail barley in this trial much better (9.7 rating for the 0.75 rate) than it did volunteer oats in the first trial (table 2). Possible explanations for the improved control are that the weeds were smaller, permitting better soil contact with the herbicide, and pronamide may be more effective in controlling foxtail barley than oats. Sethoxydim at the 0.375 lb rate completely controlled the foxtail barley. Both combinations of pronamide and sethoxydim completely controlled the foxtail barley.

Table 1. Volunteer oat control in fall-planted seedling alfalfa

Treatment[2]	Rate lbs/ai/a	Volunteer Oat Control[1] 11/19/89	4/24/90
pronamide	.5	2.1	2.3
pronamide	.75	2.9	3.5
pronamide	1.0	3.0	4.0
sethoxydim	.28	8.9	8.1
sethoxydim	.375	9.1	9.5
Check	---	0.8	0.5
LSD 0.05	1.3	1.1	1.1

Table 2. Volunteer oat control in fall-planted seedling alfalfa

Treatment[2]	Rate lbs ai/a	Foxtail Barley Control[1] 1/26/90	4/20/90
pronamide	.38	4.0	6.5
pronamide	.75	6.2	9.7
sethoxydim	.19	8.9	9.5
setoxydim	.38	9.9	10.0
pron. + seth.	.38 + .19	9.7	10.0
pron. + seth.	.75 + .38	9.8	10.0
Check	---	0.0	0.0
LSD 0.05		0.9	1.0

[1]Rating: 0 = no control 10 = all weeds dead.
[2]Crop oil concentrate (Dash) added at 2 pts/A to treatments containing sethoxydim.

The effect of trifluralin formulation on dodder control in alfalfa. Orloff, S.B. and D.W. Cudney. Dodder is the most troublesome weed in high desert alfalfa fields. Trifluralin granules have been used successfully as preemergence applications for the control of dodder. New formulations of trifluralin have become available. Two trials were established in the high desert of Southern California, with one in Newberry Springs and the other in Lucerne Valley. The purpose of these trials was to evaluate the performance of the newer formulations compared to the standard 10 percent granule. Three formulations were compared to the standard granule. Two 15% granular formulations from Dow Elanco and a 10% granular formulation from Gowan Chemical Company were compared to the common 10% granular formulation from Dow Elanco. Each formulation was evaluated as single and split applications. Single applications were made at 2.0 lb ai/a during the first week of March 1990. The split applications were made with 2.0 lb/a in March followed by another application six to eight weeks later (after the first cutting). Plots were 200 square feet in size and replicated four times. Applications were made using a Gandy AirFlow Applicator. Dodder control evaluations were made after the second and third alfalfa cuttings in both locations.

The number of dodder colonies and the amount of dodder cover were dramatically reduced with all trifluralin formulations. The split application of 2 + 2 lb/a was superior to a single 2 lb/a application. There were no significant differences between trifluralin formulations.

Table 1. Trifluralin formulation evaluation, Newberry Springs

Treatment[2]	Rate lbs ai/a	Dodder Colonies 6/5	Dodder Colonies 7/3	Dodder[1] Cover 7/3
Treflan FN3345	2	2.3	2.8	9.5
	2 + 2	1.3	1.0	3.0
Treflan FN3346	2	0.8	3.8	15.5
	2 + 2	0.5	0.8	1.8
Treflan TR-10	2	1.5	3.5	20.5
	2 + 2	0.0	0.0	0.0
Gowan Trifluralin	2	2.8	5.0	37.3
	2 + 2	0.3	0.8	1.5
Check	-	53.8	2.0	840.0
LSD .05		10.9	2.1	124.3

[1]Dodder cover - area in square feet per plot covered with dodder.
[2]Dodder plants in check plots had coalesced by this time and counts of individual colonies were no longer possible.

Table 2. Trifluralin formulation evaluation, Lucerne Valley

Treatment	Rate lbs ai/a	Dodder Colonies 6/20	Dodder Colonies 8/2
Treflan FN3345	2	1.3	2.8
	2 + 2	1.8	2.3
Treflan FN3346	2	3.5	7.5
	2 + 2	1.0	3.0
Treflan TR-10	2	3.0	4.0
	2 + 2	0.3	2.3
Gowan Trifluralin	2	2.3	5.0
	2 + 2	1.0	2.5
Check	-	14.8	22.8
LSD .05		3.1	4.6

Mustard control in seedling alfalfa. Orloff, S.B. and D.W. Cudney. Imazethapyr has been shown to kill difficult to control weeds in seedling alfalfa (filaree and common groundsel) in the high desert region of Southern California. However, in this region mustards, primarily London rocket, are the most common weed species present. This experiment was established to compare the standard treatment of 2,4-DB ester to imazethapyr for London rocket control and to investigate the feasibility of tank mixing the two herbicides.

Plots were established in Newberry Springs, California on November 30, 1989. The plots were sprayed with a constant pressure CO_2 backpack sprayer with a spray volume of 20 gallons per acre utilizing 8002 flat fan Tee Jet nozzles. Each plot was 10 by 20 feet in size and was replicated four times. Alfalfa phytotoxicity ratings were made on 12/14/89 and London rocket control ratings were made on 12/14/89 and on 4/21/90. There was no significant alfalfa phytotoxicity noted two weeks after application for 2,4-DB ester or imazethapyr, however, there were slight initial symptoms for the combination treatments. London rocket control two weeks after application was best for the imazethapyr treatments and the combination treatments. There was also a trend for increasing control as rates of both 2,4-DB and imazethapyr increased. The highest rate of 2,4-DB (0.75 lb/A) was required for effective London rocket control four months after application. Imazethapyr controlled London rocket at all four rates tested with best control at the three highest rates (0.047, 0.063, and 0.094 lb /A). Both combination treatments of 2,4-DB and imazethapyr controlled London rocket.

Mustard Control in Seedling Alfalfa
at Newberry Springs, California

Treatment[2]	Rate lb/A	Crop Injury	Ratings[1] London Rocket Control 12/14/89	4/21/90
2,4-DB	.25	0.5	3.0	5.8
2,4-DB	.50	0.0	3.3	6.6
2,4-DB	.75	0.0	3.5	9.1
imazethapyr	.032	0.3	4.3	8.3
imazethapyr	.047	0.3	3.5	9.6
imazethapyr	.063	0.4	5.5	10.0
imazethapyr	.094	0.3	6.3	10.0
imaz. + 2,4-DB	.032 + .25	1.5	6.8	10.0
imaz. + 2,4-DB	.047 + .25	0.9	6.6	0.0
Check	---	0.0	0.0	0.0
LSD 0.05		0.7	1.5	1.1

[1]Ratings 0 = no crop injury 10 = crop killed
0 = no weed control 10 = all weeds killed

[2]Nonionic surfactant (Triton Ag 98) added at 0.25% v/v to all treatments containing imazethapyr.

Dose-response confirmation of sensitive crops to sulfometuron. Callihan, R.H., L.W. Lass, and L.K. Hiller Pre-emergence treatments of sulfometuron ranging between 1.5 and 0.008 g/ha were applied to a Shano silt loam to develop dose-response curves and to characterize injury induced in five dicot crops. Crop heights and shoot symptom expressions were recorded several times during the season, and yields were measured. Statistical no-effect threshold levels of sulfometuron were reached in peas at 0.5 g/ha for shoot biomass, 0.26 g/ha for shoot chlorosis, 0.13 g/ha for pod number, and 0.06 g/ha for shoot height, flower number, and pod weight. In lentils, no-effect thresholds were reached at 0.26 g/ha for shoot chlorosis and 0.03 for shoot height. No-effect thresholds in alfalfa increased through the growing season and were reached at 0.13 g/ha for shoot biomass, 0.008 g/ha for flowering and 0.016 g/ha for seedling height. No-effect thresholds in potato tuber physical characteristics were 0.26 g/ha for knobs per tuber, 0.131 g/ha for tubers less than 7.5 cm, and 0.262 g/ha for tubers with cracks. In the first month after application sugar beet height was significantly reduced at the lowest dose (0.008 g/ha). In sugar beets, early-season no-effect thresholds were not reached for number of plants emerged and seedling shoot height, although no-effect thresholds were detected at levels as high as 0.262 g/ha later in the growing season. Temporal changes in perception of apparent no-effect thresholds of sulfometuron in all of the crops were observed throughout the growing season. Late-season recovery may be due to degradation or less uptake in proportion to plant size, to an expanded root system outside the herbicide zone, or other unknown factors. It is clear that a series of observations during plant development is necessary to ensure detection of transient effects. Response thresholds are dependent upon evaluative criteria, temporal effects, and environment. Statistically significant no-effect levels reported here are considered to be higher than those that could produce occasional effects, since effects, though not consistent, were observed at lower dose levels. (Univ. of Idaho, Dept. of Plant, Soils, and Ent. Sci., Moscow, 83843 and Washington State University, Dept. of Horticulture and Landscape Architecture, Pullman, 99163).

Broadleaf control in seedling alfalfa. Brewster, Bill D., Arnold P. Appleby, Don L. Kloft, John Leffel. Five herbicides were compared on seedling alfalfa for broadleaf weed control. The trial design was a randomized complete block with three replications and 2.5-m by 7-m plots. The herbicides were applied in a spray volume of 234 L/ha at 172 kPa through XR 8003 flat fan tips. The alfalfa ('Multileaf') had three to four trifoliolate leaves and the weeds had two to six leaves when the herbicides were applied on June 8, 1990. Visual evaluations of crop injury and weed control conducted on June 19, 1990 are presented in the table.

Bentazon, bromoxynil, and pyridate provided excellent control of all weed species, while imazethapyr controlled all species except those in the composite family. 2,4-DB amine was not effective on mayweed chamomile, a common weed in western Oregon seedling alfalfa, and caused more stunting of the crop than the other treatments. All of the herbicide treatments caused some crop stunting, but when evaluated 3 weeks later only bromoxynil and 2,4-DB were still causing visible stunting. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331)

Visual evaluation of percent weed control and crop injury following application on seedling alfalfa

Herbicide[1]	Rate	Alfalfa	ANTCO	AMAPO	LACSE	SSYOF	CHEAL	CAPBP	SOLSA	SONOL
	(kg a.i./ha)	(%)								
bentazon	1.1	12	100	97	100	100	100	96	100	100
imazethapyr	0.07	13	85	100	37	100	97	100	100	13
bromoxynil	0.4	13	100	100	100	100	100	100	100	100
pyridate	1.0	7	100	100	100	100	100	100	100	100
2,4-DB	1.1	17	40	83	80	83	97	87	90	83
check	0	0	0	0	0	0	0	0	0	0

[1]X-77 was added to the bentazon and imazethapyr treatments at 0.25% v/v.

Response of selected rotational crops to DPX-79406 and nicosulfuron. Jenks, B. M., J. O. Evans, and J. M. Torell. A plantback study was conducted to determine the response of selected rotational crops in the spring following a fall application of DPX-79406 and nicosulfuron, two sulfonylurea products being studied for weed control in corn. The treatments were arranged in a randomized complete block design with three replications.

Herbicides were applied on October 25, 1989 with a bicycle sprayer delivering 16 gal/A at 40 psi. Safflower, oats, corn, wheat, alfalfa, and beans were planted at appropriate times. Visual evaluations for herbicide injury were conducted on July 6, 1990 for all crops except for beans which were evaluated on August 7, 1990.

No damage was observed to corn or beans from any of the treatments. DPX-79406 at 0.50 and 0.75 oz/A. caused severe injury to safflower and alfalfa and moderate damage to oats. Slight damage was noted on wheat. Nicosulfuron caused slight damage to oats, safflower, wheat, and alfalfa. (Utah Agricultural Experiment Station, Logan, UT, 84322).

Effects of sulfonylurea herbicides on rotational crops.

Treatment	Rate oz ai/a	Crop Injury[1] SAFF	OATS	CORN	WHEAT	ALFA	BEANS
DPX-79406	0.25	5.7	2.3	0	0.7	6.5	0
DPX-79406	0.50	8.5	0	0	1.7	8.2	0
DPX-79406	0.75	9.3	7.5	0	3.0	9.0	0
Nicosulfuron	0.25	0.7	0	0	0	2.5	0
Nicosulfuron	0.50	1.7	1.8	0	0.7	3.5	0
Nicosulfuron	0.75	1.2	2.0	0	0.7	5.5	0
Control	----	0	0	0	0	0	0
	LSD(0.05)	0.6	0.8	NA	0.5	0.5	NA

[1]All crops were evaluated visually July 6 on a 0-10 scale with 0 = no injury and 10 = complete kill.

Shepardspurse control in established alfalfa. Tickes, B.R., E.S. Heathman. Shepardspurse (Capsella bursa) has become an increasingly widespread weed in western Arizona due to the lack of an effective herbicide to control it. This test was conducted to evaluate both registered and non-registered herbicide treatments for efficacy in controlling shepardspurse in established alfalfa and crop safety. The test was located at Provenzano Farms in the Wellton Mohawk Valley, Arizona, on a one year old stand of CUF 101 alfalfa. Ten herbicide treatments were applied with a compressed air backpack sprayer calibrated to apply a 30 gallon per acre spray volume. Treatments included metribuzin at 0.375 and 0.49 lb ai/a, paraquat at 0.28 and 0.375 lb ai/a, 2,4-DB at 1.4 lb ai/a, oxyfluorfen at 0.25 and 0.5 lb ai/a, imazethypr at 0.094 and 0.063 lb ai/a, and bromoxynil at 0.25 lb ai/a and an untreated check. Plot size was 10 by 15 ft set in a randomized complete block design with four replications. A moderate to heavy infestation of shepardspurse was present at 10 to 20 per square foot. Weeds were just emerging with some one quarter inch in height at the time of application. The alfalfa had been grazed until 2 days before application and little foliage was present. Application was made on November 28, 1988 and visual evaluations of weed control and phytotoxicity were made on February 7, 1989.

Metribuzin produced excellent control of shepardspurse at both rates. Imazethypr produced very good control at both 0.063 and 0.094 lb ai/a. All other treatments were unsatisfactory because of the continuous emergence of new shepardspurse seedlings throughout the season. Phytotoxicity to the alfalfa of 10 to 15 percent was noticeable in February, 6 to 8 weeks following treatment as a result of the metribuzin and imazethypr treatments (University of Arizona Cooperative Extension, Yuma)

Shepardspurse control in established alfalfa

Herbicide	Rate	Control	Phytotoxicity to alfalfa
	(lbs ai/a)	----------%----------	
metribuzin 75DF	0.375	99 d	15
metribuzin 75DF	0.49	99 d	13
paraquat 1.5EC	0.28	23 bc	9
paraquat 1.5EC	0.375	13 ab	4
2,4-DB 2EC	1.4	40 c	10
oxyfluorfen 1.6EC	0.25	41 c	11
oxyfluorfen 1.6EC	0.50	98 d	8
imazethypr 2EC	0.094	90 d	15
imazethypr 2EC	0.063	86 d	5
bromoxynil 2EC	0.25	15 ab	5
untreated		0 a	0

Means followed by the same letter are not significantly different at the .05 level using SNK.

Weed control in seedling alfalfa with imazethapyr. Zamora, D.L. Field trials with imazethapyr alone and in tank mixes were conducted to determine crop safety and weed control efficacy in seedling alfalfa. The field trials were conducted at Touchet and Warden, Washington on silt loam soils with 1 to 1.5% organic matter. Applications were made with a CO_2 pressurized backpack sprayer, calibrated to deliver 20 gpa at 32 psi and 3 mph. The experiments were randomized complete block designs with four replications. Plots were 7 by 25 ft. Treatments included an untreated check and were similar at both locations except that a tank mix of imazethapyr plus pendimethalin was added at Warden.

The applications were made at Touchet on April 19, 1990 when the alfalfa had 2 to 3 trifoliate leaves. Wild oats (AVEFA) had 3 to 5 leaves, common lambsquarters (CHEAL) had 4 to 6 leaves, and field bindweed (CONAR), green foxtail (SETVI), wild mustard (SINAR), flixweed (DESSO), and field pennycress (THLAR) had 2 to 4 leaves at application. The air temperature at application was 63F, soil temperature was 62F, and the relative humidity was 60%. Crop injury and weed control were visually evaluated on June 7.

The applications were made at Warden on May 3, 1990 when the alfalfa had five trifoliate leaves. Common lambsquarters and redroot pigweed (AMARE) had 2 to 4 leaves, barnyardgrass (ECHCG) had 2 to 3 leaves, wild mustard had 2 to 5 leaves, and volunteer wheat (TRIAX) had 4 to 5 leaves at application. Canada thistle (CIRAR) had 5 to 7 leaves at application. The air temperature at application was 72F, soil temperature was 65F, and the relative humidity was 30%. Crop injury and weed control were visually evaluated on June 27.

All treatments were equally safe to seedling alfalfa at Touchet (Table 1). Seedling alfalfa at Warden was stunted after application of 0.094 lb ai/a of imazethapyr (Table 2). Bentazon plus imazethapyr caused chlorosis and stunting of the alfalfa at Warden. Imazethapyr alone or in tank mix provided good control of green foxtail, mustard species, pigweed, and lambsquarters. Imazethapyr alone or in a tank mix also controlled 58 to 72% of wild oats and 58 to 79% of field bindweed. No treatment provided acceptable control of Canada thistle or volunteer wheat at Warden. (American Cyanamid Company, 4525 Cochees Way, Boise, ID 83709)

Table 1. Weed control in seedling alfalfa at Touchet, WA 49 DAT

Treatment[1]	Rate	Injury	AVEFA	SETVI	SINAR	THLAR	DESSO	CHEAL	CONAR
	(lb ai/a)	(%)	(% of check)						
imazethapyr	0.047	1.2	58	86	79	60	62	62	58
imazethapyr	0.063	0	68	86	82	65	54	66	71
imazethapyr	0.094	2.5	72	90	94	84	86	82	79
imazethapyr	0.063								
+ bromoxynil	0.25	1.2	69	89	94	91	89	92	75
imazethapyr	0.063								
+ 2,4-DB ester	0.5	5.0	62	88	92	79	74	80	72
imazethapyr	0.063								
+ bentazon	0.5	1.2	62	91	90	92	81	89	78
LSD (0.05)		N.S.	14	N.S.	N.S.	20	N.S.	16	10

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

Table 2. Weed control in seedling alfalfa at Warden, WA 55 DAT

Treatment[1]	Rate	Injury	TRIAX	ECHCG	AMARE	CHEAL	CIRAR
	(lb ai/a)	(%)	(% of check)				
imazethapyr	0.047	0	6	79	90	75	5
imazethapyr	0.063	0	21	81	96	74	14
imazethapyr	0.094	5.8	25	91	100	94	22
imazethapyr	0.063						
+ bromoxynil	0.25	0	24	90	98	90	16
imazethapyr	0.063						
+ 2,4-DB ester	0.5	1.2	17	86	95	85	10
imazethapyr	0.063						
+ bentazon	0.5	17.5	21	85	90	85	22
imazethapyr	0.063						
+ pendimethalin	0.5	0	24	85	96	82	14
LSD (0.05)		3.8	11	N.S.	N.S.	14	10

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

Grass and broadleaf herbicide combinations in seedling alfalfa. Miller, S.D. and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and alfalfa tolerance with grass and broadleaf herbicides alone or in combination. Plots were 9 by 45 ft. with three replications arranged in a randomized complete block. Alfalfa (var. DeKalb 125) was seeded April 19, 1990 in a sandy loam soil (78% sand, 12% silt and 10% clay) with 1.4% organic matter and pH 7.6. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi May 31, 1990 (air temp. 62F, relative humidity 84%, wind calm, sky clear and soil temp. - 0 inch 74F, 2 inches 58F and 4 inches 56F) to 3 trifoliolate leaf alfalfa and 1 to 2 inch weeds. Visual weed control and crop damage evaluations were made June 19 and plots harvested July 5 and August 21, 1990. Yellow foxtail (SETLU) infestations were heavy, common lambsquarters (CHEAL) and kochia (KCHSC) infestations moderate and redroot pigweed (AMARE) infestations light but uniform throughout the experimental area.

No treatment reduced alfalfa stand; however, treatments containing bromoxynil injured alfalfa 2 to 8%. Yellow foxtail control was excellent (90 to 100%) with all treatments except bromoxynil or 2,4-DB; common lambsquarters control good to excellent (88 to 95%) with bromoxynil or 2,4-DB, kochia control excellent (97 to 100%) with imazethapyr or bromoxynil and redroot pigweed control excellent (92 to 100%) with imazethapyr, bromoxynil or 2,4-DB. Weed yields were 746 to 4624 lb/A lower and alfalfa yields 321 to 2893 lb/A higher in herbicide treated areas compared to weedy check plots for the two cuttings. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1752)

Table 1. Alfalfa response to grass and broadleaf herbicides alone or in combination.

Treatment[1]	Rate lb ai/A	Alfalfa response[2] Inj %	SR %	Alfalfa yield[2] 1st cut lb/A	2nd cut lb/A	Total lb/A
sethoxydim(seth)+ocd	0.2	0	0	1011	3592	4603
sethoxydim+oc	0.2	0	0	988	3378	4366
sethoxydim+ocs	0.2	0	0	994	3443	4437
seth+imazethapyr+ocd	0.2+0.047	0	0	2618	4102	6720
seth+bromoxynil+ocd	0.2+0.25	7	0	2535	4192	6727
seth+2,4-DB+ocd	0.2+1.0	2	0	2684	4226	6910
seth+imaz+brom+ocd	0.2+0.032+0.125	2	0	2618	4232	6850
seth+brom+2,4-DB+ocd	0.2+0.125+0.5	5	0	2731	4057	6788
HOE-46360+oc	0.1	0	0	1148	3628	4776
HOE-46360+imaz+oc	0.1+0.047	0	0	2737	4032	6769
HOE-46360+brom+oc	0.1+0.25	8	0	2707	4276	6983
HOE-46360+2,4-DB+oc	0.1+1.0	0	0	2678	4301	6979
clethodim+oc	0.094	0	0	1023	3468	4491
clethodim+imaz+oc	0.94+0.047	0	0	2642	4177	6819
clethodim+brom+oc	0.94+0.25	7	0	2588	4017	6605
clethodim+2,4-DB+oc	0.94+1.0	0	0	2838	4032	6870
imazethapyr(imaz)+oc	0.047	0	0	2707	4231	6938
bromoxynil(brom)+oc	0.25	8	0	2636	4202	6838
2,4-DB+oc	1.0	0	0	2850	4007	6857
weedy check	- - - - - - - -	0	0	851	3194	4045

[1]Treatments applied May 31, 1990; ocd=Dash at 1 qt/A, oc=At Plus 411F at 1 qt/A and ocs=Sunit at 1 qt/A.
[2]Alfalfa injury (Inj) and stand reduction (SR) visually evaluated June 19 and plots harvested July 5 and August 21, 1990.

Table 2. Weed control in seedling alfalfa with grass and broadleaf herbicides alone or in combination.

Treatment[1]	Rate	Weed control[2]				Weed yield[2]		
	lb ai/A	CHEAL %	KCHSC %	AMARE %	SETLU %	1st Cut lb/A	2nd cut lb/A	Total lb/A
sethoxydim(seth)+ocd	0.2	0	0	0	100	3244	903	4147
sethoxydim+oc	0.2	0	0	0	100	3290	738	4028
sethoxydim+ocs	0.2	0	0	0	100	3280	797	4077
seth+imazethapyr+ocd	0.2+0.047	78	100	100	93	818	118	936
seth+bromoxynil+ocd	0.2+0.25	93	100	95	100	175	148	323
seth+2,4-DB+ocd	0.2+1.0	93	83	95	97	228	41	269
seth+imaz+brom+ocd	0.2+0.032+0.125	88	100	100	93	756	12	768
seth+brom+2,4-DB+ocd	0.2+0.125+0.5	95	97	97	99	125	175	300
HOE-46360+oc	0.1	0	0	0	95	2993	649	3942
HOE-46360+imaz+oc	0.1+0.047	78	100	100	92	792	177	969
HOE-46360+brom+oc	0.1+0.25	95	100	93	95	251	106	357
HOE-46360+2,4-DB+oc	0.1+1.0	92	83	95	93	257	177	434
clethodim+oc	0.094	0	0	0	100	3066	779	3845
clethodim+imaz+oc	0.094+0.047	75	100	100	95	673	165	838
clethodim+brom+oc	0.094+0.25	95	97	93	100	284	159	443
clethodim+2,4-DB+oc	0.094+1.0	92	83	93	100	274	41	315
imazethapyr(imaz)+oc	0.047	80	100	100	90	809	177	986
bromoxynil(brom)+oc	0.25	95	97	95	0	482	236	718
2,4-DB+oc	1.0	90	83	92	0	502	271	773
weedy check	- - - - - - -	0	0	0	0	3772	1121	4893

[1]Treatments applied May 31, 1990; ocd=Dash at 1 qt/A, oc=At Plus 411F 1 qt/A and ocs=Sunit at 1 qt/A.
[2]Weed control visually evaluated June 19 and plots harvested July 5 and August 21, 1990.

Weed control in seedling alfalfa with postemergence herbicide treatments. Miller, S.D. and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and alfalfa tolerance with imazethapyr, bromoxynil and 2,4-DB. Plots were 9 by 45 ft. with three replications arranged in a randomized complete block. Alfalfa (var. DeKalb 125) was seeded April 19, 1990 in a sandy loam soil (78% sand, 12% silt and 10% clay) with 1.4% organic matter and pH 7.6. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 31, 1990 (air temp. 67F, relative humidity 65%, wind SE at 6 mph, sky clear and soil temp. - 0 inch 80F, 2 inches 60F and 4 inches 58F) to 3 trifoliolate leaf alfalfa and 1 to 2 inch weeds. Visual weed control and crop damage evaluations were made June 19 and plots harvested July 5 and August 21, 1990. Common lambsquarters (CHEAL) infestations were heavy, kochia (KCHSC) infestations moderate and redroot pigweed (AMARE) and yellow foxtail (SETLU) infestations light but uniform throughout the experimental area.

No treatment reduced alfalfa stand; however, treatments containing bromoxynil injured alfalfa 3 to 10%. Imazethapyr combinations with surfactant and liquid nitrogen provided better weed control than combinations with oil concentrates regardless of rate. Weed yields were 2121 to 5170 lb/A lower and alfalfa yields 1969 to 3558 lb/A higher in herbicide treated areas compared to weedy check plots for the two cuttings. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1751)

Table 1. Alfalfa response to postemergence herbicide treatments.

Treatment[1]	Rate	Alfalfa response[2]		Alfalfa yield[2]		
		Inj	SR	1st cut	2nd cut	Total
	lb ai/A	%	%	lb/A	lb/A	lb/A
imazethapyr(imaz)+S	0.032	0	0	1797	3812	5609
imazethapyr+S+N	0.032	0	0	2398	3989	6387
imazethapyr+oc	0.032	0	0	1922	3807	5729
imazethapyr+ocs	0.032	0	0	2184	3807	5991
imazethapyr+S	0.047	0	0	2071	3641	5712
imazethapyr+S+N	0.047	0	0	2886	3891	6777
imazethapyr+oc	0.047	0	0	2071	3822	5893
imazethapyr+oc+N	0.047	0	0	2368	3788	6156
imazethapyr+ocs	0.047	0	0	2451	3881	6332
imazethapyr+ocs+N	0.047	0	0	2630	4023	6653
imazethapyr+S	0.063	0	0	2231	3763	5994
imazethapyr+S+N	0.063	0	0	2975	4150	7125
imazethapyr+oc	0.063	0	0	2261	3719	5980
imazethapyr+ocs	0.063	0	0	2219	3812	6031
bromoxynil	0.25	3	0	2695	3822	6517
bromoxynil	0.38	10	0	2457	3940	6397
bromoxynil+2,4-DB	0.25+0.5	7	0	2499	3920	6419
2,4-DB	1.0	0	0	2886	3930	6816
2,4-DB+S	1.0	0	0	2927	3881	6808
2,4-DB+oc	1.0	0	0	2898	3851	6749
bromoxynil+imaz+S	0.25+0.032	3	0	3023	4175	7198
weedy check	- - - - -	0	0	803	2837	3640

[1]Treatments applied May 31, 1990; S=X-77 at 0.25% v/v, oc=At Plus 411F at 1 qt/A, N=28% nitrogen at 1 gal/A and ocs=Sunit at 1 qt/A.
[2]Alfalfa injury (Inj) and stand reduction (SR) visually evaluated June 19 and plots harvested July 5 and August 21, 1990.

Table 2. Weed control is seedling alfalfa with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Weed control[2] CHEAL %	KCHSC %	AMARE %	SETLU %	Weed yield[2] 1st cut lb/A	2nd cut lb/A	Total lb/A
imazethapyr(imaz)+S	0.032	52	90	93	87	2691	348	3039
imazethapyr+S+N	0.032	83	95	97	95	1357	277	1634
imazethapyr+oc	0.032	55	87	95	85	2668	354	3022
imazethapyr+ocs	0.032	68	92	95	88	2242	325	2567
imazethapyr+S	0.047	58	97	97	92	2387	378	2765
imazethapyr+S+N	0.047	87	98	98	97	609	148	757
imazethapyr+oc	0.047	67	95	95	92	2329	201	2530
imazethapyr+oc+N	0.047	80	97	97	93	847	295	1142
imazethapyr+ocs	0.047	75	98	98	93	1207	277	1482
imazethapyr+ocs+N	0.047	80	98	98	93	876	212	1088
imazethapyr+S	0.063	68	98	98	97	1746	277	2023
imazethapyr+S+N	0.063	87	98	98	97	647	65	712
imazethapyr+oc	0.063	80	100	100	95	1285	277	1562
imazethapyr+ocs	0.063	75	98	98	95	1804	266	2070
bromoxynil	0.25	85	97	98	0	313	466	779
bromoxynil	0.38	97	100	98	7	174	325	499
bromoxynil+2,4-DB	0.25+0.5	94	97	98	0	484	372	856
2,4-DB	1.0	88	77	87	0	528	419	947
2,4-DB+S	1.0	92	82	90	0	328	260	588
2,4-DB+oc	1.0	92	82	90	0	325	201	526
bromoxynil+imaz+S	0.25+0.032	95	100	100	88	49	41	90
weedy check	- - - - -	0	0	0	0	4109	1151	5260

[1]Treatments applied May 31, 1990; S=X-77 at 0.25% v/v, oc=At Plus 411F at 1 qt/A, N=28% nitrogen at 1 gal/A and ocs=Sunit at 1 qt/A.
[2]Weed control visually evaluated June 19 and plots harvested July 5 and August 21, 1990.

Weed control in dormant alfalfa. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on November 14, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of alfalfa (var. W.L. 309) 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 CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi.

Visual evaluations of weed control and crop injury were made May 17, 1990. Plots were harvested for yield on May 31, 1990. Tansymustard (DESPI) control was excellent with all treatments. Downy brome (BROTE) control was good to excellent with all treatments except imazethapyr applied at 0.063 and 0.126 lb ai/A. Karmex applied at 3.0 lb ai/A caused the highest injury rating of 10. Yields ranged from a high of 4855 to a low of 3243 lb/A. All treatments resulted in a higher protein content than the untreated check. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Downy brome and tansymustard evaluations in dormant alfalfa

Treatment	Rate lb ai/A	Crop[1] Injury	Weed Control[1] DESPI	BROTE	Yield[2]	Protein
		----------------	----------------	%	----------------	----------------
norflurazon	1.5	0	100	100	4075	20.3
norflurazon	2.5	0	100	100	4820	21.3
norflurazon + prodiamine	1.5+0.75	0	100	99	3975	20.2
norflurazon + metribuzin	1.5+0.5	0	100	100	4318	19.9
norflurazon + hexazinone	1.5+0.5	0	100	100	4469	20.3
norflurazon + imazethapyr	1.5+0.094	0	100	98	4856	21.4
prodiamine	0.75	0	100	90	4462	19.1
imazethapyr	0.063	0	100	80	4526	19.4
imazethapyr	0.126	5	100	80	3653	20.7
diuron	2.0	5	100	100	3243	21.2
diuron + metribuzin	1.5+0.25	0	100	98	4344	21.7
diuron + hexazinone	1.5+0.25	0	100	100	3965	21.5
diuron	3.0	10	100	100	3637	22.4
metribuzin	0.5	0	100	100	3723	20.3
hexazinone	0.5	0	100	100	3993	19.8
untreated check		0	0	0	4125	17.5
av weeds/M^2			5	11		
LSD 0.05			ns	11	ns	2.3

1. Based on a visual scale from 0-100 where 0 = no control of crop injury and 100 = dead plants.
2. Yields expressed on a 20% moisture basis.

<u>DPXL5300 and triasulfuron tank mixes on spring barley</u>. Dial, M. J., D. C. Thill, and T. L. Carpenter. DPXL5300 and triasulfuron were evaluated for broadleaf weed control. These sulfonylurea herbicides were applied both alone and in tank mixture combinations to 'Clark' spring barley near Potlatch, Idaho. Due to several weeks of rainy weather, treatments were delayed past the three to four leaves stage of the spring barley, and were applied when the crop was tillered. The predominant broadleaf weeds were mayweed chamomile (ANTCO), field pennycress (THLAR), *Brassica* sp. (BRSRA), coast fiddleneck (AMSIN), and wild buckwheat (POLCO). Weed growth stages were; mayweed chamomile 5 in. tall, field pennycress 8 in. tall, *Brassica* sp. 10 in. tall, coast fiddleneck emerging, and wild buckwheat emerging. Herbicide treatments were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). The experimental design was a randomized complete block replicated four times. Herbicide efficacy was estimated visually on June 26 and on July 11. Grain was harvested on August 9.

Table 1. Application data

Date of application	June 4
Air temperature (F)	55
Soil temperature at 2 in. (F)	50
Relative humidity (%)	85
wind speed (mph)-direction	3-E
soil pH	6.0
OM (%)	4.2
CEC (meq/100 g soil)	22.5
Texture	silt loam

June 26 evaluation data show that all herbicide treatments controlled field pennycress, *Brassica* sp., coast fiddleneck, wild buckwheat, and mayweed chamomile 88% or better. July 11 evaluation data show that all treatments controlled mayweed chamomile and the *Brassica* species 91% or better. The tall, yellow-flowered *Brassica* sp. found in these plots appeared to be a result of outcrossing of wild birdsrape mustard (*Brassica campestris* L.) and domestic spring rapeseed (*Brassica napus* L.).

DPXL5300 + dicamba reduced barley grain yield significantly. All treatments reduced growth and suppressed bud formation of Canada thistle (CIRAR) which was found only in the first replication (data not shown). (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. DPXL5300 and triasulfuron tank mixes on spring barley

Treatment[1]	Rate (lb ai/a)	Control[2] June 26 THLAR	BRSRA	AMSIN	POLCO	ANTCO	July 11 ANTCO	BRSRA	Grain yield (lb/a)
check	------	--	--	--	--	--	--	--	3841
DPXL5300	0.0078	93	90	93	93	90	95	95	4054
DPXL5300 2,4-D amine	0.0038 0.25	94	94	95	90	94	95	95	4158
DPXL5300 MCPA amine	0.0038 0.25	95	95	95	90	95	95	95	3816
DPXL5300 dicamba	0.0038 0.125	94	93	94	93	91	95	95	3919
DPXL5300 2,4-D amine	0.0050 0.25	95	94	94	88	94	94	95	3830
DPXL5300 2,4-D amine	0.0050 0.25	95	95	95	93	95	95	95	3934
DPXL5300 dicamba	0.0050 0.125	95	91	95	92	95	95	95	3243
DPXL5300 MCPA amine	0.0078 0.25	95	95	95	85	95	95	95	3773
DPXL5300 MCPA amine	0.0078 0.25	95	94	95	82	94	95	95	3892
DPXL5300 dicamba	0.0078 0.125	94	95	94	93	94	95	95	3915
triasulfuron	0.0134	95	93	95	95	90	91	95	3826
triasulfuron bromoxynil	0.0134 0.1875	95	95	95	90	94	95	95	4181
triasulfuron bromoxynil/MCPA	0.0134 0.1875	95	94	95	95	91	94	95	4380
triasulfuron MCPA amine	0.0134 0.25	94	95	95	95	91	91	95	3987
triasulfuron 2,4-D amine	0.0134 0.25	94	94	95	95	93	95	95	3801
triasulfuron dicamba	0.0134 0.125	95	94	95	88	94	95	95	3892
LSD		NS	NS	NS	NS	NS	NS	NS	550
initial weed density (no./ft^2)		6	10	--	--	9	9	10	

[1]R-11 (a nonionic surfactant) was added to all treatments, at a rate of 0.125% v/v.

[2]visual estimate of percent reduction in plant density compared to the check.

<u>Pyridate antagonism to wild oat herbicides in spring barley</u>. Barton, D.L., and D.C. Thill. Wild oat control may be reduced when wild oat herbicides are tank mixed with pyridate, a broadleaf herbicide. A study was established in spring barley (var. 'Morex') near Bonners Ferry, Idaho, in which pyridate alone and in combination with wild oat herbicides was applied at two wild oat (AVEFA) growth stages. Plots were 10 by 30 feet, arranged in a randomized complete block design, and replicated four times. Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Crop injury was evaluated visually May 23 and June 25 for the 2 to 3 leaf and 4 to 5 leaf treatments, respectively. Wild oat control was evaluated visually at wild oat heading (July 24). Barley grain was harvested August 7.

Table 1. Herbicide application data

Application date	May 15, 1990	June 5, 1990
Wild oat leaf stage	2 to 4	3 to 5
Barley growth stage	1 tiller	flag leaf
Air temperature (F)	49	58
Soil temperature at 2 in. (F)	50	62
Relative humidity (%)	70	88
Wind (mph) - direction	3 - S	0

HOE7125 alone and in combination with pyridate delayed ripening and reduced plant height 12 in. Barley treated with diclofop tended to lodge, however, tall barley resulted in some lodging throughout the experiment. HOE6001 alone or in combination with pyridate caused 10% crop injury, 8 days after treatment (DAT). Difenzoquat, difenzoquat + pyridate, HOE7125, and HOE7125 + pyridate caused 10, 5, 35 and 65% crop injury, respectively, 20 DAT (data not shown).

Pyridate antagonized wild oat control only when tank mixed with HOE6001. Diclofop, pyridate + HOE6001, and pyridate (2 to 3 leaf stage) did not control wild oat. Pyridate (4 to 5 leaf stage) wild oat control was greater than the untreated check, however, grain yield was not different. Difenzoquat and HOE7125 treatments controlled wild oat 83% or greater. Barley treated with HOE6001, imazamethabenz, or HOE7125 alone yielded more grain than the control. Herbicides applied at the 4 to 5 leaf stage controlled wild oat better than herbicides applied at the 2 to 3 leaf stage. (Idaho Agriculture Experiment Station, Moscow, Idaho 83843).

Table 2. Wild oat control and barley grain yield

Treatment	Rate	Formulation	Applic. timing	AVEFA control[1]	Grain yield
	(lb ai/a)		(leaves)	(% of check)	(lb/a)
check	----	----	----	----	2915
pyridate	0.9	3.75 EC	2 to 3	28	3707
diclofop	1.0	3 EC	2 to 3	30	3763
pyridate + diclofop	0.9 1.0		2 to 3	56	3690
HOE6001	0.074	0.57 EC	2 to 3	73	4999
pyridate + HOE6001	0.9 0.074		2 to 3	29	3422
imazamethabenz	0.375	2.5 LC	2 to 3	64	5221
pyridate + imazamethabenz	0.9 0.375		2 to 3	85	4063
pyridate	0.9		4 to 5	43	3767
difenzoquat	1.0	2 LC	4 to 5	86	3938
pyridate + difenzoquat	0.9 1.0	3.57 EC	4 to 5	89	4029
HOE7125	0.66	3.08 EC	4 to 5	89	4542
pyridate + HOE7125	0.9 0.66		4 to 5	83	3729
$LSD_{(0.05)}$				32	1200
AVEFA density (no. of plants/ft^2)				30	

[1] Visual estimate of percent reduction in population density compared to the untreated check.

Wild oat control in spring barley with imazamethabenz formulations and adjuvants. Thill, D.C., M.J. Dial, and J.M. Lish. Four formulations of imazamethabenz plus surfactants, crop oil, and/or sodium bisulfite were evaluated in various combinations for wild oat control in 'Morex' spring barley near Bonners Ferry, Idaho. Imazamethabenz (commercial formulation) contains acid and surfactants, AC7084-005A has no surfactants, and AC7084-042A has no acid. The formulation of AC7084-001A is not available. Treatment pH was recorded before application. All treatments were applied to wild oat with 2 to 3 leaves except difenzoquat alone which was applied to wild oat with 3 to 5 leaves (Table 1). The treatments were applied with a CO_2 pressurized backpack sprayer delivering 10 gal/a at 42 psi. Plots were 10 by 30 ft and the experimental design was a randomized complete block with four replications. Wild oat control was evaluated visually on July 23 and barley grain was harvested at maturity.

Table 1. Application data

Wild oat stage (leaves)	2 to 3	3 to 4
Application date	May 15	June 5
Air temperature (F)	50	58
Soil temperature at 2 in. (F)	50	62
Relative humidity	70	88
Soil pH	7.7	
om (%)	4.0	
CEC (meq/100 g)	13.8	
texture	clay loam	

Spray solution pH ranged between 2 and 4 for all treatments containing imazamethabenz formulations. Diclofop, difenzoquat, and the water check were all pH 7. There was no correlation between herbicide efficacy and pH. Wild oat control was highly variable among treatments and no differences were found between imazamethabenz formulations. Wild oat control was poor with imazamethabenz + difenzoquat and AC7084-005A + R-11 + sodium bisulfite (Table 2). Wild oat control with AC7084-005A was best (84%) when it was applied with X-77 and poorest (60%) when it was applied with Cayuse. Grain yield was similar among all treatments. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control and barley grain yield with imazamethabenz formulations plus adjuvants

Treatment	Formulation	Rate	Wild oat control	Barley yield
	lb ai/gal	lb ai/a	%	lb/a
check	--	--	--	3590
imazamethabenz	SC 2.50	0.470	78	3993
diclofop	EC 3.00	1.000	74	3873
difenzoquat	SC 2.00	1.000	82	3782
AC7084-005A +	SC 2.50	0.410	84	4500
X-77	90%	0.250[1]		
AC7084-005A +	SC 2.50	0.410	60	3501
Cayuse	56%	0.750[1]		
AC7084-005A +	SC 2.50	0.410	71	3945
R-11	90%	0.250[1]		
AC7084-005A +	SC 2.50	0.410	66	4138
Excell90	90%	0.250[1]		
imazamethabenz +	SC 2.50	0.235	46	3470
difenzoquat	SC 2.00	0.500		
AC7084-005A +	SC 2.50	0.235	62	3786
difenzoquat +	SC 2.00	0.500		
R-11	90%	0.250[1]		
AC7084-042A +	SC 2.24	0.235	62	3969
difenzoquat +	SC 2.00	0.500		
NaH_2SO_4	94.5%	0.235		
AC7084-001A +	SC 2.50	0.235	68	4227
difenzoquat +	SC 3.00	0.500		
NaH_2SO_4	94.5%	0.235		
AC7084-005A +	SC 2.50	0.410	55	3669
NaH_2SO_4 +	94.5%	0.410		
AC7084-005A +	SC 2.50	0.410	80	4221
NaH_2SO_4 +	94.5%	0.410		
Moract		2.500[1]		
AC7084-001A +	SC 2.50	0.410	78	3728
NaH_2SO_4	94.5%	0.410		
AC7084-001A +	SC 2.50	0.410	74	3755
NaH_2SO_4 +	94.5%	0.410		
Moract		2.500[1]		
imazamethabenz	SC 2.50	0.410	76	3807
AC7084-005A +	SC 2.50	0.410	48	3697
R-11	90%	0.250[1]		
NaH_2SO_4	94.5%	0.410		
AC7084-005A +	SC 2.50	0.410	71	4130
Moract		2.500[1]		
$LSD_{0.05}$			*23*	*ns*

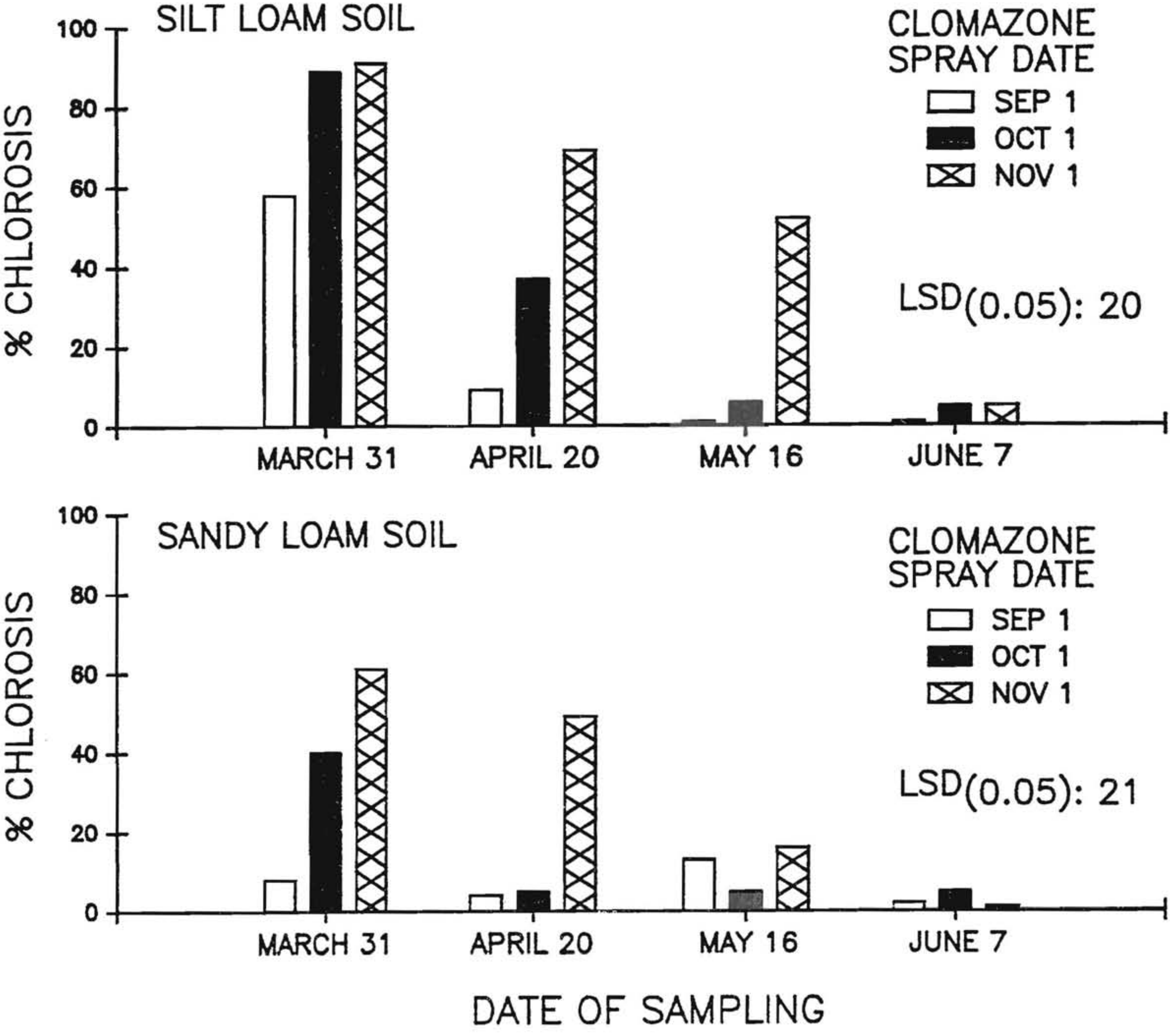
[1]Rate is expressed as % v/v.

Barley tolerance to clomazone applied in a chemical fallow production system. Anderson, R. L. Chemical fallow after winter wheat increases precipitation storage in the soil and encourages more intensive cropping rotations where corn, sorghum, or proso millet are planted in the spring 10 months after winter wheat harvest. Clomazone controls downy brome (*Bromus tectorum*) and jointed goatgrass (*Aegilops cylindrica*), and it is currently applied after August 15 for weed control during fallow. Safflower, corn, and proso millet are tolerant to clomazone applied in the previous fall. This study was conducted to determine 1) if barley is tolerant to clomazone, and 2) if date of application the previous fall affects barley's tolerance to clomazone.

Clomazone at 0.56 kg/ha was applied on Sep. 1, Oct. 1, and Nov. 1, 1987, to two soil types, a silt loam with 1.3% organic matter (OM) content and a pH of 7.0, and a sandy loam with 0.9% OM and a pH of 7.1. The experimental design was a randomized complete block with four replications. Soil samples from 0-5, 5-10, and 10-15 cm deep were collected on March 31, 1988, and every 3 weeks thereafter until June 7, 1988. Seven cores 5 cm in diameter were collected on each sampling date. The soil was stored at -3°C until a barley bioassay was conducted in the greenhouse in February and March of 1989. Six barley seeds were planted into 400 gms of soil subsampled from the collected cores for each sampling depth. Pots were watered daily to field capacity by weight. Percent chlorosis of seedlings was recorded 21 days after planting. The percent chlorosis was determined by dividing the length of the leaf which was chlorotic by the total length of the leaf, as clomazone chlorosis appears in distinct bands.

Barley tolerance to clomazone was affected by soil type, date of clomazone application, and date of soil sampling (See Figure). Cereals such as wheat and barley can survive some chlorotic damage by clomazone (lethal level of chlorosis is $\geq$ 60%: Claude Ross, FMC Corp. personal communications). Chlorosis of barley when clomazone was applied on Sept. 1 was less than 10% at the sandy loam soil at all sampling dates. At the silt loam site, barley chlorosis was > 60% for all clomazone application dates when soil was sampled on March 31, but chlorosis decreased below 10% for the Sep. 1 application with the April 20 sampling date. Barley did not exhibit chlorosis with the lower soil depths at any sampling date (data not presented), indicating that clomazone did not leach below 5 cm in quantities detectable by the barley bioassay. Precipitation between Sep. 1 and May 1 was 108% of the long-term average for this site (15.9 cm). These results indicate that barley's tolerance to clomazone is affected by time of clomazone application, time of barley planting, and soil type. Also, potential exists on selected soil types to include barley in a flexible cropping system where clomazone is applied for fallow weed control, provided clomazone is applied early in the fallow season. (USDA-ARS, Akron, CO 80720).

FIGURE. TOLERANCE OF BARLEY TO CLOMAZONE IN TWO SOILS



Evaluation of wild oat herbicides and selected tank mixes. Ozdemir, C., J. O. Evans, and J. M. Torell. Wild oats (AVEFA) are the most serious weed problem for irrigated small grain growers in Utah. Since wild oats are usually present with a complex of broadleaf weeds effective tank mixes are needed to provide weed control in one application. This experiment was established to evaluate the efficacy and crop safety of several wild oat herbicides alone and combination with the two most commonly used broadleaf herbicides, bromoxynil and 2,4-D.

Herbicides were applied on May 19, 1989 with a bicycle sprayer delivering 16 gal/A at 40 psi. Environmental conditions were: air temperature 16 C, soil temperature 23 C, relative humidity 25%, and wind 0 to 4.8 km/h from the west. The soil was a silt loam (15% sand, 77% silt, 8% clay) with pH 7.9 and organic matter 2.74%.

None of the treatments caused any discernable crop injury. Diclofop at 1.12 kg ai/ha, fenoxaprop-ethyl at 0.27 kg ai/ha, and imazamethabenz at 0.52 kg ai/ha produced excellent wild oat control. Fenozaprop-ethyl at 0.27 kg ai/ha + 2,4-D at 4.48 kg ai/ha produced 84% control of wild oats which was significantly less at the 5% level than fenoxaprop-ethyl alone at the same rate. Wild oat control with imazamethabenz at 0.52 kg ai/ha was not significantly lowered by tank mixing with 0.42 kg ai/ha bromoxynil. (Utah Agricultural Experiment Station, Logan, UT, 84322)

Wild oat control and crop injury.

Treatment	Rate ai/ha	Wild Oat Control 6/9/89	7/12/89	Crop 7/12/89
diclofop +	0.84	52d	48e	0
2,4,-D +	4.48			
thifinsulfuron methyl	0.0158			
diclofop +	0.84	37e	48e	0
2,4-D	4.48			
tribenuron methyl	0.0087			
fenoxaprop ethyl +	0.27	73bc	84bcd	0
2,4-D	4.48			
tribenuron methyl	0.0087			
diclofop	1.12	83ab	92abc	0
fenoxaprop ethyl	0.27	90a	98a	0
imazamethabenz	0.52	62cd	95ab	0
imazamethabenz +	0.52	73bc	83cd	0
bromoxynil	0.42			
imazamethabenz	0.52	70bc	92abc	0
thifensulfuron methyl +	0.0158	10f	3f	0
2,4-D	4.48			
control	0	0f	0f	0

Means within columns followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Wild oats control in barley. Miller, S.D., J.G. Lauer and A.W. Dalrymple. Plots were established under furrow irrigation at the Research and Extension Center, Powell, Wyoming to evaluate wild oats control with postemergence herbicides applied at several stages. Plots were 9 by 25 ft. with three replications arranged in a randomized complete block. Barley (var. 1202) was seeded April 19, 1990 in a clay loam soil (46% sand, 20% silt and 34% clay) with 1.2% organic matter and pH 7.7 Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi May 22 (air temp. 65F, relative humidity 40%, wind W at 5 mph, sky partly cloudy and soil temp. - 0 inch 76F, 2 inches 60F and 4 inches 58F) to 2-leaf barley, 1.5 to 2-leaf wild oats and 0.5 to 1 inch wild mustard or June 6, 1990 (air temp. 75F, relative humidity 29%, sky partly cloudy and soil temp. - 0 inch 92F, 2 inches 70F and 4 inches 68F) to 6-leaf barley, 4 to 5-leaf wild oats and 4 to 6 inch wild mustard. Visual crop damage evaluations were made June 21 and July 19, visual weed control ratings July 19, barley height measured July 19 and plots harvested August 14, 1990. Wild oats (AVEFA) infestations were heavy and wild mustard (SINAR) infestations moderate throughout the experimental site.

No treatment reduced stand; however, treatments containing fenoxaprop caused substantial barley injury (8 to 30%). Wild oats control was excellent ($\geq$95%) with imazamethabenz and good ($\geq$85%) with fenoxaprop. Wild mustard control was excellent (90 to 100%) with treatments containing imazamethabenz, MCPA and/or 2,4-D. Barley yields correlated to wild oats control and/or crop injury. Barley yields were 25 to 28 bu/A higher in imazamethabenz treated areas compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1762)

Wild oats control in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Injury 4 wk %	8 wk %	SR %	Height inches	Yield bu/A	Weed control[3] AVEFA %	SINAR %
<u>2-leaf</u>								
imazamethabenz+S	0.38+0.25%	0	0	0	27	81	96	100
imazamethabenz+oc	0.38+1qt	0	0	0	27	82	95	100
imazamethabenz+Sunit	0.38+1qt	0	0	0	27	79	95	100
imazamethabenz+S+28%N	0.38+0.25%+1g	0	0	0	28	81	95	100
imaz+bromoxynil+S	0.38+0.25+0.25%	0	0	0	27	82	96	100
imaz+brom/MCPA+S	0.38+0.5+0.25%	0	0	0	27	82	96	100
imaz+clopyralid/MCPA+S	0.38+0.44+0.25%	0	0	0	27	82	95	100
diclofop	1.0	0	0	0	27	68	80	0
diclofop+oc	0.75+1qt	8	7	0	26	73	83	0
diclofop+oc	1.0+1qt	10	8	0	25	70	87	0
diclofop+bromoxynil	1.0+0.25	0	0	0	27	78	83	67
fenoxaprop	0.082	8	12	0	24	59	90	0
<u>4-leaf</u>								
fenoxaprop/2,4-D/MCPA	0.66	23	20	0	22	56	87	92
fenoxaprop/2,4-D/MCPA	0.78	30	22	0	22	53	88	93
feno/2,4-D/MCPA+bromoxynil	0.66+0.25	20	23	0	22	51	85	93
feno/2,4-D/MCPA+bromoxynil	0.78+0.25	25	22	0	23	57	85	97
fenoxaprop	0.082	18	25	0	21	54	98	0
HOE-6025	0.54	25	20	0	21	59	80	90
difenzoquat+S	0.63+0.25%	0	0	0	27	65	72	0
difenzoquat+S	1.0+0.25%	0	0	0	27	70	87	0
dife+clopyralid/2,4-D+S	0.63+0.44+0.25%	0	0	0	27	62	72	93
weedy check	- - - - - - - - -	0	0	0	27	54	0	0

[1]Treatments applied May 22 and June 6, 1990; /=package mix, oc=At Plus 411F and S=X-77.
[2]Barley injury visually evaluated June 21 and July 19, stand reduction visually evaluated June 21, plant height measured July 19 and plots harvested August 14, 1990.
[3]Weed control visually evaluated July 19, 1990.

Canada thistle control in barley. Miller, S.D. and J.G. Lauer. Plots were established under furrow irrigation at the Research and Extension Center, Powell, Wyoming to evaluate the efficacy of postemergence herbicide treatments for Canada thistle control in barley. Plots were 9 by 25 ft. with three replications arranged in a randomized complete block. Barley (var. Klages) was seeded April 14, 1990 in a clay loam soil (40% sand, 29% silt, and 31% clay) with 1.3% organic matter and pH 7.7. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 22, 1990 (air temp. 60F, relative humidity 53%, wind calm, sky partly cloudy and soil temp. - 0 inch 72F, 2 inches 57F and 4 inches 54F) to 3-leaf barley and 2 to 5 inch Canada thistle rosettes. Visual weed control evaluations were made June 21 and July 18, visual crop damage evaluations June 21, plant height measured July 19 and plots harvested August 14, 1990. Canada thistle (CIRAR) infestations were heavy and wild mustard (SINAR), redroot pigweed (AMARE), kochia (KCHSC) and wild oats (AVEFA) infestations light but uniform throughout the experimental area.

No treatment reduced barley stand; however, treatments containing dicamba injured barley 5 to 8%. Canada thistle control increased from the 4 week to 8 week evaluations with all treatments except dicamba. Clopyralid/2,4-D or MCPA combinations with DPX-L5300 provided the highest level of Canada thistle control (82 to 83%). Wild mustard control was excellent (>90%) with all treatments except dicamba or dicamba combinations with picloram or clopyralid, redroot pigweed control excellent (≥90%) with all treatments except the low rates of clopyralid/2,4-D or MCPA, kochia control excellent (>95%) with all treatments containing bromoxynil, DPX-L5300 or dicamba and wild oats control excellent (100%) with imazamethabenz. Barley yields related closely to Canada thistle control and were 25 to 41 bu/A higher in herbicide treated areas compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1761)

Canada thistle control in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A	% Weed control[3] 4 week CIRAR	SINAR	AMARE	KCHSC	8 week CIRAR	AVEFA
clopyralid/2,4-D	0.44	0	0	34	94	53	93	83	73	67	0
clopyralid/2,4-D	0.59	0	0	34	96	63	100	98	82	70	0
clop/2,4-D+bromoxynil	0.44+0.19	0	0	34	97	62	100	100	100	73	0
clop/2,4-D+bromoxynil	0.59+0.19	0	0	34	97	63	100	100	100	72	0
clop/2,4-D+DPX-L5300+S	0.44+0.012	0	0	33	106	72	100	100	100	83	0
clop/2,4-D+DPX-L5300+S	0.59+0.012	0	0	33	105	75	100	100	100	83	0
clop/2,4-D+difenzoquat	0.44+1.0	0	0	33	96	50	93	83	73	60	83
clop/2,4-D+difenzoquat	0.59+1.0	0	0	33	98	62	100	100	83	67	83
clop/2,4-D+dicamba	0.44+0.094	7	0	32	99	62	95	97	100	73	0
clop/2,4-D+dicamba	0.59+0.094	5	0	32	101	68	100	100	98	73	0
clopyralid/MCPA	0.44	0	0	33	92	47	90	80	63	53	0
clopyralid/MCPA	0.59	0	0	32	94	53	95	90	75	67	0
clop/MCPA+bromoxynil	0.59+0.25	0	0	33	98	57	98	100	100	67	0
clop/MCPA+DPX-L5300+S	0.59+0.012	0	0	33	104	73	100	100	100	82	0
clop/MCPA+imazamethabenz	0.59+0.47	0	0	33	99	57	100	93	85	70	100
clop/MCPA+difenzoquat	0.59+1.0	0	0	33	98	57	97	92	78	70	80
clop/MCPA+dicamba	0.44+0.094	7	0	33	95	60	92	100	100	63	0
clop/MCPA+dicamba	0.59+0.094	7	0	32	103	68	97	100	100	73	0
dicamba	0.094	7	0	33	90	63	77	100	100	30	0
dicamba+picloram	0.094+0.023	8	0	32	101	72	80	100	100	53	0
dicamba+clopyralid	0.094+0.125	7	0	32	102	67	78	100	100	72	0
picloram+2,4-D	0.023+0.5	0	0	33	97	53	97	92	77	63	0
weedy check	- - - - - -	0	0	33	65	0	0	0	0	0	0

[1]Treatments applied May 22, 1990; /=package mix and S=X-77 at 0.25% v/v.
[2]Barley injury (Inj) and stand reduction (SR) visually evaluated June 21, plant height measured July 18 and plots harvested August 14, 1990.
[3]Weed control visually evaluated June 21 and July 18, 1990.

Broadleaf weed control in barley. Miller, S.D., J.M. Krall and A.W. Dalrymple. Research plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and barley tolerance with postemergence herbicide treatments. Plots were 9 by 45 ft. with three replications arranged in a randomized complete block. Barley (var. Klages) was seeded April 4, 1990 in a sandy loam soil (81% sand, 9% silt and 10% clay) with 1.3% organic matter and pH 7.7. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 10, 1990 (air temp. 67F, relative humidity 37%, wind calm, sky clear and soil temp. - 0 inch 77F, 2 inches 79F and 4 inches 69F) to 3 to 4-leaf barley and 0.5 to 1 inch weeds. Visual weed control and crop damage evaluations were made June 13, plant height measured June 29 and plots harvested July 23, 1990. Common lambsquarters (CHEAL) infestations were moderate and wild buckwheat (POLCO) and kochia (KCHSC) infestations light but uniform throughout the experimental site.

No herbicide treatment reduced barley stand and only slight injury (2 to 5%) was observed with treatments containing dicamba. Common lambsquarters control was excellent (90 to 100%) with all treatments, wild buckwheat control was excellent (90 to 100%) with all treatments except 2,4-D or MCPA and kochia control was good to excellent (87 to 100%) with all treatments except clopyralid plus MCPA. Barley yields were correlated to weed control and/or crop injury and were 3 to 11 bu/A higher in herbicide treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1760)

Broadleaf weed control in barley. Torrington Research and Extension Center, Goshen County, 1990.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A	Weed control[3] CHEAL %	POLCO %	KCHSC %
bromoxynil	0.25	0	0	26	73	100	100	100
bromoxynil	0.38	0	0	25	73	100	100	100
bromoxynil/MCPA	0.5	0	0	25	74	100	100	100
bromoxynil/MCPA	0.75	0	0	25	72	100	100	100
DPX-R9674+S	0.016	0	0	25	72	100	90	97
DPX-L5300+S	0.016	0	0	26	74	100	93	97
brom+DPX-R9674+S	0.19+0.004	0	0	25	71	100	100	100
brom+DPX-R9674+S	0.19+0.008	0	0	26	74	100	100	100
clopyralid/2,4-D	0.44	0	0	25	73	97	95	90
clopyralid/2,4-D	0.59	0	0	25	71	100	100	93
clopyralid/MCPA	0.44	0	0	26	72	90	93	53
clopyralid/MCPA	0.59	0	0	25	73	97	100	57
dicamba+clop/2,4-D	0.063+0.44	5	0	24	67	100	100	100
dica(SGF)+clop/2,4-D	0.063+0.44	5	0	24	66	100	100	100
dicamba+clop/MCPA	0.063+0.44	2	0	26	70	100	100	100
dica(SGF)+clop/MCPA	0.063+0.44	2	0	25	68	100	100	100
fluroxypyr+clop/2,4-D	0.063+0.44	0	0	26	74	97	97	100
fluroxypyr+clop/MCPA	0.063+0.44	0	0	25	73	93	93	100
dicamba+DPX-R9674+S	0.063+0.016	2	0	25	70	100	100	100
dica(SGF)+DPX-R9674+S	0.063+0.016	2	0	26	70	100	100	100
dicamba+MCPA	0.063+0.38	3	0	24	69	100	100	100
dica(SGF)+MCPA	0.063+0.38	3	0	24	68	100	100	100
dicamba+bromoxynil	0.063+0.25	3	0	26	70	100	100	100
dica(SGF)+bromoxynil	0.063+0.25	3	0	25	68	100	100	100
2,4-D	0.75	0	0	25	70	100	80	93
MCPA	0.75	0	0	25	71	97	77	87
weedy check	- - - - - - -	0	0	25	63	0	0	0

[1]Treatments applied May 10, 1990; /=package mix and S=X-77 at 0.25% v/v.
[2]Barley injury (Inj) and stand reduction (SR) visually evaluated June 13, plant height measured June 29
[3]Weed control visually evaluated June 13, 1990.

Effects of 2,4-D or dicamba drift on dry bean yields. Westra, P. and T. D'Amato. Dry bean producers suffer annual aggravations from 2,4-D or dicamba drift or volatility which adversely affect dry bean growth. Precise yield losses from such damage is hard to assess, particularly soon after the damage occurs. A large scale field study with 4 dry bean varieties was conducted at the Colorado State University Bay Farm research center in 1990. Herbicides were applied at the early flowering stage of the dry beans with a CO_2 powered backpack sprayer delivering 23 gal/a over 10 X 30 foot plots. Beans were harvested in the fall of 1990 for yield assessment.

Yield evaluations showed the following effects on dry bean yield from 2,4-D and dicamba applied early flowering to Harris great northern, UI 126 pinto, UI 114 pinto, and Olathe pinto beans (data is averaged across all 4 varieties):

herbicide	rate lbs ai/a	% yield change from check plots
2,4-D	0.0001	+ 18
2,4-D	0.001	+ 9
2,4-D	0.01	- 1
2,4-D	0.1	- 3
dicamba	0.0001	+ 7
dicamba	0.001	+ 1
dicamba	0.01	+ 4
dicamba	0.1	- 97

average check yields were 22.5 cwt/a

These results were surprising in that it took relatively high rates of 2,4-D and dicamba to seriously decrease dry bean yields. It was also obvious that dicamba was generally more damaging to the beans than was 2,4-D. Not all varieties responded in the same fashion; olathe was more sensitive to injury than the other varieties. A photographic and video record was made of this preliminary research. Further research is needed on the influence of 2,4-D and dicamba when applied to dry beans at other growth stages. This research is being used to help build a data base that could be used to settle drift or volatility claims involving dry bean damage from 2,4-D or dicamba. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Evaluation of preplant incorporated and postemergence herbicide treatments in kidney beans. Mitich, L.W., J.A. Roncoroni, and G.B. Kyser. Five herbicides in 11 treatments were evaluated for crop tolerance and weed control at the UC Davis Farm. The low-rate experimental chemical imazethapyr was evaluated in both preplant incorporated and postemergence treatments, in comparison with herbicides registered for use in dry beans.

Preplant incorporated treatments were applied 11 June 1990 to a preirrigated field of Yolo clay loam soil, then incorporated to 2 to 3 inches with a Lilliston rolling cultivator. These treatments were applied in 20 gal/a of spray solution with a CO_2 backpack sprayer. 'California Dark Red' kidney beans were planted the same day. Postemergence treatments were applied 27 July, when bean plants were 12 to 18 inches tall and barnyardgrass was 18 to 24 inches tall. Postemergence treatments were applied in a spray volume of 30 gal/a. Experimental plots were 10 ft wide (four 30-inch rows) by 20 ft long. Treatments were replicated four times in a randomized complete block design. The two application methods were blocked out separately, so no comparisons can be made between preplant incorporated treatments and postemergence treatments.

Crop tolerance and weed control were visually evaluated 24 August. Barnyardgrass (ECHCG) was the only weed present in abundance, though redroot pigweed (AMARE), tomatillo groundcherry (PHYIX), and velvetleaf (ABUTH) were observed. None of the treatments caused a significant loss of crop vigor. Of the preplant incorporated treatments, both treatments with metolachlor at 2.5 lb ai/a produced the greatest control of barnyardgrass; alachlor (2.5 lb ai/a) produced significantly less control. Of the postemergence treatments, both rates of imazethapyr produced significantly more control than either rate of bentazon.

Beans were cut 19 September and harvested 3 October. Yields varied significantly between treatments - not because any chemical produced injury, but because of differences in barnyardgrass control. Yields from preplant incorporated treatments showed a 92% correlation with barnyardgrass control, and yields from postemergence treatments showed a 56% correlation. (Department of Botany, University of California, Davis, CA 95616)

Evaluation of preplant incorporated and postemergence herbicides in kidney beans, UC Davis

Herbicide Common Name	Rate (lb ai/a)	Visual evaluations, 24 August[1] crop vigor (%)[2]	barnyardgrass control (%)[3]	Crop yield[1,3] (g/30 ft)
Preplant incorporated treatments[4]				
imazethapyr	0.032	75	48 A B	1188 B C
imazethapyr	0.047	83	55 A B	1527 A B
imazethapyr + pendimethalin	0.032 1.5	80	53 A B	1336 A B
pendimethalin + metolachlor	1.5 2.5	85	65 A	1685 A
pendimethalin	1.5	80	45 A B C	1216 A B C
metolachlor	2.5	85	65 A	1520 A B
alachlor	2.5	73	38 B C	1086 B C
control	---	70	20 C	769 C
Postemergence treatments[4]				
imazethapyr	0.032	83	55 A	1029 A B
imazethapyr	0.047	78	63 A	1352 A
bentazon	0.75	68	15 B	926 B
bentazon	1.5	73	30 B	828 B
control	---	75	25 B	774 B

[1]Average of four replications. 100% = perfect crop vigor, complete weed control.

[2]No significant differences.

[3]Values followed by the same letter are not significantly different at the 5% level.

[4]Preplant incorporated and postemergence treatments were blocked and analyzed separately.

Postemergence weed control in pinto beans. Miller, S.D., J.M. Krall and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of postemergence herbicide treatments for weed control in pinto beans. Plots were 10 by 20 ft. with three replications arranged in a randomized complete block. Pinto beans (var. UI-114) were planted in a sandy loam soil (78% sand, 13% silt and 9% clay) with 1.3% organic matter and pH 7.6 May 23, 1990. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi June 15 (air temp. 64F, relative humidity 75%, wind N at 5 mph, sky cloudy and soil temp. - 0 inch 71F, 2 inches 65F and 4 inches 62F) to 1st trifoliolate leaf beans and 0.5 to 2 inch weeds or June 20 (air temp. 75F, relative humidity 46%, wind S at 4 mph, sky clear and soil temp. - 0 inch 93F, 2 inches 72F and 4 inches 69F) to 2nd trifoliolate leaf beans and 2 to 5 inch weeds. Weed counts, crop stand counts and visual crop injury ratings were made June 29, visual weed control and crop injury ratings August 1 and plots harvested August 31, 1990. Hairy nightshade (SOLSA), common lambsquarters (CHEAL), green foxtail (SETVI) and stinkgrass (ERACN) infestations were heavy and uniform throughout the experimental area.

Herbicide treatments had little effect on pinto bean stand; however, acifluorfen plus bentazon caused 5% and imazethapyr 0 to 17% early season injury. Hairy nightshade control was good to excellent (87 to 100%) with acifluorfen plus bentazon or imazethapyr; common lambsquarters control good (90 to 93%) with acifluorfen plus bentazon; green foxtail control fair to excellent (77 to 100%) with quizalafop, fluazifop or imazethapyr and stinkgrass control good to excellent (93 to 100%) with quizalafop or fluazifop. The addition of nitrogen to the spray mixture generally increased weed control with imazethapyr regardless of additive. Pinto bean yields reflected weed control and were 227 to 1006 lb/A higher in herbicide treated areas compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1758)

Table 1. Pinto bean response to postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Pinto bean[2] % Injury June	% Injury August	Stand 1000 pl/A	Stand % reduction	Yield lb/A
Early post						
acifluorfen+bentazon+S	0.125+0.5	5	0	46.7	0	1367
acifluorfen+bentazon+S	0.125+0.75	5	0	48.3	0	1459
imazethapyr+S	0.032	0	0	48.3	0	1613
imazethapyr+S	0.047	3	0	49.1	0	1628
imazethapyr+S	0.063	3	0	46.7	0	1693
imazethapyr+S+N	0.032	2	0	47.9	0	1797
imazethapyr+S+N	0.047	8	0	46.2	0	1621
imazethapyr+S+N	0.063	12	0	46.2	0	1732
imazethapyr+oc	0.047	7	0	46.2	0	1659
imazethapyr+oc+N	0.047	12	0	48.3	0	1759
imazethapyr+ocs	0.047	13	0	46.2	0	1647
imazethapyr+ocs+N	0.047	15	0	49.7	0	1651
quizalofop+oc	0.063	0	0	45.0	3	1018
quizalofop+oc	0.125	0	0	46.5	0	1094
fluazifop+oc	0.19	0	0	45.3	2	1091
Late Post						
imazethapyr+S	0.032	2	0	47.6	0	1091
imazethapyr+S	0.047	3	0	49.1	0	1298
imazethapyr+S	0.063	5	0	49.1	0	1194
imazethapyr+S+N	0.032	13	0	44.1	4	1325
imazethapyr+S+N	0.047	10	0	45.3	2	1432
imazethapyr+S+N	0.063	17	0	43.6	6	1313
weedy check	- - - -	0	0	46.2	0	791

[1]Treatments applied June 15 and 20, 1990; S=X-77 at 0.25% v/v, N=28% w/w nitrogen at 1 gal/A, oc=At Plus 411F at 1 qt/A and ocs=Sunit at 1 qt/A.

[2]Crop stand counts were determined June 29, crop injury evaluated June 29 and August 1 and plots harvested August 31, 1990.

Table 2. Weed control in pinto beans with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	% Weed control[2] June SOLSA	June CHEAL	June SETVI	June ERACN	August SOLSA	August CHEAL	August SETVI	August ERACN
Early post									
acifluorfen+bentazon+S	0.125+0.5	97	82	0	0	87	90	0	0
acifluorfen+bentazon+S	0.125+0.75	98	79	0	0	88	93	0	0
imazethapyr+S	0.032	96	14	87	26	93	57	77	0
imazethapyr+S	0.047	97	53	92	26	98	67	80	27
imazethapyr+S	0.063	97	48	87	43	97	72	88	47
imazethapyr+S+N	0.032	90	22	87	20	100	73	87	43
imazethapyr+S+N	0.047	96	61	87	26	100	78	90	50
imazethapyr+S+N	0.063	97	61	92	43	100	78	88	50
imazethapyr+oc	0.047	94	53	92	30	100	73	85	43
imazethapyr+oc+N	0.047	97	61	92	52	100	78	88	43
imazethapyr+ocs	0.047	97	48	87	15	100	73	87	50
imazethapyr+ocs+N	0.047	96	61	92	52	100	80	88	50
quizalofop+oc	0.063	0	0	100	86	0	0	100	95
quizalofop+oc	0.125	3	0	95	86	0	0	100	100
fluazifop+oc	0.19	0	0	95	58	0	0	88	93
Late post									
imazethapyr+S	0.032	93	16	79	19	87	47	73	0
imazethapyr+S	0.047	94	43	82	32	98	62	83	33
imazethapyr+S	0.063	95	48	87	37	100	67	87	43
imazethapyr+S+N	0.032	93	29	87	40	98	73	87	47
imazethapyr+S+N	0.047	93	43	87	47	100	73	88	53
imazethapyr+S+N	0.063	96	39	92	51	100	80	90	50
weedy check	- - - -	0	0	0	0	0	0	0	0
plants/ft. row 6-inch band		2.3	0.8	0.8	1.0	- -	- -	- -	- -

[1]Treatments applied June 15 and 20, 1990; S=X-77 at 0.25% v/v, N=28% w/w nitrogen at 1 gal/A, oc=At Plus 411F at 1 qt/A and ocs=Sunit at 1 qt/A.
[2]Weed stand counts June 29 and visual weed control ratings August 1, 1990.

Weed control in pinto beans with preplant incorporated, preemergence, postemergence or sequential treatments. Miller, S.D., J.M. Krall and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of individual or combination treatments for weed control in pinto beans. Plots were 10 by 45 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Preplant incorporated treatments were applied May 22, 1990 (air temp. 76F, relative humidity 52%, wind E at 4 mph, sky partly cloudy and soil temp. - 0 inch 91F, 2 inches 79F and 4 inches 60F) and incorporated twice immediately after application with a roller harrow operating 2 to 3 inches. Pinto beans (var. UI-114) were planted May 23, 1990 in a sandy loam soil (78% sand, 13% silt and 9% clay) with 1.3% organic matter and pH 7.6 and preemergence treatments applied (air temp. 74F, relative humidity 39%, wind calm, sky clear and soil temp. - 0 inch 90F, 2 inches 78F and 4 inches 62F). Postemergence treatments were applied to 1st trifoliolate leaf beans and 0.5 to 2 inch weeds June 14 1990 (air temp. 80F, relative humidity 35%, wind W at 7 mph, sky clear and soil temp. - 0 inch 92F, 2 inches 76F and 4 inches 72F). Weed counts, crop stand counts and visual crop injury ratings were made June 28, visual weed control and crop injury ratings August 1 and plots harvested August 31, 1990. Hairy nightshade (SOLSA), common lambsquarters (CHEAL) and green foxtail (SETVI) infestations were heavy and redroot pigweed (AMARE) and stinkgrass (ERACN) infestations light but uniform throughout the experimental area.

Herbicide treatments generally had little effect on pinto bean stands; however, treatments containing imazethapyr caused 3 to 28% early season injury. Broad spectrum season - long weed control was excellent (95 to 100% control of all weed species) with imazethapyr at 0.032 and 0.047 lb/A in combination with trifluralin, pendimethalin, ethafluralin, metholachlor or EPTC plus trifluralin. Pinto bean yields generally reflected weed control and were 765 to 1332 lb/A higher in herbicide treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1757)

Table 1. Pinto bean response to preplant incorporated, preemergence, postemergence or sequential treatments.

Treatment[1]	Rate lb ai/A	Pinto bean[2] % Injury June	August	Stand 1000 pl/A	% reduction	Yield lb/A
Preplant incorporated (inc)						
trifluralin (trif)	0.75	0	0	46.2	0	1747
pendimethalin(pend)	1.0	0	0	50.9	0	1751
ethafluralin(etha)	0.94	0	0	49.3	0	1916
EPTC+trif	2.0+0.75	0	0	49.1	0	2001
Preplant inc/preemergence						
trif/imazethapyr(imaz)	0.75+0.032	15	2	47.0	0	2031
trif/imaz	0.75+0.047	25	8	44.1	5	1993
pend/imaz	1.0+0.032	17	2	50.0	0	2135
pend/imaz	1.0+0.047	28	5	44.4	4	1920
etha/imaz	0.94+0.032	20	5	48.3	0	2008
etha/imaz	0.94+0.047	25	6	49.3	0	1951
EPTC+trif/imaz	2.0+0.75+0.047	23	5	44.4	4	2020
Preplant inc/postemergence						
trif/imaz+S	0.75+0.032	10	0	45.8	1	2031
trif/imaz+S	0.75+0.047	10	0	49.1	0	2093
pend/imaz+S	1.0+0.032	10	0	46.1	0	2034
pend/imaz+S	1.0+0.047	12	2	49.1	0	1958
etha/imaz+S	0.94+0.032	12	3	49.3	0	1932
etha/imaz+S	0.94+0.047	13	3	46.7	0	2058
EPTC+trif/imaz+S	2.0+0.75+0.047	12	2	50.9	0	1955
Preemergence						
metolachlor(meto)	2.0	0	0	49.7	0	1824
imazethapyr	0.032	8	0	48.4	0	1568
imazethapyr	0.047	25	3	48.8	0	1870
imazethapyr	0.063	28	8	44.8	3	1790
meto+imaz	2.0+0.032	20	2	49.7	0	1993
meto+imaz	2.0+0.047	20	3	46.2	0	1981
Postemergence						
imazethapyr+S	0.032	3	0	47.9	0	1628
imazethapyr+S	0.047	7	0	46.2	0	1701
imazethapyr+S	0.063	12	0	49.7	0	1778
weedy check	- - - - - - -	0	0	46.2	0	803

[1]Treatments applied May 22, 23 and June 14, 1990; S=X-77 at 0.25% v/v.
[2]Crop stand counts were determined June 28, crop injury evaluated June 28 and August 1 and plots harvested August 31, 1990.

Table 2. Weed control in pinto beans with preplant incorporated, preemergence, postemergence or sequential treatments.

		% Weed control[2]							
	Rate	June			August				
Treatment[1]	lb ai/A	SOLSA	CHEAL	SETVI	SOLSA	CHEAL	AMARE	SETVI	ERACN
Preplant incorporated(inc)									
trifluralin(trif)	0.75	0	100	100	0	95	100	92	95
pendimethalin(pend)	1.0	18	100	100	0	95	97	90	93
ethafluralin(etha)	0.94	75	91	100	23	98	100	98	97
EPTC+trif	2.0+0.75	71	91	100	73	92	97	90	97
Preplant inc/preemergence									
trif/imazethapyr(imaz)	0.75+0.032	100	91	100	100	98	100	100	100
trif/imaz	0.75+0.047	100	100	100	100	100	100	100	100
pend/imaz	1.0+0.032	100	91	100	100	100	100	100	100
pend/imaz	1.0+0.047	100	100	100	100	100	100	100	100
etha/imaz	0.94+0.032	100	100	100	100	100	100	99	100
etha/imaz	0.094+0.047	100	100	100	100	100	100	100	100
EPTC+trif/imaz	2.0+0.75+0.047	100	100	100	100	100	100	100	100
Preplanting/postemergence									
trif/imaz+S	0.75+0.032	93	100	100	98	97	100	100	100
trif/imaz+S	0.75+0.047	100	100	100	100	100	100	100	100
pend/imaz+S	1.0+0.032	100	100	100	100	98	100	100	100
pend/imaz+S	1.0+0.047	100	100	100	100	100	100	100	100
etha/imaz+S	0.94+0.032	100	100	100	100	99	100	100	100
etha/imaz+S	0.94+0.047	100	100	100	100	100	100	100	100
EPTC+trif/imaz+S	2.0+0.75+0.047	100	100	100	100	99	100	100	100
Preemergence									
metolachlor(meto)	2.0	82	68	100	77	78	83	97	97
imazethapyr	0.032	93	77	59	93	78	93	72	0
imazethapyr	0.047	100	100	100	100	93	100	85	40
imazethapyr	0.063	100	100	100	100	100	100	92	73
meto+imaz	2.0+0.032	100	100	100	100	100	100	97	100
meto+imaz	2.0+0.047	100	100	100	100	100	100	97	98
Postemergence									
imazethapyr+S	0.032	89	86	29	100	70	97	70	13
imazethapyr+S	0.047	100	86	29	100	75	100	82	27
imazethapyr+S	0.063	100	91	29	100	77	100	82	47
weedy check	- - - - -	0	0	0	0	0	0	0	0
Plants/ft. row 6-inch band		0.6	0.5	0.8	- -	- -	- -	- -	- -

[1]Treatments applied May 22, 23 and June 14, 1990; S=X-77 at 0.25% v/v.
[2]Weed stand counts June 28 and visual weed control ratings August 1, 1990.

Annual grass and broadleaf weed control evaluations in pinto beans. Arnold, R.N., E.J. Gregory and D. Smeal. Research plots were established on May 21, 1990 at the Agricultural Science Center, Farmington, New Mexico to evaluate efficacy of imazethapyr and/or imazethapyr combinations applied preplant incorporated, preemergence and postemergence, in pinto beans (var. UI-126). Soil type was a Kinnear very fine sandy loam with a pH of 7.9 and an organic matter content of less than 1%. Individual plots were 12 by 30 ft in size with three replications arranged in a randomized complete block design. Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Preplant incorporated treatments were applied May 21, 1990 and immediately incorporated with a power driven rototiller to a depth of 2 to 4 in. Preemergence surface applied treatments were applied May 23, 1990 and incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied June 13, 1990, when weeds were small and pinto beans were in the first trifoliolate leaf stage. Pinto beans were planted on 34 in beds at a rate of 60 lb/A on May 21, 1990. Prostrate pigweed (AMABL), and barnyardgrass (ECHCG) infestations were heavy to moderate and kochia (KCHSC), Russian thistle (SASKR), redroot pigweed (AMARE), and black nightshade (SOLNI) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 13, 1990. All treatments provided good to excellent control of broadleaf weeds. Imazethapyr combinations gave excellent control of barnyardgrass, as compared to single applications. Pinto bean yields were 2506 to 3075 lb/A higher in the herbicide treated plots as compared to the check. Imazethapyr applied preplant incorporated at 0.094 lb ai/A gave the highest injury rating of 8. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in pinto beans, 1990

Treatment	Rate lb ai/A	Crop[1] Injury	Weed Control[1] AMARE	KCHSC	SASKR	SOLNI	AMABL	ECHCG	Yield lb/A
		%							
imazethapyr[3]	0.063	4	100	100	100	100	99	72	4202
imazethapyr[3]	0.094	8	100	100	100	100	100	87	4100
imazethapyr[3]	0.047	2	100	100	100	100	100	63	4049
imazethapyr + metolachlor[3]	0.063+1.5	3	100	100	100	100	100	100	4561
imazethapyr + pendimethalin[3]	0.063+0.75	4	100	100	100	100	100	100	4561
imazethapyr + metolachlor[4]	0.063+1.5	4	100	100	100	100	100	100	4561
imazethapyr + trifluralin[3]	0.063+0.75	3	100	100	100	100	100	100	4509
imazethapyr + EPTC[3]	0.063+3.0	2	100	100	100	100	100	100	4458
trifluralin + EPTC[3]	1.0+3.0	0	100	100	100	88	100	100	4356
imazethapyr + pendimethalin[4]	0.063+0.75	3	100	100	100	100	100	100	4612
imazethapyr[4]	0.063	4	100	100	100	100	93	85	4100
imazethapyr[4]	0.047	3	100	100	100	100	87	72	4151
imazethapyr[5]	0.063	4	100	100	100	100	100	62	4356
imazethapyr[5]	0.047	4	100	100	100	100	98	53	4202
handweeded check		0	100	100	100	100	100	100	4458
check		0	0	0	0	0	0	0	1537
av weeds/m[2]			9	4	6	7	26	16	

1. Based on a visual scale from 0-100, where 0 = no control or crop injury and 100 = dead plants.
2. Amare = redroot pigweed, KCHSC = kochia, SASKR = Russian thistle, Solni = black nightshade, AMABL = prostrate pigweed, and ECHCG = barnyardgrass.
3. Preplant incorporated.
4. Preemergence surface applied.
5. Postemergence with a crop oil concentrated at 0.25% v/v.

Weed control in pinto beans with preplant incorporated herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 21, 1990 at the Agricultural Science Center, Farmington, New Mexico to evaluate annual grass and broadleaf weed control in pinto beans (var. UI-126). Soil type was a Kinnear very fine sandy loam with a pH of 7.9 and an organic matter content of less than 1%. Individual plots were 12 by 30 ft in size with three replications arranged in a randomized complete block design. Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. All treatments were applied preplant incorporated on May 21, 1990 and immediately incorporated with a power driven rototiller to a depth of 2 to 4 in. Pinto beans were planted on 34 in beds at a rate of 60 lb/A on May 22, 1990. Prostrate pigweed (AMABL), barnyardgrass (ECHCG), and redroot pigweed (AMARE) infestations were heavy to moderate and kochia (KCHSC), black nightshade (SOLNI), and Russian thistle (SASKR) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 12, 1990. All treatments gave excellent control of AMABL, ECHCG, and AMARE. SASKR, SOLNI, and KCHSC control was good to excellent with all treatments except metolachlor applied at 2.0 lb ai/A. Pinto bean yields were 2562 to 3023 lb/A higher in the herbicide treated plots as compared to the check. No crop injury was apparent in any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control in pinto beans with preplant incorporated herbicides.

Treatment	Rate lb ai/A	Crop[1] Injury	AMABL	AMARE	ECHCG	KCHSC	SASKR	SOLNI	Yield lb/A
		----------	----------	----------	%	----------	----------	----------	
ethalfluralin	1.2	0	100	100	100	100	100	97	4612
trifluralin	1.0	0	100	100	100	100	100	93	4612
ethalfluralin + EPTC	0.75+3.0	0	100	100	100	100	100	100	4510
trifluralin + EPTC	0.75+3.0	0	100	100	100	100	100	100	4663
metolachlor	2.0	0	100	100	100	82	87	65	4202
metolachlor + EPTC	2.0+3.0	0	100	100	100	90	95	100	4458
handweeded check		0	100	100	100	100	100	100	4663
check		0	0	0	0	0	0	0	1640
av weeds/m^2			12	10	14	5	5	7	

Weed Control[1] spans AMABL through SOLNI.

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

Evaluation of selected herbicides for use in chickpeas. Miller, T.W. and R.H. Callihan. The purpose of this experiment was to determine the effectiveness of several herbicides for use in chickpeas by evaluating crop yield and weed control. The primary weeds of concern were mayweed chamomile (Anthemis cotula L.) and common lambsquarters (Chenopodium album L.), both late-season competitors.

Plots were established on farmer-prepared and seeded field at Genesee, Idaho. Plots measured 10 x 30 feet, and treatments were arranged in a randomized complete block design and replicated 4 times at each location. Pre-emergent (pre) and post-plant incorporated (popi) treatments were applied April 19, with the popi treatments incorporated using the cooperator's harrow. Post-emergent (post) applications were made on June 22, after plants were at least at the 4-node stage of growth. Treatments were applied in a carrier volume of 19 gal water/a using a 9-foot boom plot sprayer equipped with flat fan nozzles. Weed control percentage was based on weed density (100% = no weeds), and was estimated to the nearest 5% after mayweed flowering. Plots were harvested at maturity and the seed was cleaned and weighed. Statistical analysis was performed using analysis of variance procedure. Means were separated using Fisher's LSD test.

Several products controlled both mayweed and lambsquarters without harming the crop. Chickpeas treated with metolachlor + metribuzin rated highest in yield and showed excellent control of both weed species. Metribuzin (pre) and cyanazine also performed well in all evaluated aspects, as did the two experimental compounds (SAN 582 H and UBI-C4243). Imazethapyr showed good control of mayweed (85%) and complete control of lambsquarters (100%), resulting in the second highest yield in the study. This high level of weed control was not consistent with results of our 1990 dry pea and lentil experiments, where imazethapyr did not provide good weed control when used alone.

Herbicides that seemed to cause crop damage at tested rates were MCPA, MCPB, bentazon, and metribuzin (post and pre + post). The metribuzin treatments might have yielded better if harvest had been delayed, as many of these plants were still green when the plots were cut. It is unclear whether this reflects delay of flowering, a prolonged period of flowering, or a late recovery from herbicide injury. The other treatments clearly thinned the stand, resulting in lower yields. (University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Mayweed chamomile and common lambsquarters control and yield of chickpeas at Genesee, Idaho (1990).

Herbicide[1]	Rate	Timing[2]	Mayweed	Lambs-quarters	Chickpea Yield
	(ai or ae/a)		(% control)		(lbs/a,rank)
Metribuzin +	0.25 lb +	pre			
Metribuzin	0.2 lb	post	100	100	647 (13)
SAN 582 H	1.25 lbs	pre	100	100	966 (7)
Cyanazine	2.7 lbs	pre	100	100	997 (5)
Metribuzin	0.25 lb	pre	99	100	1009 (4)
UBI-C4243	0.06 lb	pre	98	99	1077 (3)
Metolachlor +	1.64 lbs +				
Metribuzin	0.36 lb	pre	98	99	1374 (1)
Bentazon	0.75 lb	post	88	60	447 (15)
Imazethapyr	0.042 lb	pre	85	100	1255 (2)
MCPA	0.375 lb	post	66	70	171 (17)
Pyridate	1.2 lb	post	40	80	937 (8)
Pendimethalin	0.5 lb	popi	31	8	814 (10)
Metribuzin	0.2 lb	post	29	38	592 (14)
Trifluralin	0.375 pt	popi	21	18	866 (9)
MCPB	1 lb	post	21	6	244 (16)
Pendimethalin	1 lb	popi	18	28	982 (6)
UBI-C4874[3]	0.09 lb	post	0	0	790 (11)
Check	-	-	0	0	673 (12)
lsd (0.05)			30	26	207
c.v.			36	31	18

[1]Pre-plant incorporated applications of 1.25 lbs triallate and 0.56 lb ethalfluralin per acre were used at all plots.
[2]Popi = post-plant incorporated, pre = pre-emergent, post = post-emergent.
[3]UBI-C4874 mixed with 1.5 pt/a crop oil.

Post emergent shattercane control in corn. Westra, P.W. and T.J. D'Amato. An herbicide trial was conducted near Yuma, CO, to evaluate the effectiveness of several herbicides for control of shattercane (SORVU) and to assess crop damage due to insecticide interaction and herbicide application method.

The study was designed as a randomized complete block with three replications. All herbicide treatments were applied on June 15, 1990 with a CO_2 pressurized backpack sprayer and 11002LP flat fan tips. Broadcast treatments were sprayed from a 10 foot boom at 24 gallons per acre. Post directed treatments were applied from a single drop nozzle at 70 gallons per acre. At application time the corn was 6 to 8 inches tall with 5 to 6 leaves,the shattercane was 4-6 inches tall, at the 4 leaf stage and at a density of 30 plants per square foot. Plot size was 10 by 30 feet.

Imazethapyr was applied at three rates broadcast over the corn and three rates post directed over the top of the shattercane but only at the lower portion of the corn plants. Primisulfuron and DPX-V9360 were applied broadcast at one rate. All herbicide treatments were sprayed over terbufos and chlorpyrifos. The insecticides were banded at planting in 4 rows each of an 8 row planter.

Visual evaluations of crop damage and shattercane control were taken 7, 18, 32, and 48 days after herbicide application,and corn yields were obtained on October 18, 1990. No significant differences were observed among the insecticide/herbicide interactions. DPX-V9360 and primisulfuron provided excellent control of the shattercane (see table). Imazethapyr provided poor to fair shattercane control, with the broadcast applications being slightly more effective than the post directed treatments. Corn injury was generally greater in the broadcast imazethapyr treatments, though the injury symptoms were not significantly different from the other treatments when rated 6 weeks after treatment application. Corn yields were highest in the DPX-V9360 and primisulfuron plots, though significant yield differences were only noted between the treated plots and untreated checks. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Evaluation and yield data for post emergent shattercane control in corn

herbicide treatment	rate lbs ai/a	application method	SORVU % control 8-2-90 terbufos	SORVU % control 8-2-90 chlorpyrifos	yield bu/a 10-18-90 terbufos	yield bu/a 10-18-90 chlorpyrifos
check			0	0	117	90
imazethapyr	.032	post directed	50	65	151	172
imazethapyr	.047	post directed	45	45	158	140
imazethapyr	.063	post directed	48	48	143	174
imazethapyr	.016	broadcast	72	72	164	184
imazethapyr	.032	broadcast	67	67	157	142
imazethapyr	.047	broadcast	82	85	155	186
DPX-V9360	.032	broadcast	99	99	190	160
primisulfuron	.036	broadcast	91	90	210	192
check			0	0	55	73
LSD (.05)			26	27	76	73

Triazine resistant redroot pigweed and kochia control in corn. Westra, P. and T. D'Amato. Protracted triazine use has resulted in triazine resistant biotypes of redroot pigweed and kochia. This study, conducted in eastern Colorado, investigated several alternate herbicides for redroot pigweed and kochia control in corn.

The experiment was a randomized complete block with three replications. Plots were 10 feet by 30 feet. Carrier volume was 24 gal/a delivered at 20 psi through 11002LP flat fan nozzles. Redroot pigweed and kochia plots were broadcast treated on June 7, 1990 and June 5, 1990, respectively. At the time of herbicide application redroot pigweed was at the 2 to 6 leaf stage, 0.5 to 2 in. tall, and present at 5 plants/ row foot. Kochia was 1.5 to 3 in. tall with 3 plants/ row foot. Corn was at the 5 to 6 leaf stage and was 6 to 8 in. tall.

Atrazine alone provided no control of redroot pigweed or kochia when compared to check plots. However, when tank mixed with pyridate excellent weed control was provided. Binary tank mixes of pyridate with cyanazine, primisulfuron, or DPX-V9360 also provided excellent weed control. Pyridate/cyanazine caused minimal corn damage but did not diminish yields when compared to the untreated check. 2,4-D amine alone provided unacceptable weed control but when tank mixed with dicamba provided excellent weed control. Dicamba or bromoxynil alone provided excellent weed control. All treatments produced greater corn yields than the untreated check except atrazine alone. Plots treated with atrazine alone had yields similar to the untreated check. Redroot pigweed and kochia control by each treatment are tabulated below. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Triazine resistant redroot pigweed and kochia control in eastern Colorado

Herbicide	Rate	Pigweed control	Kochia control
	(lb ai/a)	---------(% of check)	------------
atrazine	1.2	0	0
pyridate	0.45		
+ atrazine	0.6	98	95
pyridate	0.9		
+ cyanazine	1.2	99	100
pyridate	0.45		
+ primisulfuron	0.05	100	100
pyridate	0.45		
+ DPX-V9360	0.05	100	100
2,4-D	0.5	86	55
dicamba	0.5	100	92
2,4-D	0.5		
+ dicamba	0.25	100	88
bromoxynil	0.25	100	93
LSD (0.05)		7	8

Postemergence weed control in corn. Miller, S.D., J.M. Krall and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of postemergence herbicide treatments for weed control in corn. Plots were 10 by 45 ft. with three replications arranged in a randomized complete block. Corn (var. Pioneer 3902) was seeded in a sandy loam soil (75% sandy, 15% silt and 10% clay) with 1.4% organic matter and pH 7.6 May 2, 1990. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 31, 1990 (air temp. 76F, relative humidity 52%, wind SW at 6 mph, sky clear and soil temp. - 0 inch 84F, 2 inches 64F and 4 inches 62F) to 4-leaf corn and 0.5 to 2 inch weeds. Weed counts, crop stand counts and visual crop injury ratings were made June 11, visual weed control ratings July 10 and plots harvested October 11, 1990. Common lambsquarters (CHEAL) infestations were heavy and hairy nightshade (SOLSA), common sunflower (HELAN), Russian thistle (SASKR) and green foxtail (SETVI) infestations light but uniform throughout the experimental site.

No treatment reduced corn stand; however, treatments containing cyanazine injured corn 10 to 25%. Broadleaf weed control was excellent (93 to 100%) with all treatments except CGA-136872 alone and green foxtail control was excellent (92 to 100%) with bromoxynil-atrazine-CGA-136872, dicamba-atrazine-cyanazine, dicamba-atrazine-CGA-136872 or pyridate-DPX-V9360 combinations. Corn yields related directly to weed control and were 48 to 87 bu/A higher in herbicide treated areas compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1756)

Weed control in corn with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Yield bu/A	% Weed Control June CHEAL	SOLSA	SETVI	July CHEAL	SOLSA	HELAN	SASKR	SETVI
CGA-136872+S	0.018	0	0	99	37	53	89	47	10	87	43	70
CGA-136872+S	0.036	0	0	115	43	53	89	75	30	95	60	75
bromoxynil(brom)	0.25	0	0	129	100	100	0	97	100	100	90	0
bromoxynil	0.38	0	0	129	100	100	20	100	100	100	100	0
brom+CGA-136872+S	0.25+0.018	0	0	127	100	100	83	100	100	100	100	70
brom/atrazine(atra)	0.75	0	0	127	100	100	72	100	100	100	100	82
brom/atra+CGA-136872+S	0.75+0.018	0	0	131	100	100	100	100	100	100	100	97
dicamba+pendimethalin(pend)	0.38+1.0	0	0	120	89	100	89	100	100	100	100	50
dicamba+cyanazine(cyan)	0.38+1.0	20	0	129	100	100	100	100	100	100	100	95
dicamba+pend+cyan	0.38+1.0+1.0	25	0	131	100	100	100	100	100	100	100	100
dicamba+clopyralid(clop)	0.38+0.19	0	0	120	96	100	17	100	100	100	100	7
dicamba+CGA-136872+S	0.38+0.018	0	0	129	91	100	80	100	100	100	100	53
dicamba/atra	1.0	0	0	136	100	100	83	100	100	100	100	80
dicamba/atra+pend	1.0+1.0	0	0	129	100	100	100	100	100	100	100	88
dicamba/atra+cyan	1.0+1.0	25	0	133	100	100	100	100	100	100	100	98
dicamba/atra+clop	1.0+0.19	0	0	136	98	100	72	100	100	100	100	82
dicamba/atra+CGA-136872+S	1.0+0.018	0	0	136	100	100	100	100	100	100	100	92
pyridate+atra	0.45+0.5	0	0	136	100	100	72	100	100	97	97	73
pyridate+atra	0.9+0.5	0	0	133	100	100	89	100	100	97	97	83
pyridate+cyan	0.45+1.0	20	0	136	100	100	89	100	100	100	100	97
pyridate+cyan	0.9+0.5	10	0	127	100	100	83	100	100	100	93	88
pyridate+DPX-V9360+S	0.45+0.032	0	0	136	96	100	89	100	100	93	93	100
pyridate+DPX-V9360+S	0.9+0.032	0	0	138	99	100	100	100	100	100	100	98
weedy check	- - - - -	0	0	51	0	0	0	0	0	0	0	0
plants/ft. of row 6-inch band		- -	1.6	- -	2.5	0.3	0.5	2.7	0.4	0.2	0.3	0.7

[1]Treatments applied May 31, 1990; /=package mix treatments and S=X-77 at 0.25% v/v.
[2]Corn stand counts (SR=stand reduction) and visual injury (Inj) evaluated June 11 and plots harvested October 11, 1990.
[3]Weed stand counts June 11 and visual weed control ratings July 10, 1990.

Weed control in corn with DPX-V9360 and DPX-79406. Miller, S.D., J.M. Krall and A.W. Dalrymple. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and corn tolerance with postemergence applications of DPX-V9360 and DPX-79406 alone or in combination with other herbicides. Plots were 10 by 45 ft. with three replications arranged in a randomized complete block. Corn (var. Pioneer 3902) was seeded in a sandy loam soil (75% sand, 15% silt and 10% clay) with 1.4% organic matter and pH 7.6 May 2, 1990. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 31, 1990 (air temp. 72F, relative humidity 60%, wind SW at 3 mph, sky clear and soil temp. - 0 inch 78F, 2 inches 62F and 4 inches 60F) to 4-leaf corn and 0.5 to 2 inch weeds. Weed counts, crop stand counts and visual crop injury ratings were made June 11, visual weed control ratings July 10 and plots harvested October 11, 1990. Common lambsquarters (CHEAL) infestations were heavy and hairy nightshade (SOLSA), redroot pigweed (AMARE), kochia (KCHSC), Russian thistle (SASKR), and green foxtail (SETVI) infestations light but uniform throughout the experimental site.

No corn injury or significant stand reduction was observed with any herbicide treatment. Green foxtail control was good to excellent (90 to 100%) with DPX-V9360 or DPX-79406 alone or in combination with herbicides for broadleaf weed control. The only broadleaf weed effectively controlled by DPX-V9360 or DPX-79406 was redroot pigweed (92 to 98%). Broadleaf weed control was excellent (100%) with treatments containing dicamba, bromoxynil or dicamba plus atrazine and good (83 to 98%) with treatments containing 2,4-D. Corn yields related closely to weed control and were 9 to 47 bu/A higher in herbicide treated areas compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1755)

Weed control in corn with DPX-V9360 and DPX-79406.

Treatment[1]	Rate	Corn[2]			% Weed control[3]								
					June			July					
	lb ai/A	Inj %	SR %	Yield bu/A	CHEAL	SOLSA	SETVI	CHEAL	SOLSA	AMARE	KCHSC	SASKR	SETVI
DPX-V9360	0.032	0	0	106	3	33	83	30	0	95	47	40	90
DPX-V9360	0.047	0	0	109	0	47	83	38	10	98	53	43	98
DPX-V9360+dicamba(dica)	0.032+0.5	0	0	140	91	100	83	100	100	100	100	100	93
DPX-V9360+bromoxynil	0.032+0.38	0	0	144	100	100	83	100	100	100	100	100	95
DPX-V9360+bromoxynil	0.047+0.25	0	0	142	100	100	83	100	100	100	100	100	95
DPX-V9360+bromoxynil	0.047+0.38	0	0	140	100	100	80	100	100	100	100	100	94
DPX-V9360+dica/atrazine	0.032+0.8	0	0	140	100	100	100	100	100	100	100	100	98
DPX-V9360+dica/atrazine	0.032+1.0	0	0	142	100	100	100	100	100	100	100	100	100
DPX-V9360+2,4-D	0.032+0.38	0	0	128	73	100	83	95	97	93	88	83	93
DPX-79406	0.016	0	3	116	0	13	72	47	10	92	50	43	93
DPX-79406	0.023	0	3	116	0	33	83	63	17	100	60	53	97
DPX-79406+dicamba	0.016+0.5	0	0	142	92	100	89	100	100	100	100	100	93
DPX-79406+dicamba	0.023+0.5	0	0	135	88	100	89	100	100	100	100	100	96
DPX-79406+bromoxynil	0.016+0.25	0	0	135	100	100	83	100	100	100	100	100	96
DPX-79406+bromoxynil	0.016+0.38	0	0	132	100	100	89	100	100	100	100	100	93
DPX-79406+bromoxynil	0.023+0.25	0	0	137	100	100	89	100	100	100	100	100	96
DPX-79406+bromoxynil	0.023+0.38	0	0	132	100	100	83	100	100	100	100	100	96
DPX-79406+dica/atrazine	0.016+0.8	0	0	132	100	100	83	100	100	100	100	100	99
DPX-79406+dica/atrazine	0.023+0.8	0	0	132	100	100	100	100	100	100	100	100	100
DPX-79406+atrazine	0.016+0.5	0	0	142	100	100	89	100	100	100	100	100	99
DPX-79406+atrazine	0.023+0.5	0	0	140	100	100	85	100	100	100	100	100	98
weedy check	- - - - -	0	0	97	0	0	0	0	0	0	0	0	0
plants/ft. row 6-inch band			1.5	- -	1.7	0.3	0.4	2.1	0.4	0.2	0.2	0.3	0.5

[1]Treatments applied May 31, 1990; / = package mix and X-77 included with all treatments at 0.25% v/v.
[2]Corn stand counts (SR=stand reduction) and visual injury (Inj) evaluated June 11 and plots harvested October 11, 1990.
[3]Weed stand counts June 11 and visual weed control ratings July 10, 1990.

Wild proso millet control in corn with sequential herbicide treatments. Miller, S.D. and A.W. Dalrymple. Plots were established near Cassa, Wyoming under furrow irrigation to evaluate the efficacy of sequential herbicide treatments for wild proso millet control in corn. Plots were 10 by 30 ft. with three replications arranged in a randomized complete block. Corn (var. Golden Harvest 2445) was seeded May 15, 1990 in a silt loam soil (52% sand, 34% silt and 14% clay) with 2.1% organic matter and pH 7.7. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi except postdirected treatments applied with three drop nozzles at 40 gpa. Metolachlor was applied preemergence May 18 (air temp. 68F, relative humidity 66%, wind calm, sky cloudy and soil temp. - 0 inch 70F, 2 inches 57F and 4 inches 56F), spike treatments applied June 1 (air temp 60F, relative humidity 78%, wind NW at 5 mph, sky cloudy and soil temp. - 0 inch 64F, 2 inches 58F and 4 inches 56F) to emerging corn and wild proso millet, post treatments applied June 6 (air temp. 68F, relative humidity 40%, wind NW at 5 mph, sky partly cloudy and soil temp. - 0 inch 78F, 2 inches 68F and 4 inches 60F) to 2-leaf corn and 1 to 2 inch wild proso millet and postdirected treatments applied July 2, 1990 (air temp. 97F, relative humidity 17%, wind SW at 4 mph, sky clear and soil temp. - 0 inch 110F, 2 inches 98F and 4 inches 84F) to 8-leaf corn and 5 to 7 inch wild proso millet. Weed counts, crop stand counts and visual crop injury ratings were made June 21, visual crop injury ratings July 6, visual weed control ratings July 27, and plots harvested September 14, 1990. Wild proso millet (PANMI) infestations were moderate (3.6 plants/linear ft.) and uniform throughout the experimental area.

No treatment significantly reduced corn stands; however, corn injury was substantial with DPX-79406 (25 to 32%) or paraquat (13 to 22%) treatments. Late season wild proso millet control ranged from 55 to 88% and was better with sequential treatments than metolachlor alone. Corn yields were 2.7 to 6.5 T/A higher in herbicide treated compared to weedy check plots and yields generally were correlated to wild proso millet control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1754)

Wild proso millet control in corn with sequential herbicide treatments.

Treatment[1]	Rate lb ai/A	Corn[2] % Injury June	Corn[2] % Injury July	Corn[2] SR %	Corn[2] Silage T/A	PANMI control[3] June %	PANMI control[3] July %
Preemergence							
metolachlor(meto)	2.5	0	0	0	12.5	69	55
Preemergence/spike							
meto/pendimethalin(pend)	2.5/1.0	0	0	2	16.3	87	75
meto/cyanazine(cyan)	2.5/1.0	7	5	0	15.5	96	78
meto/pend+cyan	2.5/1.0+1.0	10	5	2	16.3	97	82
Preemergence/post							
meto/DPX-79406+S	2.5/0.016	25	12	0	14.1	93	77
meto/DPX-79406+S	2.5/0.023	32	12	5	14.0	96	80
meto/CGA-136872+S	2.5/0.018	0	0	4	13.7	70	62
meto/CGA-136872+S	2.5/0.036	0	0	0	13.7	88	63
meto/dica+atra+cyan	2.5/1.0+1.0	10	3	4	14.9	96	83
Preemergence/postdirected							
meto/paraquat+S	2.5/0.125	0	13	0	14.1	68	83
meto/paraquat+S	2.5/0.19	0	18	0	13.8	71	88
meto/paraquat+S	2.5/0.25	0	22	0	13.6	69	88
meto/paraquat+cyan+S	2.5/0.125+0.5	0	20	2	13.6	69	88
weedy check	- - - - - - - -	0	0	0	9.8	0	0
plants/ft. row 6-inch band		- -	- -	1.8	- -	3.6	- -

[1]Treatments applied May 18, June 1, June 6 and July 2, 1990; S=X-77 at 0.25% v/v.
[2]Corn injury visually evaluated June 21 and July 6, stand reduction (SR) determined June 21 and yield determined September 14, 1990.
[3]Wild proso millet stand counts June 21 and visual weed control ratings July 27, 1990.

Wild proso millet control in corn with postemergence herbicide treatments. Miller, S.D. and A.W. Dalrymple. Plots were established near Cassa, Wyoming under furrow irrigation to evaluate the efficacy of postemergence herbicide treatments for wild proso millet control in corn. Plots were 10 by 30 ft. with three replications arranged in a randomized complete block. Corn (var. Golden Harvest 2445) was seeded May 15, 1990 in a silt loam soil (52% sand, 34% silt and 14% clay) with 2.1% organic matter and pH 7.7. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi June 6 (air temp. 68F, relative humidity 40%, wind NW at 5 mph, sky partly cloudy and soil temp. - 0 inch 78F, 2 inches 68F and 4 inches 60F) to 2-leaf corn and 1 to 2 inch wild proso millet or June 13, 1990 (air temp. 66F, relative humidity 33%, wind calm, sky partly cloudy and soil temp. - 0 inch 87F, 2 inches 68F and 4 inches 63F) to 4-leaf corn and 3 to 4 inch wild proso millet. Weed counts, crop stand counts and visual crop injury ratings were made June 21, visual crop injury ratings July 6, visual weed control ratings July 27, and plots harvested September 21, 1990. Wild proso millet (PANMI) infestations were moderate (3.4 plants/linear ft.) and uniform throughout the experimental area.

No treatment significantly reduced corn stands; however, visual injury was substantial (27 to 40%) with 2-leaf DPX-79406 treatments regardless of additive or rate. Late season wild proso millet control ranged from 59 to 85% and was generally better with treatments applied to 3 to 4 inch than 1 to 2 inch wild proso millet. Corn yields were 0.6 to 4.9 T/A higher in areas treated with herbicides compared to weedy check plots. Corn yields generally related closely to late season wild proso millet control and/or early season crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1753)

Wild proso millet control in corn with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Corn[2] % Injury June	July	SR %	Silage T/A	PANMI control[3] June %	July %
2-leaf							
DPX-V9360+S	0.032	10	0	0	13.3	62	59
DPX-V9360+S+N	0.032	13	0	0	14.0	73	67
DPX-V9360+oc	0.032	8	3	0	14.1	68	63
DPX-V936+oc+N	0.032	12	3	0	13.4	66	60
DPX-V9360+S	0.047	12	0	0	13.7	74	73
DPX-V9360+oc	0.047	12	3	0	14.0	68	72
DPX-V9360+S	0.063	13	3	0	14.2	73	70
DPX-V9360+S+N	0.063	12	0	0	13.7	72	70
DPX-V9360+oc	0.063	10	3	0	13.9	72	68
DPX-V9360+oc+N	0.063	12	5	0	13.6	72	70
DPX-79406+S	0.016	27	10	0	12.5	75	70
DPX-79406+S+N	0.016	30	12	0	12.3	75	67
DPX-79406+oc	0.016	28	13	0	12.1	72	68
DPX-79406+oc+N	0.016	30	15	0	11.3	75	68
DPX-79406+S	0.023	35	12	2	11.3	86	78
DPX-79406+S+N	0.023	37	17	2	11.1	85	77
DPX-79406+oc	0.023	32	12	2	11.3	82	80
DPX-79406+oc+N	0.023	33	20	0	11.1	85	77
DPX-79406+S	0.032	40	20	0	10.6	87	85
DPX-79406+oc	0.032	37	18	0	10.6	83	80
4-leaf							
DPX-V9360+S	0.032	3	0	0	14.3	66	72
DPX-V9360+S	0.047	3	0	0	14.4	61	72
DPX-V9360+S	0.063	7	0	5	14.9	65	75
DPX-79406+S	0.016	0	0	0	14.5	60	70
DPX-79406+S	0.023	5	0	2	14.5	64	73
DPX-79406+S	0.032	10	0	0	14.3	78	82
weedy check	- - -	0	0	0	10.0	0	0
plants/ft. row 6-inch band		- -	- -	1.7	- -	3.4	- -

[1]Treatments applied June 6 and 13, 1990; S=X-77 at 0.25% v/v, N=28% w/w nitrogen at 1 gal/A and oc=At Plus 411F at 1 qt/A.
[2]Corn injury visually evaluated June 21 and July 6, stand reduction (SR) determined June 21 and yield determined September 21, 1990.
[3]Wild proso millet stand counts June 21 and visual weed control ratings July 27, 1990.

Annual grass and broadleaf weed control with complimentary preemergence/postemergence/late postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established at the Agricultural Science Center, Farmington, New Mexico to evaluate the efficacy of complementary preemergence/postemergence/late postemergence herbicide treatments for annual grass and broadleaf weed control in field corn (var. Super Crost 5460). Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Field corn was planted on May 8, 1990. Preemergence treatments were applied May 10, 1990 and immediately incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied June 4, 1990 when corn was in the 3 to 4 leaf stage and weeds were small. Late postemergence treatments were applied June 21, 1990 when corn was in the 6 to 7 leaf stage. Weeds heights were kochia, Russian thistle, black nightshade, and redroot pigweed 1 in, prostrate pigweed 0.5 in, and barnyardgrass 2 to 3 in. All postemergence treatments were applied with a COC at 0.25% v/v. Prostrate and redroot pigweed, and barnyardgrass infestations were heavy, black nightshade infestations were moderate, and Russian thistle and kochia infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made on July 26, 1990. All treatments gave from good to excellent control of broadleaf weeds. Barnyardgrass control was excellent with all treatment except CGA-136872 applied late postemergence at 0.047 lb ai/A. No crop injury was apparent with any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control in field corn with complimentary preemergence/postemergence/late postemergence herbicides

Treatment[1]	Rate lb ai/A	Crop[2] Injury	-----------Weed Control[2]----------- AMARE	AMABL	SASKR	KCHSC	SOLNI	ECHCG
		----------------------%----------------------						
atrazine + metolachlor[3] (pm)	2.7	0	100	100	100	100	98	100
atrazine + metolachlor (pm)/ CGA-136872	2.7/0.035	0	100	100	100	100	100	100
atrazine + metolachlor (pm)/ CGA-136872/ CGA-136872	2.7/0.017/0.017	0	100	100	100	100	100	100
atrazine + metolachlor (pm)/ CGA-136872/ CGA-136872	2.7/0.027/0.009	0	100	100	100	100	100	100
CGA-136872[4]	0.035	0	100	100	100	100	87	75
atrazine + dicamba[3] (pm)	1.0	0	100	100	100	100	97	100
atrazine + dicamba (pm)/ CGA-136872	1.0/0.035	0	100	100	100	100	100	100
atrazine + dicamba (pm)/ CGA-136872/ CGA-136872	1.0/0.017/0.017	0	100	100	100	100	100	100
atrazine + dicamba (pm)/ DPX-79406	1.0/0.05	0	100	100	100	100	100	100
atrazine + dicamba (pm)/ DPX-V9360	1.0/0.05	0	100	100	100	100	100	100
atrazine + metolachlor (pm)/ DPX-79406	2.7/0.05	0	100	100	100	100	100	100
atrazine + metolachlor (pm)/ DPX-V9360	2.7/0.05	0	100	100	100	100	100	100
DPX-79406[4]	0.05	0	100	100	100	100	86	100
DPX-V9360[4]	0.05	0	100	100	100	100	87	100
handweeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/M^2			12	22	5	3	8	15
LSD 0.05			ns	ns	ns	ns	2.1	9.1

1. All postemergence treatments were applied with a COC at 0.25 v/v.
2. Based on a visual scale from 0-100 where 0 = no control and 100 = dead plants.
3. Treatments were applied preemergence only.
4. Treatments were applied postemergence only.

<u>Annual grass and broadleaf weed control in field corn with preemergence herbicides.</u> Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 9, 1990 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Super Crost 5460) and annual grass and broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted on May 9, 1990. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Treatments were all applied preemergence surface on May 11, 1990 and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL), infestations were heavy and barnyardgrass (ECHCG), redroot pigweed (AMARE), kochia (KCHSC), Russian thistle (SASKR), and green foxtail (SETVI) infestations were moderate to light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 6, 1990. All treatments gave over 80% control of AMARE, and SASKR. AMABL control was good to excellent with all treatments except dicamba applied 0.25 lb ai/A. KCHSC control was excellent with all treatments except metolachlor and alachlor both applied at 2.0 lb ai/A. ECHCG and SETVI control was excellent with all treatments except dicamba applied at 0.25 and 0.5 lb ai/A. Metolachlor applied at 2.0 lb ai/A caused the highest injury rating of 12. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Weed control evaluations in field corn with preemergence herbicides

Treatment	Rate lb ai/A	Crop[1] Injury	Weed Control[1] AMARE	AMABL	KCHSC	SASKR	ECHCG	SETVI
		%						
dicamba + atrazine (pm)	0.8	0	100	100	100	100	100	100
dicamba + atrazine (pm)	1.6	0	100	100	100	100	100	100
dicamba + atrazine (pm)	2.4	0	100	100	100	100	100	100
dicamba + atrazine (pm) + cyanazine	0.8+2.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + alachlor	0.8+2.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + pendimethalin	0.8+1.0	0	100	100	100	100	100	100
pendimethalin + dicamba	1.0+0.25	2	100	98	100	100	100	100
dicamba + atrazine (pm) + metolachlor	0.8+2.0	8	100	100	100	100	100	100
dicamba	0.5	3	100	83	100	100	0	0
metolachlor	2.0	12	100	100	77	88	100	100
pendimethalin	1.0	5	100	100	96	88	98	99
cyanazine	2.0	5	100	100	100	88	100	100
alachlor	2.0	0	99	98	75	83	99	100
dicamba	0.25	0	96	75	98	92	0	0
handweeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/M[2]			8	18	3	4	9	6

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

Annual grass and broadleaf weed control in field corn with postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 8, 1990 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Super Crost 5460) and annual grass and broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Treatments were all applied postemergence on May 29, 1990 when corn was in the 3 to 4 leaf stage and weeds were small. Prostrate pigweed (AMABL), redroot pigweed (AMARE), and barnyardgrass (ECHCG) infestations were heavy, green foxtail (SETVI) infestations were moderate, and Russian thistle (SASKR) and kochia (KCHSC) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 6, 1990. All treatments gave good to excellent control of broadleaf weeds. ECHCG and SETVI control was excellent with all treatments except dicamba + 2-4D both applied at 0.25 lb ai/A. No crop injury was apparent in any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499)

Weed control evaluations in field corn with postemergence herbicides

Treatment	Rate lb ai/A	Crop[1] Injury	AMARE	KCHSC	AMABL	SASKR	ECHCG	SETVI
		-----Weed Control[1]-----						
		-----%-----						
atrazine + dicamba[2] (pm)	0.8	0	100	100	99	99	100	97
atrazine + dicamba[2] (pm)	1.2	0	100	100	100	100	100	100
atrazine + dicamba (pm)	0.8	0	100	100	98	99	100	100
atrazine + dicamba (pm)	1.2	0	100	100	100	100	100	100
atrazine + dicamba (pm) + cyanazine	0.8+1.0	0	100	100	100	100	100	100
atrazine + dicamba (pm) pendimethalin	0.8+1.0	0	100	100	100	100	100	100
atrazine + dicamba (pm) + DPX-V9360	0.8+0.047	0	100	100	100	100	100	100
atrazine + dicamba (pm) + DPX-79406	0.8+0.047	0	100	100	100	100	100	100
atrazine + dicamba (pm) + CGA-136872	0.8+0.032	0	100	100	100	100	100	100
dicamba + cyanazine	0.38+1.0	0	100	100	100	100	100	100
dicamba + pendimethalin	0.38+1.0	0	100	100	100	100	98	98
dicamba + cyanazine + pendimethalin	0.38+1.0+1.0	0	100	100	100	100	100	100
dicamba + DPX-79406	0.38+0.047	0	100	100	100	100	82	85
dicamba + 2-4D	0.25+0.25	0	100	100	100	100	0	0
handweeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/M^2			11	3	18	3	11	6

1. Based on a visual scale from 0-100 where 0 = no control and 100 = dead plants.
2. A COC was added at 0.25% v/v.
3. pm = packaged mix.

Evaluation of herbicide treatments in conventional and no-till field corn. Mitich, L.W., J.A. Roncoroni, and G.B. Kyser. Nine herbicides, including the experimental chemicals pyridate, DPX-79406 (a 1:1 mix of DPX-V9630 and DPX-E9636), and DPX-E9636, were evaluated for crop tolerance and weed control in 22 treatments in 'Pioneer 3377' field corn. No-till and conventional till blocks were planted, though the experimental design does not permit statistical comparison of the two cultural methods.

Corn was planted at the UC Davis Farm 21 May 1990 one inch deep into moisture in Yolo clay loam soil. Plots were 10 ft (four 30-inch rows) wide by 20 ft long, in four replications on a randomized complete block design. The conventional till block was worked up into smooth beds before planting and treatment, while the no-till block was simply cut into rough beds, leaving a cloddy soil surface. Corn emerged 31 May.

In both blocks a foundation herbicide was applied before most experimental treatments, allowing for a 'treated check.' In the conventional till block, most treatments were prefaced with alachlor (2 lb ai/a) applied 21 May and incorporated with a Lilliston rolling cultivator and a power cultivator. In no-till, most treatments were prefaced with a commercial mix of alachlor + salt of glyphosate (2.6 + 1.4 lb ai/a) applied 22 May and incorporated by rain and sprinkler irrigation 22 and 23 May.

Postemergence treatments were applied 26 June, when the crop had 6 to 8 leaves. All treatments were applied with a CO_2 backpack sprayer delivering 25 gal/a of spray solution through 8002 nozzles. Weeds present at postemergence treatment included barnyardgrass (ECHCG), 4 to 7 inches; common purslane (POROL), 4 to 10 inches; redroot pigweed (AMARE), up to 10 inches; and scattered tomatillo groundcherry (PHYIX) and velvetleaf (ABUTH). Weeds were larger than recommended for most postemergence treatments. Surfactant was not used with DPX-79406 or DPX-E9636.

On 9 July plots were rated visually for crop tolerance and weed control. In conventional till, high rates of DPX-79406 caused significant crop injury (20%). None of the no-till treatments caused injury. Treatments producing top-ranked barnyardgrass control included, in conventional till, the high rate of pyridate + atrazine and the lowest rate of DPX-79406; in no-till, the high rate of pyridate + atrazine and the low rate of atrazine alone produced best barnyardgrass control. Treatments producing top-ranked groundcherry control included, in conventional till, the high rate of pyridate + atrazine and pyridate + cyanazine; in no-till, best groundcherry control was produced by both rates of pyridate + atrazine and by dicamba + atrazine. Significant differences in purslane control were detected only in conventional till; the high rate of pyridate + atrazine and pyridate + cyanazine produced best control.

Corn was harvested 18 October. No significant yield differences were detected, in large part because squirrels damaged several plots late in the season. (Department of Botany, University of California, Davis, CA 95616)

Evaluation of herbicide treatments for crop tolerance and weed control in conventional till and no-till field corn at the University of California, Davis

No-Till Corn[3]

Herbicide treatment	Rate (lb ai/a)	Visual evaluation, 9 July 1990[1,2] percent crop vigor	percent weed control ECHCG	PHYIX	Yield[1] corrected to 15.5% moisture (g/20 ft)
pyridate + atrazine**	0.45 + 0.60	83	58 B	90 AB	4874
pyridate + atrazine**	0.90 + 1.20	90	80 A	95 AB	5060
atrazine**	0.60	85	65 AB	58 CDEF	4754
atrazine**	1.20	88	55 B	83 ABC	5238
pyridate*	0.45	88	48 B	53 DEF	4723
pyridate*	0.90	93	53 B	68 BCDE	5397
dicamba + atrazine*	0.52 + 0.98	75	53 B	100 A	5078
2,4-D*	1.0	93	58 B	80 ABCD	4717
treated check*	(see note*)	88	58 B	40 EF	4565
untreated check	---	68	10 C	33 F	3997

*Treated with alachlor + salt of glyphosate (2.6 + 1.4 lb ai/A) May 22, 1990.
**0.25% X-77 added; also treated as in *.

Conventional tilled corn[3]

Herbicide treatment	Rate (lb ai/a)	Visual evaluation, 9 July 1990[1,2] crop vigor (percent)	percent weed control ECHCG	PHYIX	POROL	Yield[1] corrected to 15.5% moisture (g/20 ft)
pyridate + atrazine**	0.45 + 0.60	83 BC	68 ABC	75 AB	80 AB	5639
pyridate + atrazine**	0.90 + 1.20	90 ABC	78 A	98 A	93 A	5555
atrazine**	0.60	100 A	53 ABCDE	45 BCD	80 AB	5667
atrazine**	1.20	98 A	50 ABCDE	63 ABC	68 ABC	5346
pyridate*	0.45	100 A	40 CDE	18 D	40 CD	5243
pyridate*	0.90	100 A	55 ABCD	38 BCD	38 CD	5328
pyridate + cyanazine*	0.45 + 0.60	93 ABC	48 BCDE	60 ABC	85 A	5287
cyanazine*	0.60	95 AB	33 DE	35 BCD	48 BCD	5236
treated check*	(see note*)	98 A	48 BCDE	30 CD	33 CD	5514
DPX-79406	0.25 oz	90 ABC	73 AB	58 ABCD	38 CD	5170
DPX-79406	0.5 oz	80 C	55 ABCD	55 BCD	23 D	5139
DPX-79406	1.0 oz	80 C	50 ABCDE	58 ABCD	40 CD	4368
E9636	0.5 oz	88 ABC	68 ABC	38 BCD	15 D	4777
untreated check	---	90 ABC	25 E	30 CD	38 CD	5201

*Treated with alachlor (2 lb ai/A) on May 21, 1990.
**0.25% X-77 added; also treated as in *.

[1]All values are mean of 4 replications. Values followed by the same letter (or not followed by letter) are not different at the 5% level of significance.

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

[3]No-till and conventional till sections were blocked and analyzed separately.

Junglerice and prairie cupgrass control in cotton. Bell, C. E. and C. E. Engle. This research was conducted to evaluate potential postemergent grass herbicides in cotton. The experiment was located at the University of California Imperial Valley Research and Extension Center.

The trial was a Randomized Complete Block Design with four replications. Plots were two beds (1m wide each) by 15m. Cotton was sown on April 12,1990 and irrigated immediately. Natural weed infestations of junglerice, prairie cupgrass, wrights groundcherry, and tumble pigweed appeared after irrigation. Treatments 2 to 8 were applied on May 4 when the grasses had 2-4 true leaves. Treatments 9 to 14 were applied on May 16 when the grass had approximately 15 leaves. Carrier volume was 183 l/ha, pressure was 173 kPa, and 3-TX8 HC nozzles were used. All treatments had crop oil concentrate at 0.25% v/v. Visual evaluations of grass control were made on May 10, May 17, June 8 and June 13, 1990. Visual evaluation of cotton vigor was made on June 8. Biomass samples of crop and weeds were taken on June 19 (Replication 1 and 2) and June 22 (Replication 3 and 4). Samples were 1m of each bed. Cotton and weeds were separated by species, however, the two grass species were combined. Samples were dried at 54°C for 72 hours and weighed.

Analysis of variance was conducted on all quantitative data. The field where the trial was conducted had an apparent fertility gradient perpendicular to the blocks. Therefore, there were high standard deviations in these samples.

When applied at the 2-4 leaf stage of these grasses, the herbicides tested, with one exception, worked excellently. The exception, treatment 2, also worked well, but grass biomass was higher at the end of the trial. When these herbicides were applied to grasses with 15 leaves or more, the level of control was reduced. Cotton vigor was also reduced. Additionally, biomass of the two broadleaf weeds was reduced, apparently from competition from the grasses. None of the treatments caused visible injury to the cotton. An inverse relationship between grass biomass and biomass of either broadleaf weed was observed, suggesting that the grass species present were more competitive then these other weeds. (University of California Cooperative Extension, Holtville, CA 92250 and Mobay Corporation, Fallbrook, CA 92028.)

Annual grass control in cotton in the Imperial Valley of California

Treatment	Rate	Timing[a]	Weed control %				Vigor[b]	Biomass			
			--May--		----June----			---(gm/M^2)---			
			10	17	8	13	8	cotton	grasses	AMAAL	PHYWR
1. Untreated control			0	0	0	0	6.0	45.7 c	249.7 a	2.0	16.3
2. RO173664	0.039	2-4	60	76	93	87	9.0	103.4 bc	17.3 b	12.9	83.9
3. RO173664	0.059	2-4	72	93	99	98	10.0	216.8 ab	0.1 b	56.7	145.8
4. RO173664	0.078	2-4	70	88	98	99	9.8	275.3 a	0.4 b	115.0	124.1
5. RO173664	0.097	2-4	67	93	99	98	9.0	189.3 ab	0.1 b	15.7	65.6
6. Quizalofop	0.112	2-4	67	95	100	100	10.0	189.9 ab	0.2 b	24.5	107.1
7. Fluaz/butyl[c]	0.21	2-4	70	95	100	100	10.0	210.1 ab	0.0 b	40.2	129.2
8. Sethoxydim	0.21	2-4	77	96	99	99	9.8	195.1 ab	0.0 b	126.8	175.0
9. RO173664	0.078	15	0	0	95	76	7.3	96.4 bc	10.3 b	12.4	11.7
10. RO173664	0.097	15	0	0	76	77	7.3	184.2 ab	12.6 b	55.4	22.2
11. RO173664	0.118	15	0	0	50	69	6.8	95.1 bc	34.0 b	0.6	44.2
12. Quizalofop	0.112	15	0	0	50	39	7.0	133.7 bc	63.5 b	9.6	22.9
13. Fluaz/butyl	0.21	15	0	0	93	85	7.8	201.0 ab	33.1 b	42.1	33.1
14. Sethoxydim	0.21	15	0	0	69	58	7.5	123.9 bc	33.0 b	31.9	18.7

Numbers followed by letters in the same column are not significantly different according to Duncan's Multiple Range Test (.05).

[a] - number of leaves at time of treatment

[b] - vigor, 10 = most vigorous growth, 0 = no growth

[c] - Fluaz/butyl = Fluazifop-butyl

Reduced tillage "relay" planting of cotton into an established stand of alfalfa. Kempen, H.M., M.P. Gonzalez, and D. J. Munier. In a trial on "relay planting" of cotton into 4th year alfalfa after the first spring cutting, we studied several herbicides to kill or suppress alfalfa. When planting cotton into the alfalfa we had learned that a 20-inch horizontal blade in front of the planter cut off alfalfa plants but that regrowth in the middles was rapid.

The check in which this trial was placed was sheeped off in mid-March and border irrigated March 29, 1990. The alfalfa was treated April 6 with glyphosate at 2.5 lb ai/a, except for our trial site. A light irrigation was applied April 9 and then planted on April 16. Middles were cultivated on April 27 and several times thereafter and a layby prometryn treatment was made on June 28. Fertilizer was topdressed on May 24, 1990.

Data on top kill and regrowth was taken on alfalfa in the middles until it was cultivated on April 26, 10 days after planting. Glyphosate suppression was perhaps adequate at 1.5 lb ai/a and sulfosate at 1.12 lb ai/a. Glufosinate caused quick top kill but allowed rapid regrowth, yet might be suitable. Paraquat, ENQUIK, and flaming caused rapid burn down and rapid regrowth. Adding the residuals, prometryn and pendimethalin did not improve mid-season control because few grasses, lambsquarter or pigweed emerged. Those present were weeded after counts showed no differences.

Crop growth and production was judged normal with a yield of 2.5 bales per acre, with no differences from treatments. The technique saves about $200 in land preparation costs and permits an additional cutting of alfalfa in the spring before cotton planting. In this area the concern of high particulate matter in the air makes this a potential practice to reduce particulates.

Further study should include blading off all alfalfa crowns at planting. (Univ. of Calif. Coop. Ext. Bakersfield, CA 93307)

Table 1. Field and application data

CROP:	Cotton, Prema	APPLICATION DATE:	4/4/90
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2 backpack
PLANTING DATE:	4/16/90	VOLUME:	20 gpa @ 22psi
PLOT SIZE:	8.3 ft by 15 ft	SOIL TYPE:	heavy sandy loam
PLOT DESIGN:	RCB K2X, 3 reps.	O.M.:	~1.0 %
IRRIGATION METHOD:	Border to furrow	CULTIVATION:	4/27, 5/4, 5/11, 6/1
CONDITIONS:	80°F, variable wind; none to light SE, moist soil		
WEED SPECIES:	Alfalfa, London rocket (*Sisymbrium irio L.*)		

Table 2. Summary of alfalfa injury and London rocket control prior to cultivation
(0 to 10 Rating: 0=no control, 10=kill)

TREATMENT	1X RATE† (lb ai/a)	ALFALFA INJURY April 6 1X	April 6 2X	April 12 1X	April 12 2X	April 25 1X	April 25 2X	LONDON ROCKET INJURY April 12 1X	April 12 2X
Control	—	0.0	-	0.0	-	2.3	-	4.3	-
Flamed w/propane	—	6.3	-	9.0	-	0.0	-	10.0	-
Glyphosate+pendimethalin +prometryn*	0.75+0.75 +1.0	1.3	2.0	5.0	7.0	4.7	6.3	10.0	10.0
Glyphosate*	0.75	1.7	3.0	3.7	5.7	4.3	6.7	8.0	9.7
Glyphosate*	2.0	3.3	3.7	7.3	9.0	8.2	10.0	10.0	10.0
Glyphosate+prometryn*	0.75+1.0	0.3	0.7	5.0	6.3	6.3	8.0	10.0	10.0
Sulfosate*	1.12	2.0	3.7	5.0	7.0	7.0	8.7	10.0	10.0
Glufosinate	0.67	3.3	4.3	8.7	10.0	4.0	6.3	10.0	10.0
Paraquat*	0.5	4.7	6.0	5.3	6.7	3.0	1.3	10.0	10.0
ENQUIK*	20gpa	5.7	6.7	4.7	6.0	2.3	1.7	9.7	10.0
LSD (0.05)		1.2		0.6		2.3		1.6	

† All 2X treatments were double-sprayed, like an overlap (K2X)
* Surfactant at 0.25%

Comparison of ivyleaf morningglory control at the seedling stage versus the twining stage in cotton. Gonzalez, M.P. and H.M. Kempen. Applications were made over-the-top (OT) to 10 inch cotton (6 nodes) on June 14, 1990 and 8 days later. Ivyleaf morningglory (*Ipomea hederifolia L.*) was at the cotyledon - 1st true leaf stage for the early application and 3rd leaf at the later application. Cotton symptom ratings showed slight yellowing of new leaves but recovered by the July 5 ratings. Ivyleaf morningglory was severely stunted by all DPX treatments, with the growing points killed, but older leaves surviving. MSMA and cyanazine, post-directed (PDS), did well at the early date but was poorer once morningglory began twining. Mon 13202 with surfactant PDS was not effective on emerged morningglory. On July 12 when cotton was 36 inches, no injury was evident; all DPX treatments had live morningglory plants, but they did not grow since treatment, whereas in the control and Mon-13202, the morningglory was twining over the cotton.

DPX-PE 350-2 looked outstanding against ivyleaf morningglory and lower rates than these might preclude a residual carryover problem. (Univ. of Calif. Coop. Ext. Bakersfield, CA 93307)

Table 1. Field and application data

CROP:	Cotton , GC 356	APPLICATION DATE:	6/14/90, 6/22/90
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2
PLANTING DATE:	4/12/90	VOLUME:	35 gpa
ROW SPACING:	40 inches	IRRIGATION METHOD:	Solid set sprinklers
PLOT DESIGN:	RCB (split applications)	PLOT SIZE:	4 beds by 20 ft.
SOIL TYPE:	San Emidigo silty clay loam, OM~1.0%		
CONDITIONS:	85°F, dry surface, moist root zone; 6/14: light NW wind, 6/22: no wind		
WEED SPECIES:	6/14: Morningglory (IPOHE) seedling/cotyledon to 1st leaf 6/22: Morningglory 1st leaf to twining (ave 3rd leaf)		

Table 2. Summary of cotton symptoms and morningglory control (0-10 Rating: 0=no injury, 10=kill)

TREATMENT	RATE (lb ai/a)	COTTON SYMPTOMS June 28, 1990 early	late	July 5, 1990 early	late	MORNINGGLORY CONTROL June 28, 1990 early	late	July 5, 1990 early	late
Control	—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MSMA + cyanazine (PDS)	2.0 +1.0	1.7	2.0	1.0	0.7	8.0	4.3	9.3	7.0
DPX-PE 350-2 * (OT)	0.8 oz	2.3	0.7	0.3	0.0	7.0	4.7	8.0	7.0
DPX-PE 350-2 * (OT)	1.2 oz	2.7	2.7	0.0	0.0	6.3	5.0	8.0	8.0
DPX-PE 350-2 * (OT)	1.6 oz	3.3	2.3	0.3	0.0	8.0	5.0	9.3	8.0
DPX-PE 350-2 * (OT)	2.0 oz	4.0	2.3	1.0	0.0	8.3	5.7	9.0	7.7
DPX-PE 350-2 * (OT)	2.4 oz	3.3	2.7	0.7	1.0	8.7	7.0	9.3	9.0
Mon-13202 * (PDS)	0.25	1.0	0.0	0.0	0.0	2.0	3.0	1.3	1.3
LSD (0.05)		0.9	1.2	NS	NS	1.8	2.0	1.3	2.9
				NS				2.1	

PDS = Post Directed Spray
OT= Over-The-Top
* Surfactant at 0.25%

Foliar herbicides on emerging weeds. Kempen, H.M. and M. P. Gonzalez. Cotton was planted in dry beds on April 12, 1990 immediately after lettuce harvest and sprinkled. Treatments were made on April 20, 1990, 8 days later, when some weeds had emerged as cotton began emerging. Any emerged cotton killed by treatments was not included in the ratings of May 23 (Table 2). Soil surface moisture was variable in portions of the test site at emergence. Where the surface had dried, fewer numbers of weeds germinated. Cotton emergence varied from 70 to 100%. Nightshade (*Solanum nigrum L.*) was generally dense but only 2 to 6 volunteer melons and ivyleaf morningglory (*Ipomea hederifolia L.*) were present in each plot (40 inches by 15 ft).

The data showed no differences despite marked numerical differences. They suggest that none of these foliar herbicides were persistent in the soil. (Univ. of Calif. Coop. Ext. Bakersfield, CA 93307)

Table 1. Field and application data

CROP:	Cotton, GC 356	APPLICATION DATE:	4/20/90
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2 backpack
PLANTING DATE:	4/12/90	VOLUME:	35 gpa @ 24psi
PLOT DESIGN:	RCB K2X, 3 reps.	PLOT SIZE:	40 inches by 15 ft
SOIL TYPE:	San Emidgio silty clay loam, OM ~ 1.0%		
IRRIGATION METHOD:	Sprinklers, irrigated 4/13/90 (2 inches), 4/22/90		
CONDITIONS:	70°F, no wind, dry to moist soil,		
WEED SPECIES:	nightshade cotyledon stage (SOLNI), ivyleaf morningglory (IPOHE), volunteer watermelon		

Table 2. Summary of cotton injury, nightshade control, morningglory control, and melon control on May 23, 1990 (0-10 Rating: 0=no injury, 10=control)

TREATMENT	1X RATE† (lb ai/a)	COTTON INJURY 1X	2X	NIGHTSHADE CONTROL 1X	2X	MORNINGGLORY CONTROL 1X	2X	MELON CONTROL 1X	2X
Control	—	0.0	-	1.7	-	0.0	-	0.0	-
Glyphosate	0.25	1.0	0.3	5.7	7.8	2.7	1.3	0.0	0.0
Glyphosate	1.00	1.0	0.0	5.3	6.0	2.7	1.3	0.0	0.0
Glufosinate	0.50	0.0	0.0	4.7	4.8	1.3	1.3	1.3	0.0
Paraquat	0.25	0.0	1.0	4.0	5.0	1.3	1.3	1.3	0.0
Sulfosate	0.25	0.3	0.3	2.7	4.3	0.0	0.0	0.0	0.0
Sulfosate	1.00	0.0	0.7	3.3	3.7	0.0	0.0	1.3	0.0
LSD (0.05)		NS		NS		NS		NS	

† All 2X treatments were double-sprayed, like an overlap (K2X)
NS = No Significance

Pre-emergence control of weeds in cotton. Kempen, H.M. and M.P. Gonzalez. San Joaquin Valley growers occasionally plant cotton dry and sprinkler irrigate to germinate it. Late plantings after April lettuce harvest are done this way. Such a practice maximizes injury potential of herbicides, and permits a worse-case scenario for safety.

This study included many registered herbicides in comparison to a few new products at 2 or 4 rates each. A comparison was made of the dinitro-anilines, trifluralin vs. pendimethalin at 4 rates to see if trifluralin might be used effectively at higher rates and it would then dissipate from the surface and permit earlier rotations.

Results showed that pendimethalin was much more effective on nightshade than trifluralin at equal rates, and at the higher rates trifluralin was not adequately effective. Pendimethalin here was safe to cotton at 2 lb ai/a, though previous trials have shown shoot stunting at rates over 1 lb ai/a.

The two new candidate herbicides, Valent's V-53482 and Monsanto's Mon-13202 were very effective on nightshade at the lowest rates. V-53482 was safe at all rates tested, but Mon-13202 stunted cotton at all but the lowest rate of 0.25 lb ai/a.

The registered cotton nightshade herbicides, prometryn, fluometuron and cyanazine did well on nightshade (*Solanuim nigrum L.*) at the 1X and 2X rates, but safety under sprinklers was best with prometryn, intermediate with fluometuron and unsafe with cyanazine. (Note that cyanazine is registered only to 30 days before planting or after cotton is 8 inches) Norflurazon at 0.25 lb ai/a was not quite effective enough on nightshade, while at the 2X rate was causing slight retardation of cotton.

On scattered ivyleaf morningglory (*Ipomea hederifolia*), cyanazine, fluometuron or prometryn were best. On scattered volunteer watermelons, fluometuron and norflurazon were best; of note is that cyanazine and pendimethalin at 0.25 or 0.50 caused no injury to watermelon, yet good nightshade control. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307)

Table 1. Field and application data

CROP:	Cotton, GC 356	APPLICATION DATE:	4/12/90
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2 backpack
PLANTING DATE:	4/12/90	VOLUME:	35 gpa @ 24psi
PLOT DESIGN:	RCB K2X, 3 reps	PLOT SIZE:	3.3 ft by 15 ft
SOIL TYPE:	San Emidgio silty clay loam, OM ~ 1.0%		
IRRIGATION METHOD:	Sprinklers, irrigated 4/13/90 - 2", 4/22/90		
CONDITIONS:	88°F, variable wind; none to light, dry soil,		
WEED SPECIES:	black nightshade (coty) (SOLNI), ivyleaf morningglory (IPOHE), volunteer watermelon		

Table 2. Summary of cotton injury and cotton stand

TREATMENT	1X RATE† (lb ai/a)	COTTON INJURY* April 30, 1990 (cotyledon) 1X	2X	May 9, 1990 (3-4 leaf) 1X	2X	May 23, 1990 (5-6 leaf) 1X	2X	COTTON STAND (%) May 23, 1990 (100% emerged) 1X	2X
Control	—	0.5	-	0.5	-	0.5	-	86.7	-
Trifluralin	0.25	0.7	1.0	0.3	0.0	0.7	0.3	86.7	90.0
Trifluralin	1.00	0.7	1.0	1.3	1.3	0.3	1.3	86.7	86.7
Pendimethalin	0.25	1.0	0.3	0.3	0.7	0.3	0.0	86.7	90.0
Pendimethalin	1.00	0.7	0.7	1.3	1.7	1.3	1.7	83.3	86.7
Prometryn	1.00	0.7	2.0	1.7	4.3	1.0	2.7	80.0	83.3
Fluometuron	1.00	1.0	1.0	1.0	3.3	0.7	4.0	90.0	83.3
Cyanazine	1.00	1.0	1.0	2.0	6.7	3.0	7.7	86.7	43.3
V-53482	5.7g	1.3	2.7	0.7	2.0	1.0	1.7	86.7	83.3
V-53482	7.1g	1.3	2.7	1.7	2.0	1.3	1.7	80.0	80.0
Mon-13202	0.25	2.7	3.0	3.0	4.3	1.7	3.7	80.0	76.7
Mon-13202	0.70	3.7	5.0	5.0	7.0	4.7	6.0	33.3	35.0
Norflurazon	0.25	2.3	2.7	2.0	2.3	0.7	3.0	83.3	86.7
LSD (0.05)		1.3		1.7		1.9		22.0	

† All 2X treatments were double-sprayed, like an overlap (K2X)
* 0-10 Rating: 0 = no injury, 10 = kill

Table 3. Summary of weed control (0-10 Rating: 0=no injury, 10=kill)

TREATMENT	1X RATE† (lb ai/a)	Nightshade Control (population variable) May 9		May 23		Morningglory Control (2-6 plants/plot) May 9		May 23		Melon Control (2-6 plants/plot) May 9		May 23	
		1X	2X	1X	2X	1X	2X	1X	2X	1X	2X	1X	2X
Control	—	0.5	-	0.3	-	0.0	-	0.0	-	0.0	-	0.0	-
Trifluralin	0.25	1.7	3.3	2.0	2.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
Trifluralin	1.00	4.0	8.0	4.7	7.7	0.0	1.7	1.3	1.3	0.0	0.0	0.0	0.0
Pendimethalin	0.25	9.0	10.0	8.0	9.3	3.3	0.0	2.7	0.0	3.3	1.7	0.0	1.3
Pendimethalin	1.00	10.0	10.0	9.8	10.0	6.7	4.3	4.3	5.7	4.0	3.7	2.0	5.0
Prometryn	1.00	10.0	10.0	9.7	10.0	9.3	10.0	8.3	10.0	4.7	6.7	0.3	3.3
Fluometuron	1.00	9.7	10.0	9.7	10.0	10.0	10.0	10.0	10.0	9.0	10.0	10.0	7.3
Cyanazine	1.00	10.0	10.0	9.7	9.7	10.0	10.0	10.0	10.0	1.0	4.3	0.0	3.3
V-53482	5.7g	9.3	10.0	9.7	10.0	10.0	10.0	6.7	10.0	3.3	4.3	0.7	0.7
V-53482	7.1g	10.0	10.0	9.5	9.8	7.7	7.3	1.0	5.0	4.3	2.7	1.3	0.7
Mon-13202	0.25	10.0	10.0	10.0	10.0	7.7	10.0	4.3	7.7	5.7	10.0	2.0	5.0
Mon-13202	0.70	10.0	10.0	10.0	10.0	7.3	10.0	7.3	10.0	10.0	10.0	6.7	9.3
Norflurazon	0.25	7.8	10.0	6.7	9.5	9.7	9.7	7.3	9.8	5.0	9.7	8.0	9.8
LSD (0.05)		2.1		1.8		4.2		4.5		5.5		4.9	

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

Vegetation control in chemical fallow with glyphosate and sulfosate. Dial, M. J. and D. C. Thill. Glyphosate and sulfosate were applied at two rates alone and with ammonium sulfate (AMS), R-11, or AMS + R-11 to evaluate control of downy brome (BROTE) in chemical fallow. Plots were located 3 miles south of Lewiston, Idaho. The herbicides were applied on March 22 to downy brome with 4 to 5 leaves. Four hours after the herbicides were applied, the field received 0.20 in. precipitation as rain and snow. The plots were 10 by 30 ft and treatments were arranged in a randomized complete block split plot design, with herbicide and rate combinations as main plots and the spray additives as subplots. The experiment was replicated four times. The experiment was evaluated visually for downy brome control on April 13.

Glyphosate was applied alone and in tank mixture with several herbicides to evaluate vegetation control in chemical fallow. The plots were located 12 miles south of Lewiston, Idaho. The herbicide treatments were applied on March 27 to volunteer winter wheat (TRIAX) with 4 tillers, downy brome with 3 to 5 leaves, and prickly lettuce (LACSE) was 5 in. in diameter. The plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. Herbicide efficacy was evaluated on April 13 and April 30.

Herbicide treatments in both experiments were applied with a CO_2 pressurized back pack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1).

Table 1. Application data

Application date	March 22	March 27
Air temperature (F)	60	45
Soil temperature at 2 in. (F)	60	45
Relative humidity (%)	50	65
Wind speed (mph) - direction	1-W	1-S
Soil pH	5.3	4.9
OM (%)	3.7	3.1
CEC (meq/100g soil)	19.8	20.2
Texture	silt loam	silt loam
Weed density (plants/ft2)		
volunteer winter wheat	-	10
downy brome	25	10
prickly lettuce	-	3

Glyphosate and sulfosate applied at either rate controlled downy brome equally (Table 2, 3). The precipitation immediately following application of the herbicides may have washed the herbicide off the foliage and reduced uptake, this likely caused lower percent control ratings than expected. Adding both R-11 and AMS to glyphosate or sulfosate improved downy brome control compared to the herbicides applied alone (Table 4).

All treatments except UBIC4243 + Moract controlled volunteer winter wheat, downy brome and prickly lettuce 90% or greater (Table 5). UBIC4243 plus UBI119738 controlled vegetation the same as glyphosate alone or in tank mixture. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Effect of herbicide on downy brome control

Herbicides	Formulation	Control[1] BROTE
		(% of check)
check		--
glyphosate	3.00 SC	41
sulfosate	6.00 SC	38
LSD (0.05)		ns

Table 3. Effect of herbicide rate on downy brome contol

Rate	Control[1] BROTE
(lb ae/a)	(% of check)
0.14	34
0.28	45
LSD (0.05)	ns

Table 4. Effect of spray additive on downy brome control

Additive	Rate	Control[1] BROTE
	(%v/v)	(% of check)
none		27
R-11[2]	0.5	40
AMS[2]	0.83	38
R-11 + AMS	0.5 + 0.83	54
LSD (0.05)		18

[1]Visual estimate of percent reduction in population density compared to the check.

[2]R-11 is a nonionic surfactant, rate is expressed as % v/v. AMS rate is 0.83 lb product per 10 gal spray solution.

Table 5. Volunteer winter wheat, downy brome, and prickly lettuce control in chemical fallow with glyphosate tank mixtures

			Control[2]					
Treatment[1]	Formulation	Rate	TRIAX		BROTE		LACSE	
		(lb ae/a)	Apr 13	Apr 30	Apr 13	Apr 30	Apr 13	Apr 30
check			--	--	--	--	--	--
glyphosate	3.00 SC	0.28	93	95	95	95	95	90
glyphosate + triasulfuron[3]	3.00 SC 75 DF	0.28 0.0179	93	95	91	94	93	94
glyphosate + triasulfuron	3.00 SC 75 DF	0.28 0.0268	94	96	95	95	95	95
glyphosate + DPXL5300[3]	3.00 SC 75 DF	0.28 0.0038	94	95	94	95	94	95
glyphosate + DPXL5300	3.00 SC 75 DF	0.28 0.0056	93	95	93	95	93	94
glyphosate + DPXL5300	3.00 SC 75 DF	0.28 0.0078	91	95	94	95	94	94
glyphosate + 2,4-D amine	3.00 SC 3.8 SC	0.28 0.25	91	95	93	95	93	94
glyphosate + UBIC4243[3]	3.00 SC 0.83 EC	0.28 0.125	93	93	94	95	93	94
sulfosate + UBIC4243	6.00 SC 0.83 EC	0.28 0.125	90	93	90	93	93	95
UBIC4243 + Moract	0.83 EC	0.125 0.25%	0	0	0	0	0	0
UBIC4243 + Moract	0.83 EC	0.188 0.25%	0	0	0	0	0	0
UBIC4243 + UBI119738[3] + Moract	0.83 EC 1.00 EC	0.188 0.125 0.25%	90	94	91	95	93	90
LSD (0.05)			6	3	3	2	2	6

[1] All treatments except the UBIC4243 + Moract or UBI119738 were applied with 0.5% v/v R-11, a nonionic surfactant.

[2]Visual estimate of percent reduction in population density compared to the check.

[3]Rate is lb ai/a.

Volunteer crop, downy brome, and broadleaf weed control with fall applied dicamba/atrazine in chemical fallow. Dial, M. J. and D. C. Thill. Three rates of dicamba/atrazine tank mixed with 0.28 lb ae/a glyphosate were applied to plots established in winter wheat stubble near Lewiston, Idaho on October 16, 1989. Glyphosate also was applied on the same date and on March 21, 1990 for comparison.

Growth stage of vegetation at the October 16, application date was; volunteer winter wheat (TRIAX) 4 to 5 leaves, downy brome (BROTE) 2 to 3 leaves, and prickly lettuce (LACSE) was 5 in. in diameter. Growth stage of vegetation at the March 21, application date was; volunteer winter wheat 4 tillers, downy brome 6 leaves, prickly lettuce pre-bolt, and purple mustard (COBTE) had 3 leaves.

Herbicide treatments were applied with a CO_2 pressurized back pack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). Plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times.

Volunteer winter wheat and broadleaf weed control were evaluated visually on March 21 and April 13. Downy brome control was evaluated visually on April 30. The chemical fallow portion of the experiment was terminated on April 30. The plot area was stubble-mulch fallowed during the summer. The plot area was seeded October 12, 1990 to observe the winter wheat crop for effects of dicamba/atrazine residual. The wheat will be harvested in August of 1991 to determine if grain yield is affected by chemical fallow herbicide treatment.

Table 1. Application data

Application date	October 16	March 21
Air temperature (F)	60	60
Soil temperature at 2 in. (F)	50	45
Relative humidity (%)	50	56
Wind speed (mph) - direction	1-W	1-W
Soil pH	5.3	
OM (%)	3.7	
CEC (meq/100g soil)	19.8	
Texture	silt loam	
Weed density (plants/ft^2)		
volunteer winter wheat	6	7
downy brome	15	15
prickly lettuce	8	8
purple mustard	-	10

All fall applied herbicide treatments controlled volunteer winter wheat 93% or greater at the March 21 evaluation date (Table 2). On the April 13 evaluation date, only glyphosate applied in the fall controlled volunteer winter wheat less than 90%.

Dicamba/atrazine applied at 0.6, 0.8, and 1.2 lb ai/a + glyphosate and glyphosate applied in the spring controlled downy brome 81% or greater. Control of purple mustard and prickly lettuce was 0% with the fall applied herbicide treatments. Glyphosate applied on March 21, controlled purple mustard and prickly lettuce 93%. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Vegetation control with fall applied dicamba/atrazine tank mixed with glyphosate in chemical fallow

Treatment	Formulation	Rate	Appl. date	Control[2] TRIAX Mar 21	TRIAX Apr 13	BROTE Apr 30
		lb ai/a		% of check		
dicamba/atrazine +	3.2 FL	0.4	Oct 16	93	90	68
glyphosate +	3.0 SC	0.28[1]				
R-11[3]		0.5%				
dicamba/atrazine +		0.6	Oct 16	95	90	90
glyphosate +		0.28[1]				
R-11		0.5%				
dicamba/atrazine +		0.8	Oct 16	93	91	90
glyphosate +		0.28[1]				
R-11		0.5%				
dicamba/atrazine +		1.2	Oct 16	95	93	94
glyphosate +		0.28[1]				
R-11		0.5%				
glyphosate +		0.28[1]	Oct 16	95	68	50
R-11		0.5%				
glyphosate +		0.28[1]	Mar 21	--	91	81
R-11		0.5%				
LSD (0.05)				ns	28	23

[1]Glyphosate rate is based on acid equivalent.

[2]Visual estimate of percent reduction in population density compared to the check.

[3]R-11 is a nonionic surfactant, rate is expressed as % v/v.

Adjuvants affect vegetation control with glyphosate and glufosinate. Thill, D.C., M.J. Dial, and J.M. Lish. Some adjuvants enhance vegetation control with glyphosate. Glufosinate is a recently developed nonselective herbicide used in fallow and other areas where total vegetation control is desired. Vegetation control with glyphosate and glufosinate plus adjuvants, and efficacy of glufosinate formulations were tested in three experiments at the University of Idaho Plant Science Farm east of Moscow, Idaho. Plots were 10 by 30 ft and the experimental design was a randomized complete block with four replications. Treatments were applied with a CO_2 pressurized backpack sprayer at 42 psi (Table 1). Soil type, pH, organic matter, and cation exchange capacity were silt loam, 5.0, 2.5%, and 34 meq/100 g soil, respectively. Treatments in the glufosinate experiments were evaluated visually for reduction of plant growth June 15, June 21, and July 11. The glyphosate treatments were evaluated June 19 and June 25.

Table 1. Application data

	Glyphosate-adjuvant	Glufosinate formulation	Glufosinate-adjuvant
Date of application	June 5	June 5	June 13
Spray volume (gal/a)	10	10	25
Air temp. (F)	70	70	65
Soil temp. @ 2 in. (F)	65	65	67
Relative humidity (%)	52	52	50
Wind speed (mph)	3 - east	4 - east	1 - west
Growth stage			
spring barley	6 leaf	6 leaf	4 tiller
wild buckwheat	4 leaf	4 leaf	8 in. tall
mayweed chamomile	3 in. diameter	3 in. diameter	4 in. tall
common lambsquarters	5 leaf	5 leaf	none
winter rape	none	none	4 in. tall
Canada thistle	none	none	3 in. tall

Total vegetation control was higher with all combinations of glyphosate at 0.28 lb ae/a than glyphosate at 0.14 lb ae/a except glyphosate (0.14 lb ae/a) + AMS (ammonium sulfate) at 14 DAT (days after treatment) (Table 2). Control continued to improve up to 20 DAT, at which time control of individual species was evaluated. Barley (HORVU) control was at least 93% with glyphosate at 0.28 lb ae/a except in combination with Cayuse + R-11 (85% control). Barley control with glyphosate at 0.14 lb ae/a + Cayuse was low (80%) compared to treatments with higher glyphosate rates, but glyphosate at 0.14 lb ae/a + AMS controlled barley (88%) as well as glyphosate at 0.28 lb ae/a. Mayweed chamomile (ANTCO) and common lambsquarters (CHEAL) were controlled with all treatments. Wild buckwheat (POLCO) control was highly variable between treatments with control ranging 83 to 95%.

Barley control with glufosinate was not improved with the adjuvants tested (Table 3). Barley control with glufosinate plus all adjuvants except Genopol was lower than glufosinate alone on July 11. Barley control with glufosinate + Agridex or glufosinate + Penetrator was lower than glufosinate alone on all evaluation dates. The 1 lb ai/gal glufosinate formulation tended to control barley better than the 1.25 lb ai/gal formulation.

Glufosinate-05 and glufosinate-06 + Genopol, controlled barley better than other formulations on June 21; however, control was better only with 0.56 lb ai/a or higher (Table 4). Glufosinate-05 at 0.56 lb ai/a controlled barley better than other formulations at higher rates except glufosinate-06 + Genopol (0.75 lb ai/a + 1.0%). Barley control with all formulations increased proportionately with rate increase. Only glufosinate-06 + Genopol (0.75 lb ai/a + 1.0%) controlled barley 90% by June 25, and barley control was not adequate with any treatment on July 11. (Idaho Agricultural Experiment Station, Moscow, Idaho)

Table 2. Effect of adjuvant with glyphosate for vegetation control

Treatment	Rate	14 DAT Total vegetation	20 DAT HORVU	ANTCO	POLCO	CHEAL
	lb ae/a	%				
glyphosate	0.28	89	93	95	91	95
glyphosate	0.14	74	86	95	85	95
AMS +	0.85					
glyphosate	0.28	90	95	95	88	95
AMS +	0.85					
glyphosate	0.14	80	88	95	83	95
Cayuse +	0.75[1]					
glyphosate	0.28	94	94	95	91	95
Cayuse +	0.75[1]					
glyphosate	0.14	60	80	94	89	95
AMS +	0.85					
glyphosate +	0.28					
R-11	0.50[1]	97	95	95	95	95
AMS +	0.85					
glyphosate +	0.14					
R-11	0.50[1]	80	95	95	88	95
Cayuse +	0.75[1]					
glyphosate +	0.28					
R-11	0.50[1]	86	85	95	94	95
$LSD_{0.05}$		*12*	*9*	*1*	*12*	*ns*

[1]Rate is expressed as % v/v.

Table 3. Effect of glufosinate plus adjuvants on barley growth

Treatment	Formulation	Rate	Barley growth June 21	June 25	July 11
	lb ai/gal	lb ai/a	%		
glufosinate	1.00 EC	0.63	85	89	83
glufosinate + Genopol	1.00 EC	0.63 0.125[1]	86	84	79
glufosinate + Ally-700	1.00 EC	0.63 0.125[1]	75	74	63
glufosinate + X-77	1.00 EC	0.63 0.125[1]	75	70	61
glufosinate + Agridex	1.00 EC	0.63 0.125[1]	70	61	53
glufosinate + Penetrator	1.00 EC	0.63 0.125[1]	71	60	58
glufosinate	1.25 EC	0.47	80	69	64
glufosinate	1.25 EC	0.63	78	70	72
$LSD_{0.05}$			*11*	*18*	*20*

[1]Rate is expressed as % v/v.

Table 4. Glufosinate formulations effect on spring barley growth

Treatment	Formulation	Rate	Barley growth June 21	June 25	July 11
	lb ai/gal	lb ai/a	%		
glufosinate-06 + Genopol	5.00	0.50 1.00[1]	76	30	33
glufosinate-01	1.67	0.50	76	40	33
glufosinate-05	1.25	0.375	75	49	31
glufosinate-02	1.00	0.50	76	46	29
glufosinate-06 + Genopol	5.00	0.63 1.00[1]	90	79	45
glufosinate-01	1.67	0.63	81	70	45
glufosinate-05	1.25	0.473	79	69	36
glufosinate-02	1.00	0.63	79	73	58
glufosinate-06 + Genopol	5.00	0.75 1.00[1]	95	90	34
glufosinate-01	1.67	0.75	85	88	66
glufosinate-05	1.25	0.56	93	88	54
glufosinate-02	1.00	0.75	86	69	26
$LSD_{0.05}$			*1*	*30*	*30*

[1]Rate is expressed as % v/v.

Weed control in chemical fallow with SC-0224 and glyphosate. Downard, R.W. and D.W. Morishita. Research was conducted to evaluate six herbicide treatments in chemical fallow for broadleaf and grass weed control.

Treatments were arranged in a randomized complete block design with four replications. Plot size was 7.3 ft by 25 ft. Herbicide treatments were applied with a handheld sprayer at 38 psi pressure and 10 gpa, with water as the carrier. The sprayer was equipped with 11001 flat fan nozzles. Additional application data is shown in Table 1. Weed control was evaluated visually on August 27 and September 10, 1990.

Glyphosate containing 2,4-D or dicamba controlled all weed species 86% or better on both evaluation dates (Table 2). All SC-0224 treatments controlled redroot pigweed (AMARE) and wild oat (AVEFA) 88% or better on August 27. By September 10, only SC-0224 plus 2,4-D controlled wild oat better than 90%. Overall, glyphosate and SC-0224 with or without 2,4-D or dicamba controlled redroot pigweed and wild oat about equally. SC-0224 with or without 2,4-D or dicamba did not control barnyardgrass (ECHCG) as well as glyphosate. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, ID 83301)

Table 1. Application data for weed control treatments

Date Applied	8/6/90
Air Temperature(F)	72
Soil Temperature (F)	64
Relative Humidity (%)	50
Wind Direction	East
Wind Velocity (mph)	4

Table 2. Weed control in chemical fallow near Kimberly, Idaho.

		Weed Control[a]					
		AMARE		ECHCG		AVEFA	
Treatment[b]	Rate	1[c]	2[d]	1	2	1	2
	(lbs ai/A)	(%)					
Check		-	-	-	-	-	-
SC-0224	.375	94	91	70	70	89	81
SC-0224 + 2,4-D amine	.375 + .25	94	96	83	79	95	83
SC-0224 + 2,4-D LVE	.375 + .25	94	95	81	81	95	91
SC-0224 + dicamba	.375 + .125	88	93	75	70	91	79
Glyphosate	.688	95	95	88	79	95	81
Glyphosate & 2,4-D	.688	100	99	96	97	99	99
Glyphosate & Dicamba	.525	96	97	89	89	98	86
LSD (0.05)		4	4	12	13	5	8

[a]Weed species evaluated were redroot pigweed (AMARE), barnyardgrass (ECHCG), and wild oat (AVEFA).

[b]All herbicide treatments applied with 0.5% v/v nonionic surfactant.

[c]First weed control evaluation taken August 27, 1990.

[d]Second weed control evaluation taken September 10, 1990.

Field bindweed control in fallow wheat stubble with various herbicide combinations. Westra, P. Three field studies were initiated in 1988 to assess the long term control of field bindweed with 20 combinations of herbicides commonly used on field bindweed in Colorado. Products tested included picloram, dicamba, 2,4-D, Landmaster BW, and Fallowmaster. Visual control (0= no control; 100= total control) ratings were taken 6 to 8 weeks after treatment, 1 year after treatment, and 2 years after treatment. While many herbicide combinations provided good field bindweed burndown, those mixtures which included picloram at a minimum rate of 0.06 lb ai/a provided best long term control. Mixing Landmaster, 2,4-D, or dicamba with picloram enhanced long term field bindweed control, especially when measured 2 years after application without further control measures. Field bindweed control tended to drop 15 to 20% between the first and second year following application. An analysis of the response surface showing the interaction of picloram rates with Landmaster rates showed that while the majority of the control was provided by the picloram component of such mixes, Landmaster provided a measurable and important addition to the control provided by picloram alone. Other problem weeds encountered during field bindweed control operations may dictate which herbicide mixture is most effective for fallow wheat stubble weed control. Control of 65 to 90% was provided two years after application by picloram at 0.25 lb ai/a plus either 2,4-D at 0.5 to 1 lb ai/a or dicamba at 0.5 lb ai/a. Landmaster BW at the labeled rate plus 0.125 lb ai/a of picloram provided 50% control 2 years after application (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Evaluation of selected herbicides for use in lentils. Miller, T.W. and R.H. Callihan. The purpose of this experiment was to determine the effectiveness of several herbicides for use in lentils. The primary weeds of concern were mayweed chamomile (*Anthemis cotula* L.) and wild oat (*Avena fatua* L.).

Plots were established on farmer-prepared and seeded fields at 2 sites in north central Idaho. Plots measured 10 x 30 feet, and treatments were arranged in a randomized complete block design and replicated 4 times at each location. All pre-emergent (pre) and post-plant incorporated (popi) treatments were applied the same day at each site, with the popi treatments hand-raked into the top 2 inches of the seedbed. All post-emergent (post) applications for a site were made on the same day, after plants were at least at the 4-node stage of growth. Treatments were applied in a carrier volume of 19 gal water/a using a 9-foot boom plot sprayer equipped with flat fan nozzles. Weed control percentage was based on weed density (100% = no weeds), and was estimated to the nearest 5% after mayweed flowering. Statistical analysis was performed using analysis of variance procedure. Means were separated using Fisher's LSD test.

Two sites were established; a broad-leaf weed study at Troy and a post-emergence herbicide study for wild oat control at Potlatch. The Troy study was located in an extremely wet drainage. As a result, crop injury could not be evaluated in 2 replicates. Although some visual estimates of crop injury were made from the lentils in the 1st and 4th replicates, 1990 lentil injury estimates are not considered definitive.

The top mayweed treatment was UBI-C4243 (97%), but crop injury was excessive (approaching 100%), so further testing of this compound in lentils may not be productive. Metribuzin (either pre or pre + post) was extremely effective on mayweed (93 and 96%, respectively). The post-emergent metribuzin application may prove helpful in filling gaps in wild oat control (31%), but its mayweed control was virtually nonexistent. No evidence of crop injury from metribuzin was evident. The imazethapyr + metribuzin treatment provided 85% control of mayweed, but other imazethapyr tank mixes were not as effective. Post-emergent imazethapyr controlled 41% of wild oat in plots at Potlatch, but also delayed maturity of the lentils. Whether this was a result of early crop damage followed by recovery, a delay in flowering, or a prolonging of flowering was not clear. The metolachlor + metribuzin treatment in lentils provided 86% control of mayweed with no apparent crop injury. Bentazon at both rates caused unacceptable injury to lentils, even though temperatures were too cool for adequate control of mayweed. Excellent post-emergent wild oat control was provided by sethoxydim, UBI-C4874, quizalofop, and diclofop. (University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Mayweed chamomile and wild oat control in lentils at two locations[1] in northern Idaho (1990).

Herbicide[2]	Rate	Timing[3]	Mayweed	Wild Oat
	(ai or ae/a)		(% control)	
UBI-C4243	0.06 lb	pre	97	-
Metribuzin +	0.25 lb +	pre		
Metribuzin	0.2 lb	post	96	-
Metribuzin	0.25 lb	pre	93	-
Metolachlor +	1.64 lbs +			
Metribuzin	0.36 lb	pre	86	-
Imazethapyr +	0.042 lb +			
Metribuzin	0.2 lb	pre	85	-
SAN 582 H	1.25 lbs	pre	75	-
Trifluralin +	0.375 lb +			
Metribuzin	0.2 lb	popi	43	-
Imazethapyr +	0.042 lb +			
Pendimethalin	0.5 lb	popi	29	-
Imazethapyr +	0.042 lb +			
Ethalfluralin	0.38	popi	25	-
Pendimethalin	0.75 lb	popi	23	-
Bentazon	0.5 lb	post	24	-
Imazethapyr	0.031 lb	post	10	41
Imazethapyr	0.042 lb	pre	8	-
Bentazon	0.25 pt	post	9	-
Metribuzin	0.2 lb	post	3	31
Sethoxydim[4]	0.28 lb	post	-	100
Quizalofop[4]	0.044 lb	post	-	98
UBI-C4874[4]	0.09 lb	post	-	99
Diclofop	0.75 lbs	post	-	90
lsd (0.05)			25	27
c.v.			40	28

[1]Troy plots evaluated for mayweed control; Potlatch plots evaluated for wild oat control.
[2]Pre-plant incorporated applications of 1.3 lbs triallate per acre were used at all mayweed plots; wild oat plots were treated with 1.25 lbs triallate per acre.
[3]Popi = post-plant incorporated, pre = pre-emergent, post = post-emergent.
[4]Sethoxydim, UBI-C4874, and quizalofop treatments were mixed with 2, 1.5 and 1.5 pt/a crop oil, respectively.

Evaluation of herbicides for winter weed control in grain lupine at UC Davis. Mitich, L.W., J.A. Roncoroni, and T.E. Kearney. Five herbicides in 8 treatments were evaluated for crop tolerance and weed control in 'Minnesota Ultra' grain lupine. Treatments included linuron and sethoxydim, which are not registered in lupine, and imazethapyr, which is not cleared for any crop in California.

Lupine was planted 2 November 1989 in Yolo clay loam soil at the UC Davis Farm. Preemergence treatments were applied 6 November and sprinkler incorporated 9 November. A single postemergence treatment (sethoxydim) was applied 29 January 1990, when lupine was 3 to 5 inches and annual bluegrass was 1 to 2 inches. All treatments were applied with a CO_2 backpack sprayer delivering 20 gal/a. Plots were 10 ft by 56 ft, arranged in randomized complete blocks in 4 replications.

Treatments were visually rated 20 March. Metolachlor + linuron produced the least crop injury (2.5%), though no treatment appeared to endanger the crop. Treatments with metolachlor produced best control of annual bluegrass (POAAN). Linuron and metolachlor both produced acceptable control of shepherdspurse (CAPBP). Imazethapyr produced best control of common chickweed (STEME). Metolachlor + linuron and sethoxydim both controlled volunteer wheat.

Plots treated with metolachlor + linuron produced highest yields, though these did not differ significantly from the next 4 highest-producing treatments. Control plots and plots treated with sethoxydim produced lowest yields. (Department of Botany, University of California, Davis, CA 95616)

Grain lupine herbicide trial, UC Davis, 1990

Herbicide	Rate (lb ai/a)	Visual evaluation 20 March 1990[1,2] crop vigor (percent)	percent weed control POAAN	CAPBP	STEME	wheat	Yield[1] (g/308 sq ft)
linuron	1.0	93 B	65 A	88 AB	38 CD	25 B	6629 BCD
linuron	2.0	93 B	70 A	98 A	58 BC	25 B	7057 ABC
imazethapyr	0.063	93 B	68 A	70 BC	85 AB	25 B	6272 CD
imazethapyr	0.094	90 B	78 A	85 AB	100 A	25 B	6905 ABC
pendimethalin + metolachlor	1.0 + 2.0	93 B	95 A	85 AB	60 BC	25 B	7133 ABC
metolachlor + linuron	2.0 + 1.0	98 A	95 A	90 AB	35 CD	75 A	7629 A
pendimethalin + linuron	1.0 + 1.0	93 B	63 A	60 C	43 CD	25 B	7252 AB
sethoxydim	0.5	93 B	28 B	8 D	15 DE	100 A	5950 D
control	---	93 B	15 B	0 D	0 E	25 B	5716 D

[1]All values are mean of 4 replications. Values followed by the same letter are not different at the 5% level of significance.

[2]100 = perfectly healthy crop, complete weed control.

WINTER WEED CONTROL IN GRAIN LUPINE. L. W. Mitich, T. E. Kearney, J. A. Roncoroni, and G. B. Kyser, Weed Scientist, Farm Advisor, Staff Research Associate, and Research Assistant, Department of Botany, University of California, Davis, CA 95616.

Abstract. Grain lupine, a cool-season legume crop, provides an alternative to small grains and sugarbeets in California's Central Valley. Lupine seed, green chop, and silage are used as livestock feed; seed is used in poultry feed with minimal processing. In California, lupine is planted in fall and grows slowly during the cool season. Winter weeds can outgrow lupine during this critical period, reducing seed yields 25% to 80%.

Preemergence herbicide treatments provide most effective weed control and best crop safety when applied postplant preemergence and incorporated by sprinklers or rainfall. The most successful herbicide treatments include linuron (2 lb/a), metolachlor + linuron (2 + 1 lb/a or 1 + 2 lb/a), pendimethalin + linuron (1 + 1 lb/a), and imazethapyr (0.094 lb/a). Linuron is the most effective herbicide for controlling the spectrum of winter broadleaf weeds found in grain lupine, particularly mustards. Pendimethalin and metolachlor provide some control of annual bluegrass, a common winter grass problem. Imazethapyr shows potential for controlling several problem species, though it has been tested at Davis only during the past 2 yr.

Most postemergence treatments injure grain lupine, except for some grass herbicides (sethoxydim, fluazifop, and cloproxydim), which are useful for controlling grasses such as volunteer cereals. However, these do not control annual bluegrass.

Lupine weed control research at UC Davis has contributed to the registration of pendimethalin and metolachlor, separately and in combination, for grain lupine. These herbicides are the only treatments registered for weed control in lupine; they control many winter weeds but fail to control mustards and most winter grasses adequately. Registration of linuron, alone or with these herbicides, would be an important step toward making grain lupine economically feasible. Registration of a postemergence grass herbicide would be a useful adjunct.

Morphological and reproductive characteristics of fifteen wild proso millet (Panicum miliaceum) accessions from the United States and Canada. Westra, P., and W. Stump. Wild proso millet is a rapidly spreading weed that has become a major problem in row crop production. In order to evaluate and compare characteristics of the numerous North American weedy biotypes reported in the literature, fifteen seed accessions were obtained from researchers across the United States and Canada. This research was conducted at the C. S. U. Bay Farm in Fort Collins, Colorado.

Each accession was grown out in a separate 5 by 10 foot block, which was prepared by covering tilled ground with a piece of landscape fabric (also known as Weed-Mat). Six inch holes were cut in the fabric with one foot equidistant spacing between holes. Each accession was replanted with seed produced in the previous years study. In addition to the 15 weedy biotypes, three domestic proso millet varieties were also planted. Approximately twenty seeds were planted one-half inch deep in each hole. After emergence seedlings were thinned to five plants per hole. Throughout the summer, observations and measurements were taken on plant height, heading dates, and general growth characteristics. After maturity, plants were harvested by cutting two inches above ground level, and retained seed was threshed by shaking panicles in a bucket. Whole-block dry weights were taken. Shattered seed was collected by vacuuming the landscape fabric in each block, and this was combined with threshed seed to obtain whole-block seed weights. Seeds were then subjected to germination tests to determine any differences in dormancy status between accessions. The 3 domestic varieties had greater seed yields, were taller, and produced more dry weight than the wild accessions. Differences were noted between all accessions on date of heading. The freshly harvested seed from the Colorado accessions exhibited the greatest levels of dormancy at 50% vs 10% on all other accessions. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Characteristics of North American wild proso millet accessions at maturity grown in Fort Collins, Colorado

Place of origin and accession	Plant Height (in)	% heading 7-19-90	Seed grams/ plot	Dry weight/ plot	% Dormancy
Minnesota					
Cambridge type	32	8	645	3040	7
Crown type	33	100	775	2670	4
LeSeur type	32	10	750	3005	8
Canada					
Rosemount	30	48	837	2918	8
Huron	28	30	795	2340	7
Michigan Kent County	31	0	747	3299	10
Wisconsin	36	50	717	3573	9
Oregon					
Stayton	35	70	807	4360	6
Grnd. Island	29	83	750	2668	8
Nebraska					
U.N.L. Center	28	0	822	3763	16
Western	30	0	817	3588	7
Wyoming	35	10	835	4010	43
Colorado					
Black type	37	78	880	4655	56
Olive type	28	5	870	3720	41
Tan type	28	0	975	3255	20
Domestic					
Cope	45	100	1390	3340	2
Rise	47	25	1958	4352	2
Dawn	43	100	1567	3591	5

<u>Broadleaf weed control in dry peas and lentils.</u> Boerboom, C.M. Six herbicides were compared for efficacy of broadleaf weed control in dry peas and lentils. Experiments were conducted near Spangle and Farmington, WA respectively.

Each experiment was designed as a randomized complete block with 10 by 30 ft plots and four replications. Pre-plant incorporated (PPI) treatments were applied to the pea experiment on April 6, 1990 and incorporated with a cultivator and harrow. PPI treatments were applied to the lentil experiment on April 11, 1990 and incorporated with a rodweeder and harrow. 'Columbia' peas and 'Brewer' lentils were seeded on April 9 and 17, respectively. Preemergence (PRE) treatments were applied on April 11 and 18 for peas and lentils, respectively. Metribuzin was applied postemergence (POST) to both crops on May 5. All applications were made at 9.4 gal/a at 30 psi.

Common lambsquarters (CHEAL), field pennycress (THLAR), and lentil stands were counted on June 21, 1990. A visual control rating was made in peas and lentils on July 13 and 28, respectively, for mayweed chamomile (ANTCO) and common lambsquarters; weeds which often cause harvest problems. Only the lentil experiment was harvested for yield.

Of the currently registered herbicides, metribuzin plus imazethapyr provided the most effective and consistent control. Metribuzin by itself was less effective on the heavier weed infestation present in the peas than in the lentils. UBI-C4243 provided good control at higher application rates. At these rates, injury occurred to emerging lentils which reduced stands and yields. Pea stands were not visually affected by UBI-C4243. Cyanazine gave good control at the 2 and 3 lb ai/a rates and did not visually injure peas or lentils. (Department of Agronomy and Soil, Washington State Univ., Pullman, WA 99164)

Table 1. Application data

	Peas		
Application date	April 6	April 11	May 17
Air temperature (F)	74	54	63
Soil temp. at 2 in. (F)	59	52	67
Relative humidity (%)	79	88	55
Wind (mph)/direction	5/NW	5/S	5/SW
Delivery rate (gal/a)	9.4	9.4	9.4
	Lentils		
Application date	April 6	April 18	May 17
Air temperature (F)	57	50	55
Soil temp. at 2 in. (F)	52	60	65
Relative humidity (%)	80	80	60
Wind (mph)/direction	3/S	0	2/NW
Delivery rate (gal/a)	9.4	9.4	9.4

Table 2. Broadleaf weed control in peas and lentils

Treatment[1]	Rate	Time of appl.	Stand counts[2] Peas CHEAL	Stand counts[2] Peas THLAR	Stand counts[2] Lentils CHEAL	Stand counts[2] Lentils THLAR	Stand counts[2] Lentils Lentil	Control[3] Peas ANTCO	Control[3] Peas CHEAL	Control[3] Lentils ANTCO	Control[3] Lentils CHEAL	Lentil yield
	(lb ai/a)		(no./m^2)					(% of check)				(lb/a)
check			42	46	23	5	108	0	0	0	0	1746
metribuzin	0.25	PRE	2	10	0	0	114	50	84	93	98	1788
metribuzin	0.38	PRE	1	6	0	0	108	75	94	87	98	1653
metribuzin + metribuzin	0.25 0.19	PRE POST	0	2	-	-	-	90	100	-	-	-
metribuzin	0.19	POST	-	-	0	0	114	-	-	100	100	1628
UBI-C4243	0.031	PRE	11	40	3	1	102	50	66	70	85	1520
UBI-C4243	0.063	PRE	7	14	0	0	72	83	85	100	98	1433
UBI-C4243	0.094	PRE	7	12	0	0	66	93	85	99	100	1278
imazethapyr	0.047	PPI	6	6	11	2	120	55	99	20	97	1671
imazethapyr	0.047	PRE	4	5	4	0	114	55	87	8	86	1714
metribuzin + imazethapyr	0.25 0.047	PRE PRE	1	2	0	0	114	94	99	96	97	1795
pendimethalin	0.50	PPI	18	46	40	12	102	5	48	0	18	1765
pendimethalin	0.50	PRE	10	33	19	11	108	13	97	5	49	1786
pendimethalin + imazethapyr	0.50 0.047	PRE PRE	1	7	1	0	108	58	100	50	100	1689
metolachlor + metribuzin[4]	1.23 0.27	PPI PPI	8	15	32	4	102	63	58	8	13	1635
metolachlor + metribuzin	1.23 0.27	PRE PRE	13	10	2	1	108	38	48	100	97	1790
cyanazine	1.00	PRE	7	17	3	1	108	55	55	100	85	1831
cyanazine	2.00	PRE	4	8	1	0	102	93	96	100	99	1776
cyanazine	3.00	PRE	0	2	2	1	108	100	98	100	99	1758
LSD (0.05)			11	11	11	5	21	46	29	22	16	181

[1] All treatments include a pre-plant incorporation of triallate at 1.25 lb ai/a.
[2] Mid-season stand counts made on June 6 1990.
[3] Late-season visual control ratings made in peas and lentils on July 13 and 28 1990, respectively.
[4] Formulated as the commercial product Turbo.

Evaluation of selected herbicides for use in dry peas. Miller, T.W., B.B. Barstow, and R.H. Callihan. The purpose of this experiment was to determine the effectiveness of several herbicides for use in dry peas as alternatives to the herbicide dinoseb. The primary weeds of concern were mayweed chamomile (*Anthemis cotula* L.) and common lambsquarters (*Chenopodium album* L.), both late-season competitors.

Plots were established on farmer-prepared and seeded fields at 3 locations in north central Idaho. Plots measured 10 x 30 feet, and treatments were arranged in a randomized complete block design and replicated 4 times at each location. Pre-emergent (pre) and post-plant incorporated (popi) treatments were applied the same day at each site, with the popi treatments hand-raked into the top 2 inches of the seedbed. All post-emergent (post) applications for a site were made on the same day, after plants were at least at the 4-node stage of growth. Treatments were made in a carrier volume of 19 gal water/a using a 9-foot boom plot sprayer equipped with flat fan nozzles. Weed control percentage was based on weed density (100% = no weeds), and was estimated to the nearest 5% after mayweed flowering. Plots at one location were harvested at maturity and the seed was cleaned and weighed (data not shown). Statistical analysis was performed using analysis of variance procedure. Means were separated using Fisher's LSD test.

Plots were at Culdesac, Craigmont, and Moscow, Idaho. Twenty-nine treatments were scheduled for evaluation at each site. The Culdesac site did not receive post-emergent treatments due to wet weather from the 4-node stage until flowering. Results are listed in Table 1 (mayweed) and Table 2 (lambsquarters).

The top treatments were the cyanazine treatments, both of which controlled 100% of the mayweed and 99 and 91% of the lambsquarters, respectively. These treatments appeared to cause some pea injury, however. Bentazon at 0.75 lb provided 98% control of mayweed, but lower rates were not as effective. The biggest drawback to bentazon was the poor control of lambsquarters at all tested rates. In order to increase lambsquarters control, tank mixes with MCPB and MCPA were also tested this year. Bentazon + MCPB (0.5 lb + 0.5 lb) was an excellent combination (97% mayweed, 96% lambsquarters). By comparison, bentazon + MCPB (0.25 lb + 1 lb) had lower mayweed control (85%) but slightly increased lambsquarter control (99%). The MCPB tank mixes were more effective in controlling lambsquarters than were the bentazon + MCPA treatments, although these treatments performed well on mayweed.

UBI-C4243 gave excellent mayweed and lambsquarters control (93% and 97%, respectively), but apparently caused pea injury, particularly in the wetter plots. At the one rate studied, SAN 582 H controlled 82% of the mayweed, but only 5% of the lambsquarters. Additional study of UBI-C4243 at slightly lower rates and SAN 582 H at higher rates is warranted based on these results.

Other treatments providing excellent control of lambsquarters were pendimethalin alone, imazethapyr + pendimethalin, imazethapyr + ethalfluralin, metribuzin + MCPA, metribuzin + MCPB, bentazon + metribuzin, and metribuzin alone (applied post or post + pre). These treatments ranged from poor to good in their control of mayweed. (University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Table 1. Mayweed chamomile control in dry peas at three sites in northern Idaho (1990).

Herbicide[1]	Rate	Timing	--Location[2]- Cu	Cr	Mo	Avg
	(ai or ae/a)		---(% control)----			
Cyanazine	2.7 lbs	pre	100	100	100	100
Cyanazine	1.8 lbs	pre	100	100	100	100
Bentazon	0.75 lb	post	-	97	99	98
Bentazon + MCPB	0.5 lb + 0.5 lb	post	-	95	98	97
Bentazon + MCPA	0.5 lb + 0.25 lb	post	-	95	98	97
Bentazon + Metribuzin	0.5 lb + 0.2 lb	post	-	90	95	93
UBI-C4243	0.06 lbs	pre	93	94	91	93
Bentazon + MCPA	0.25 lb + 0.38 lb	post	-	88	92	90
Bentazon + Quizalofop[3]	0.5 lb + 0.044 lb	post	-	90	89	90
Bentazon + Sethoxydim[3]	0.5 lb + 0.28 lb	post	-	84	95	90
Bentazon	0.25 lb	post	-	83	89	86
Metolachlor + Metribuzin	1.64 lbs + 0.36 lbs	pre	95	84	78	86
Bentazon + MCPB	0.25 lb + 1 lb	post	-	74	96	85
Bentazon	0.5 lb	post	-	98	68	83
SAN 582 H	1.25 lbs	pre	85	86	74	82
Metribuzin + Metribuzin	0.25 lb + 0.2 lb	pre post	-	74	87	81
Metribuzin	0.25 lb	pre	86	78	73	79
Imazethapyr + Metribuzin	0.047 lb + 0.2 lb	pre	90	38	65	64
Imazethapyr + Pendimethalin	0.047 lb + 1 lb	popi	78	44	44	55
Pendimethalin + Metribuzin	1 lb + 0.2 lb	popi	50	-	58	54
Ethalfluralin + Metribuzin	0.56 lb + 0.2 lb	popi	81	25	-	53
Imazethapyr + Ethalfluralin	0.047 lb + 0.56 lb	popi	72	31	-	52
Trifluralin + Metribuzin	0.375 lb + 0.2 lb	popi	-	44	55	50
Imazethapyr	0.047 lb	pre	63	16	49	43
Imazethapyr + Trifluralin	0.047 lb + 0.375 lb	popi	-	-	36	36
Imazethapyr	0.031 lb	post	-	33	30	32
Metribuzin + MCPA	0.2 lb + 0.25 lb	post	-	16	44	30
Pendimethalin	0.5 lb	popi	50	13	16	26
Pendimethalin	1 lb	popi	39	5	34	26
Metribuzin	0.2 lb	post	-	4	25	15
Metribuzin + MCPB	0.2 lb + 1 lb	post	-	0	1	1
lsd (0.05)			26	17	29	-
c.v.			51	22	33	

[1]PPI applications: 1 lb triallate/a were used at all plots, Culdesac plots also received 0.375 lb/a trifluralin, Moscow plots also received 0.375 lb/a ethalfluralin.

[2]Cu = Culdesac, Cr = Craigmont, Mo = Moscow.

[3]Sethoxydim and quizalofop treatments were mixed with 2 and 1.5 pt/a crop oil, respectively.

Table 2. Common lambsquarters control and yield of dry peas at Craigmont, Idaho (1990).

Herbicide[1]	Rate	Timing[2]	Control
	(ai or ae/a)		(%)
Imazethapyr + Pendimethalin	0.042 lb + 1 lb	popi	100
Pendimethalin	0.5 lb	popi	100
Imazethapyr + Ethalfluralin	0.042 lb + 0.56 lb	popi	100
Metribuzin + MCPA	0.2 lb + 0.25 lb	post	100
Metribuzin + MCPB	0.2 lb + 0.5 lb	post	100
Bentazon + MCPB	0.25 lb + 1 lb	post	99
Cyanazine	2.7 lbs	pre	99
UBI-C4243	0.06 lb	pre	97
Bentazon + Metribuzin	0.5 lb + 0.2 lb	post	97
Metribuzin +	0.25 lb +	pre	
Metribuzin	0.2 lb	post	97
Bentazon + MCPB	0.5 lb + 0.5 lb	post	96
Metribuzin	0.2 lb	post	94
Cyanazine	1.8 lbs	pre	91
Bentazon + MCPA	0.25 lb + 0.375 lb	post	73
Imazethapyr	0.042 lb	pre	73
Pendimethalin	1 lb	popi	72
Imazethapyr + Metribuzin	0.042 lb + 0.2 lb	pre	68
Metribuzin	0.25 lb	pre	65
Metholachlor + Metribuzin	1.64 lb + 0.36 lb	pre	58
Bentazon + Sethoxydim[3]	0.5 lb + 0.28 lb	post	54
Bentazon + Quizalofop[3]	0.5 lb + 0.044 lb	post	53
Bentazon + MCPA	0.5 lb + 0.25 lb	post	51
Bentazon	0.5 lb	post	37
Bentazon	0.75 lb	post	23
Ethalfluralin + Metribuzin	0.56 lb + 0.2 lb	popi	23
Trifluralin + Metribuzin	0.375 lb + 0.2 lb	popi	23
Bentazon	0.25 lb	post	8
SAN 582 H	1.25 lbs	pre	5
Imazethapyr	0.031 lb	post	0
lsd (0.05)			31
C.V.			36

[1] Pre-plant incorporated applications of 1 lb triallate per acre were used at all plots.
[2] Popi = post-plant incorporated, pre = pre-emergent, post = post-emergent.
[3] Sethoxydim and quizalofop treatments were mixed with 2 and 1.5 pt/a crop oil, respectively.

Annual grass and broadleaf weed control evaluations in field potatoes. Arnold, R.N., E.J. Gregory and D. Smeal. Research plots were established on April 17, 1990 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of Centennial potatoes and annual grass and broadleaf weeds to herbicides. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Centennial potatoes were planted at 3000 lb/A on April 17, 1990. All treatments were applied preemergence surface on May 16, 1990 after drag-off and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL), and barnyardgrass (ECHCG) infestations were heavy to moderate and kochia (KCHSC), Russian thistle (SASKR), redroot pigweed (AMARE), and green foxtail (SETVI) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 18, 1990. All treatments gave good to excellent control of ECHCG, AMABL, AMARE. Metolachlor and trifluralin applied at 1.5 and 0.75 lb ai/A were the only treatments that gave poor control of SASKR. KCHSC control was good to excellent with all treatments except metolachlor applied at 1.5 lb ai/A. Solni control was good to excellent with all treatments except metolachlor applied at 1.5 lb ai/A, trifluralin applied 0.75 lb ai/A, and pendimethalin applied at 1.0 lb ai/A. Potato yields were 139 to 222 cwt/A higher in the herbicide treated plots as compared to the check. Fluorochloridone applied alone or in combination caused injury ratings of 25, 40, and 55, respectively. (Agricultural Science Center, New Mexico State University, Farmington, NM 87499).

Weed control evaluations in field potatoes, 1990

Treatment	Rate lb ai/A	Crop[1] Injury	ECHCG	SOLNI	AMABL	AMARE	SASKR	KCHSC	Yield cwt/A
		Weed Control[1]							
		%							
trifluralin + metribuzin (pm)	0.75	0	100	83	100	100	100	100	459
trifluralin + metribuzin (pm)	1.5	0	100	100	100	100	100	100	399
metolachlor + metribuzin (pm)	1.5	0	100	100	100	100	100	100	457
metolachlor + metribuzin (pm)	3.0	3	100	100	100	100	100	100	382
pendimethalin + metribuzin	1.0+0.25	0	100	100	100	100	100	100	482
pendimethalin + metribuzin	2.0+0.5	0	100	100	100	100	100	100	462
metribuzin + fluorochloridone	0.25+0.25	25	100	100	98	100	100	100	411
metribuzin + fluorochloridone	0.5+0.5	55	100	100	100	100	100	100	400
metribuzin	0.38	0	100	88	98	100	97	100	447
metolachlor	1.5	0	100	77	92	98	65	77	422
metribuzin	0.75	10	100	100	100	100	100	100	412
flurorchloridone	0.38	40	97	100	100	100	100	100	472
trifluralin	0.75	0	88	63	82	88	70	83	399
pendimethalin	1.0	0	87	73	92	97	90	92	450
handweeded check		0	100	100	100	100	100	100	458
check		0	0	0	0	0	0	0	260
av weeds/m^2			11	6	24	7	7	6	

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

Tolerance of Italian ryegrass cultivars to fenoxaprop applied at different growth stages. Hassan, G. and G. W. Mueller-Warrant. Previous experiments revealed differential tolerance to fenoxaprop in 22 cultivars of Italian ryegrass. Knowledge of the influence of growth stages on this tolerance is lacking. Studies were undertaken in a greenhouse environment to evaluate the genotypic response to rates of fenoxaprop applied at 3- to 4-leaf and 3- to 4-tiller stages. From the previously established tolerance groups, two cultivars were selected from the susceptible group (Ace and Futahara), three from the intermediate group (Waseyutaka, Barmultra, and Tetrone), and five from the tolerant group (Aubade, Torerro, Gulf, Marshall, and Sakurawase). In attempts to obtain 50% reduction in all cultivars, different ranges of rates were applied to each of the three groups. In addition to three untreated checks in each group, the susceptible group was treated with 0.028, 0.056, 0.084, 0.11, and 0.17 kg ha^{-1}, the intermediate with 0.056, 0.11, 0.17, and 0.22 kg ha^{-1}, and the tolerant group with 0.056, 0.11, 0.17, 0.28, and 0.45 kg ha^{-1} fenoxaprop. The experiment was a factorial arrangement of growth stages, cultivars, and rates, with five replications. One of the three checks was harvested at the time of fenoxaprop application for recording the initial weight and the remaining two checks were harvested along with the treated plots. Difference between weights of controls gave the expected weight gain during the period following treatment for each of the growth stages. The performance of each treatment was evaluated as its fresh weight relative to fresh weight gained by the check. GR_{50} (growth reduction 50%) values were computed for each cultivar within single replications or pairs of replication by regression.

There was a 4- to 5-fold difference in tolerance between the most susceptible and the most tolerant cultivars at both growth stages (Table 1). Tolerance sometimes increased with the increasing age of the seedlings, the magnitude of the enhanced tolerance was not the same for all cultivars. No appreciable gain in tolerance was observed in Waseyutaka, Tetrone, Sakurawase, Barmultra, and Aubade, but increased tolerance was recorded in the five other cultivars included in the studies, and was the most pronounced in the cultivars Gulf and Marshall. (Crop and Soil Science Department, Oregon State University, and USDA-ARS, Corvallis, OR 97331.)

GR_{50} estimates for 10 cultivars of Italian ryegrass (*Lolium multiflorum* Lam.) treated with fenoxaprop at 2 growth stages.

Cultivar	GR_{50} (kg ai/ha)	
	3- to 4-leaf stage	3- to 4-tiller stage
Futahara	0.027 a[1]	0.084 a
Ace	0.034 a	0.087 a
Waseyutaka	0.071 bc	0.113 a
Barmultra	0.086 bc	0.073 a
Tetrone	0.057 ab	0.078 a
Aubade	0.078 bc	0.084 a
Torerro	0.069 bc	0.184 ab
Gulf	0.097 c	0.287 bc
Marshall	0.102 c	0.364 c
Sakurawase	0.056 ab	0.099 a

[1]Means sharing a letter in common do not differ significantly by Duncan's new multiple range test at 5% probability level in the respective column.

<u>Hairy nightshade control in sugarbeets with clopyralid tank mixtures.</u> Morishita, D. W. and R. W. Downard. A field experiment was conducted near Parma, Idaho to evaluate the control of hairy nightshade (SOLSA), common lambsquarters (CHEAL) and redroot pigweed (AMARE) with clopyralid and clopyralid combinations in sugarbeets ('Beta 46-89'). The experiment was established as a randomized complete block design with six replications. Sugarbeets were planted to a spacing of four inches and hand thinned June 5, 1990 to nine inch spacings. Soil type was a silt loam with 1.4% o.m., pH of 7.7 and CEC of 21.7 meq/100 g soil. All herbicides were applied broadcast with a hand held four-nozzle sprayer equipped with 11001 flat fan nozzles. The sprayer was calibrated to deliver 10 gpa at 58 psi. Herbicide application information is shown in Table 1. Visual weed control and crop injury evaluations were taken June 5 and July 3, 1990.

Clopyralid applied at 0.094 lb ai/A at the later date injured sugarbeets the most. Clopyralid alone or applied as a split application did not satisfactorily control redroot pigweed. The split application of clopyralid applied at the cotyledon growth stage and 7 days later controlled hairy nightshade and common lambsquarters 81% or better at both evaluations. The best overall weed control (89% or better) was with the combinations of clopyralid and phenmedipham plus desmedipham applied in tank mixture and sequentially. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83843)

Table 1. Herbicide application information.

Application date	5/16/90	5/23/90
Application type	Cotyledon	7 d later
Air temperature (F)	70	63
Soil temperature (F)	72	60
Relative humidity (%)	56	74
Wind direction	East	East
Wind velocity (mph)	4	1

Table 2. Weed control and sugarbeet injury with sequential applications of clopyralid near Parma, Idaho.

Treatment	Rate	Appl. date	Crop injury 1[b]	Crop injury 2[c]	Weed control[a] SOLSA 1	SOLSA 2	CHEAL 1	CHEAL 2	AMARE
	(lb ai/A)		(%)						
Check	-	-	-	-	-	-	-	-	-
Handweeded[d]	-	-	-	-	-	-	-	-	-
Clopyralid	0.094	5/16	3	0	95	84	70	66	53
Clopyralid	0.094	5/23	10	0	98	78	93	83	63
Clopyralid / clopyralid	0.094 / 0.094	5/16 5/23	3	0	99	93	98	81	50
Clopyralid / phenmedipham & desmedipham	0.094 / 0.325	5/16	3	0	100	86	96	89	89
Clopyralid + phenmedipham & desmedipham / clopyralid	0.094+ 0.325/ 0.094	5/16 5/23	5	1	100	96	100	90	91
Clopyralid + phenmedipham & desmedipham / phenmedipham & desmedipham	0.094+ 0.325/ 0.325	5/16 5/23	0	0	99	95	100	91	94
Phenmedipham & desmedipham / clopyralid	0.325/ 0.094	5/16 5/23	1	0	100	86	100	94	86
Phenmedipham & desmedipham / clopyralid + phenmedipham & desmedipham	0.325/ 0.094+ 0.325	5/16 5/23	3	0	100	98	100	89	94
Phenmedipham & desmedipham / phenmedipham & desmedipham	0.325/ 0.325	5/16	0	0	98	68	98	85	91
LSD (0.05)			6	ns	19	26	20	29	29

[a]Weed species evaluated were hairy nightshade (SOLSA), common lambsquarters (CHEAL), and redroot pigweed (AMARE).

[b]First crop injury and weed control evaluation taken June 5, 1990.

[c]Second crop injury and weed control evaluation taken July 3, 1990.

[d]Weeds removed from handweeded check July 3, 1990.

Broadleaf weed control in sugarbeets. Downard, R.D. and D.W. Morishita. Seven herbicides were evaluated for control of common lambsquarters (CHEAL), hairy nightshade (SOLSA) and redroot pigweed (AMARE) in sugarbeets ('Beta 46-89') near Parma, Idaho.

Twenty treatments including an untreated check and a handweeded check were arranged in a randomized complete block design with six replications. Plot size was 10 ft by 30 ft. The herbicides were applied with a handheld sprayer at 10 gpa using 11001 flat fan nozzles. Herbicides were applied preplant incorporated (PPI), preemergence (Pre) and postemergence at the cotyledon or 2 to 4 leaf stage. Application data are shown in Table 1. Soil type in this study was a silt loam with a pH of 7.8, 1.4% o.m. and CEC of 21.7 meq/100 g soil. Crop injury and weed control were evaluated visually on June 5 and July 3, 1990. Sugarbeets were harvested with a two-row beet lifter on October 9, 1990.

Crop injury was highest with the sequential application of phenmedipham and desmedipham plus clopyralid treatment on both evaluation dates (Table 2). This herbicide treatment controlled common lambsquarters, hairy nightshade and redroot pigweed 96% or better throughout the season, but yields were reduced. Additional herbicide treatments which controlled all three weed species in this study were ethofumesate plus pyrazon, cycloate plus diethatyl at 2.0 + 2.0 lb ai/A (PPI), ethofumesate (Pre) and diethatyl (PPI). From these, only ethofumesate plus pyrazon and diethatyl (PPI) were among the top yielding treatments. Cycloate at 4.0 lb ai/A, ethofumesate (Pre) and diethatyl plus ethofumesate at 2.0 + 1.0 lb ai/A (Pre) were among the other high yielding treatments. (Department of Plant, Soil and Entomological Sciences, University of Idaho, Twin Falls, ID 83301)

Table 1. Application data on weed control in sugarbeets.

	Type of Application				
	PPI 1[a]	PPI 2	PRE	Cotyledon	2 to 4 lf
Application date	4/9/90	4/26/90	4/26/90	5/16/90	5/23/90
Air temp. (F)	74	52	58	70	63
Soil temp. (F)	72	54	60	72	60
Relative humidity (%)	50	74	34	56	74
Wind direction	-	West	East	East	East
Wind velocity (mph)	-	4	1	4	1

[a]Early preplant treatment with metham.

Table 2. Crop injury, weed control and yield and quality in sugarbeet, near Parma, Idaho.

Treatment	Rate	Timing[b]	Crop Injury 1[c]	Crop Injury 2[d]	Weed Control[a] CHEAL 1	CHEAL 2	SOLSA 1	SOLSA 2	AMARE	Crop yield	Sucrose	
	(lb ai/A)		(%)							(T/A)	(%)	(lb/A)
Check			-	-	-	-	-	-	-	26	14.2	6217
Handweeded[e]			0	0	0	100	0	100	100	40	13.8	9039
Cycloate	3.0	1	1	0	89	91	96	94	95	41	13.8	9282
Cycloate	4.0	1	2	1	95	82	97	88	92	43	13.6	9526
Cycloate + diethatyl	1.8 + 2.0	1	2	3	88	83	93	89	94	31	14.1	7200
Cycloate + diethatyl	2.6 + 1.0	1	2	1	94	84	93	86	96	40	13.7	8912
Cycloate + diethatyl	2.0 + 2.0	1	1	1	97	90	97	93	98	42	14.0	9695
Diethatyl	4.0	1	0	2	98	93	95	86	98	44	14.2	10395
Ethofumesate	2.1	1	3	1	95	88	89	83	98	38	13.7	8666
Diethatyl + ethofumesate	2.0 + 1.0	1	1	1	98	97	85	90	99	42	14.3	10015
Diethatyl + ethofumesate	1.5 + 1.5	1	3	1	92	92	83	73	98	39	14.1	9226
Diethatyl	4.0	2	0	1	58	59	69	47	84	28	14.0	6560
Ethofumesate	2.1	2	2	1	97	89	98	89	98	43	13.5	9525
Diethatyl + ethofumesate	2.0 + 1.0	2	1	0	79	93	78	85	94	43	14.0	9832
Diethatyl + ethofumesate	1.5 + 1.5	2	1	0	81	84	87	79	95	41	13.9	9246
Ethofumesate + pyrazon	1.75 + 1.5	2	0	0	99	93	98	97	100	44	14.4	10618
Metham	10.0	1	0	0	82	33	75	48	43	25	13.9	5626
Metham	15.0	1	0	1	45	56	30	41	31	32	14.1	7553
Phenmedipham & desmedipham / phenmedipham & desmedipham	0.3 / 0.3	3 / 4	1	1	83	81	83	78	96	41	14.3	9746
Phenmedipham & desmedipham / phenmedipham & desmedipham + clopyralid	0.3 / 0.3 / 0.125	3 / 4	8	4	100	98	98	96	99	39	14.1	9204
LSD (0.05)			3	3	25	24	14	25	17	4	0.6	983

[a]Weed species evaluated were common lambsquarters (CHEAL), hairy nightshade (SOLSA), and redroot pigweed (AMARE).

[b]1 = Preplant incorporated, 2 = Preemergence, 3 = Cotyledon, and 4 = 2 to 4 leaf.

[c]First crop injury and weed control evaluation taken June 5, 1990.

[d]Second crop injury and weed control evaluation taken July 3, 1990.

[e]Weeds removed from handweeded check July 3, 1990.

Postemergence Canada thistle control in sugarbeets. Miller, S.D. and K.J. Fornstrom. Plots were established under furrow irrigation at the Research and Extension Center, Powell, Wyoming to evaluate the efficacy of clopyralid alone or in combination with desmedipham plus phenmedipham for Canada thistle control in sugarbeets. Plots were 9 by 30 ft. with three replications arranged in a randomized complete block design. Ethofumesate plus diethatyl (2 plus 2 lb/A) was applied and incorporated over the entire experimental area prior to seeding sugarbeets (var. MonoHyR2) April 19, 1990. The soil in the experimental area was classified as a clay loam (40% sand, 29% silt and 31% clay) with 1.4% organic matter and pH 7.7. Postemergence treatments were applied with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi June 6, 1990 (air temp. 75F, relative humidity 40%, wind calm, sky cloudy and soil temp. - 0 inch 80F, 2 inches 70F and 4 inches 65F) to 6-leaf sugarbeets and 4 to 6 inch Canada thistle rossettes. All weeds but Canada thistle were removed several times throughout the growing season. Sugarbeet stand and Canada thistle populations were determined June 20, Canada thistle control visually evaluated July 18 and plots harvested September 21, 1990. Canada thistle (CIRAR) densities averaged 0.5 plant/ft. of row in a 3-inch band in the untreated check.

No sugarbeet injury or stand reduction was observed with any treatment. Canada thistle control with clopyralid ranged from 73 to 97% depending upon rate. Canada thistle control was similar with clopyralid alone or in combination with desmedipham plus phenmedipham. Sugarbeet yields correlated to Canada thistle control and were 4.0 to 5.7 T/A higher in plots treated with clopyralid than in the untreated check. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1764)

Sugarbeet response and Canada thistle control with clopyralid.

Treatment[1]	Rate lb ai/A	Sugarbeets[2] Inj %	stand 1000 pl/A initial	stand 1000 pl/A harvest	Sucrose %	Yield T/A	CIRAR[3] Control %
desmedipham/phenmedipham	1.0	0	26.1	22.5	14.5	16.5	20
desm/phen+clopyralid	1.0+0.094	0	26.1	27.3	14.7	19.6	73
desm/phen+clopyralid	1.0+0.19	0	27.1	27.1	14.8	19.7	83
desm/phen+clopyralid	1.0+0.25	0	24.9	25.9	14.8	20.6	95
desm/phen+clopyralid	1.0+0.38	0	25.9	26.1	14.7	20.8	97
clopyralid	0.094	0	27.1	29.0	14.7	19.8	73
clopyralid	0.19	0	27.8	28.5	14.7	19.4	88
clopyralid	0.25	0	24.9	24.9	14.7	20.0	93
clopyralid	0.38	0	25.4	24.9	14.8	21.2	95
weedy check	- - - -	0	25.4	22.5	14.5	15.7	0
Plants/ft. of row 3-inch band		- -	1.05	- -	- -	- -	0.5

[1]Treatments applied June 6, 1990; /=package mix treatments.
[2]Crop injury (Inj) and initial stand determined June 20 and plots harvested September 21, 1990.
[3]Canada thistle control determined July 18, 1990.

Evaluation of postemergence grass herbicides in sugarbeets. Miller, S.D. and K.J. Fornstrom. Plots were established under sprinkler irrigation at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of postemergence grass herbicides for weed control in sugarbeets. Plots were 10 by 22 ft. with three replications arranged in a randomized complete block. Sugarbeets (var. Monohikari) were planted May 1, 1990 in a sandy loam soil (77% sand, 13% silt and 10% clay) with 1.3% organic matter and pH 7.6. The entire experimental area was treated with desmedipham/phenmedipham (May 24, 1990) for broadleaf weed control. In addition, broadleaf weed populations were removed by hand once during the growing season. Grass treatments were applied with a CO_2 pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi June 15, 1990 (air temp. 69F, relative humidity 76%, wind E at 5 mph, sky cloudy and soil temp. - 0 inch 71F, 2 inches 65F and 4 inches 63F) to 6 to 8-leaf sugarbeets and 3 to 4-leaf green foxtail (SETVI). Weed counts, crop stand counts and visual injury ratings were made July 2, grass control visually evaluated July 19 and plots harvested September 29, 1990. Grass densities averaged 1.4 plants/ft. of row in a 3-inch band in the untreated check.

No sugarbeet injury or stand reduction was observed with any treatment. Sugarbeet stands at harvest were high regardless of treatment. Green foxtail control was good to excellent with all treatments ranging from 85 to 100% 4 weeks after treatment. Sugarbeet yields were 2.0 to 6.4 T/A higher in plots treated with postemergence grass herbicides than in the untreated check. (Wyoming Agric Exp. Sta., Laramie, WY 82071 SR 1763)

Sugarbeet response and grass control with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Sugarbeets[2] Inj %	Stand 1000 pl/A initial	Stand 1000 pl/A harvest	Sucrose %	Yield T/A	% SETVI[3] Control 2 wk	% SETVI[3] Control 4 wk
sethoxydim+ocd	0.15	0	48.9	48.8	16.2	30.1	92	98
sethoxydim+oc	0.15	0	54.0	48.8	16.0	28.2	93	96
sethoxydim+ocs	0.15	0	47.0	48.8	16.0	26.6	95	100
sethoxydim+ocd+N	0.15	0	48.8	45.3	15.9	26.6	95	100
sethoxydim+ocd	0.2	0	52.2	47.0	15.9	27.7	95	99
quizalofop+oc	0.063	0	52.2	47.0	16.0	26.7	90	95
quizalofop+oc	0.094	0	48.9	47.0	16.0	27.1	92	100
quizalofop+oc	0.125	0	47.0	45.3	16.0	28.1	96	100
pantera+oc	0.032	0	48.9	47.0	16.3	26.2	88	95
pantera+oc	0.063	0	47.0	45.3	16.2	27.1	92	99
pantera+oc	0.094	0	47.0	43.6	16.0	28.2	92	100
clethodim+oc	0.078	0	47.0	43.6	16.2	28.1	93	99
clethodim+oc	0.094	0	54.0	47.0	16.2	27.1	95	100
clethodim+oc	0.125	0	48.9	45.3	15.9	27.3	95	100
fluazifop+oc	0.125	0	53.1	48.8	16.0	25.7	78	85
fluazifop+oc	0.188	0	50.5	45.3	16.2	26.6	83	88
HOE-46360+oc	0.1	0	48.9	45.3	15.9	26.8	87	93
HOE-46360+oc	0.125	0	54.0	47.0	16.0	26.5	92	97
weedy check	- - -	0	50.5	43.6	15.9	23.7	0	0
plants/ft. of row 3-inch band		- -	2.9	- -	- -	- -	1.4	- -

[1]Treatments applied June 15, 1990; ocd=Dash at 1 qt/A, oc=At Plus 411F at 1 qt/a, ocs=Sunit at 1 qt/A and N=28% w/w nitrogen.
[2]Crop stand counts and visual (Inj) evaluated July 2 and plots harvested September 29, 1990.
[3]Weed counts July 2 and visual weed control ratings July 19, 1990.

Tolerance of triticale to aryloxyphenoxy wild oat herbicides. Grasham, C.G., M.J. Dial, and D.C. Thill. Triticale tolerance to fenoxaprop was evaluated in field experiments at the University of Idaho Plant Science Farm. Triticale, var.'Juan', was planted May 8,1990 into a conventionally prepared seed bed. The plot area was wild oat free. The experimental design was a randomized complete block with four replications. Plots were 10 by 30 ft. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph. HOE46360 (0.576EC) and HOE6001 (0.056EC) were applied on June 6 at the 1 tiller stage. HOE46360, HOE7125 (3.08EC), and HOE6001 were applied on June 12, at the 4 tiller stage. During both applications, diclofop (3.0EC) was applied for comparison purposes.

Application and edaphic data are presented in Table 1. Bromoxynil/MCPA (0.25 lb ai/a) was applied June 17 for broadleaf weed control. Crop injury was evaluated visually on July 3, plant height at heading was measured on July 13, herbage biomass was collected on July 27, and the experiment was harvested on September 10.

Table 1. Application and edaphic data

Treatment date	June 5,1990	June 12, 1990
Growth stage	1 tiller	4 tillers
Air temperature (F)	65	50
Soil temperature at 2 in. (F)	60	52
Relative humidity (%)	50	72
Soil texture	silt loam	
organic matter (%)	2.5	
pH	5.0	
CEC (meq/100 g)	34.3	

HOE46360 injured triticale 100% and 92% at the 1 and 4 tiller application times, respectively (Table 2). Plant height and grain yield were not measured in these treatments. HOE6001 applied at the 1 tiller or 4 tiller stage caused 11% or 1% crop injury, respectively. Herbage biomass, plant height, and grain yield were not different between the two treatment timings, but herbage biomass was less than the control at the later application timing. HOE7125 was applied only at the 4 tiller stage and injured triticale 76%. Herbage biomass was reduced 46% and plant height was reduced 28% compared to the control. Grain yield was reduced 33% by HOE7125 compared to the control. Triticale was not injured by diclofop. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Triticale tolerance to aryloxyphenoxy wild oat herbicides.

Treatment	Rate	Appl. time	Crop[1] injury	Herbage biomass	Plant[2] height	Grain yield
	(lb ai/a)		(-%check-)	(lb/a)	(in.)	(bu/a)
Check				7534	32	30
HOE46360[3]	0.082	1 tiller	100	0	0	0
HOE6001	0.082	1 tiller	11	5855	31	33
Diclofop	1.00	1 tiller	0	6150	33	35
HOE46360	0.082	4 tillers	92	1384	0	0
HOE7125	0.78	4 tillers	76	4044	23	20
HOE6001	0.082	4 tillers	1	5338	30	34
Diclofop	1.00	4 tillers	2	6990	31	36
LSD (0.05)			5	2024	2	6

[1]Visual estimate of crop injury compared to the check, 100 = 100% kill, 0 = no injury.

[2]Measured at heading.

[3]All HOE treatments contain fenoxaprop.

<u>Canarygrass control in red wheat</u>. Tickes, B.R., E.S. Heathman. Littleseed canarygrass (Phalaris minor) has become an increasingly widespread weed in wheat grown in central and southwestern Arizona. Only two herbicides, barban and diclofop methyl have been used effectively to control this weed. Barban is no longer manufactured and available supplies were depleted in 1989 and the labeled rate of diclofop was lowered to marginal control levels in 1990. This test was conducted to evaluate new treatments for the control of littleseed canarygrass in Arizona wheat.

This test was conducted at the University of Arizona Yuma Valley Agricultural Center in 1990 to evaluate six herbicide treatments for the control of canarygrass in red wheat. Treatments were applied postemergence on January 4, 1990 to canarygrass that was at the 1 to 3 leaf stage. The infestation was 25 to 50 plants per square foot at the time of application. The wheat was tillering. Plot size was 50 by 25 ft with four replications set in a randomized complete block design. A backpack compressed air sprayer was used and applied a 20 gallons per acre spray volume. Visual evaluations of canarygrass control, broadleaf weed control and wheat injury were made 30 days prior to harvest on April 4, 1990. Broadleaf weeds present were lambsquarter and silversheath knotweed at one per square foot. Herbicide treatments were Fenoxaprop-ethyl at 0.057, 0.064 and 0.071 lb ai/a, oxyfluorfen at 0.125 and 0.25 lb ai/a, diclofop methyl at 1.25 lb ai/a and an untreated check. Wheat yields were measured with a small plot combine on May 23, 1990. Harvested subplots measured 43 ft by 5 ft.

An average of ninety two percent control of canarygrass was achieved with fenoxaprop-ethyl at the highest rate tested (0.071 lb ai/a). All other rates of fenoxaprop-ethyl produced commercially unacceptable levels of control. Diclofop methyl produced variable levels of control of 30 to 90 percent at 1.25 lb ai/a. The average control for this treatment was 70 percent. Oxyfluorfen controlled canarygrass present at the time of application but failed to control canarygrass which emerged after application. Both rates of oxyfluorfen did an excellent job of controlling the broadleaf weeds present in this test. All other treatments produced no broadleaf control. None of the treatments produced visible injury when evaluated on April 4, 1990. (University of Arizona Cooperative Extension, Yuma)

Canarygrass and broadlead weed control
in red wheat

Herbicide	Rate	Wheat injury	Canarygrass control	Broadleaf control	Yield
	(lb ai/a)	---------------(%)---------------			(lb/a)
fenoxaprop-ethyl	0.057	0	42	0	5663
fenoxaprop-ethyl	0.064	0	66	0	6429
fenoxaprop-ethyl	0.071	0	92	0	7143
oxyfluorfen	0.125	0	37	99	6173
oxyfluorfen	0.25	0	35	97	6122
diclofop methyl	1.25	0	70	0	6735
untreated	--	0	0	0	2806

Russian thistle control in spring wheat. Boerboom, C.M. Russian thistle (SASKR) is a serious weed problem in the low rainfall region of Eastern Washington. Russian thistle germinates in late spring or early summer in one to several flushes, depending on rainfall. This study was conducted to evaluate the efficacy of several postemergence herbicides and to determine if overall Russian thistle control could be improved by delaying applications so that secondary flushes would be controlled by the initial application.

A site near Washtucna, WA was selected for this study. The field which contained the study area was prepared and seeded by the cooperating farmer. The experiment was a randomized complete block design with four replications. Plots measured 8 by 30 ft. The early applications were made on May 5, 1990 when the Russian thistle was 1 to 4 inches tall and the spring wheat was beginning to tiller with 5 to 6 leaves. The late applications were made on June 4, 1990 when the Russian thistle was 4 to 6 inches tall and the wheat was starting to head. Applications were made at a rate of 17 gal/a at 30 psi. Control was rated visually on July 2, 1990.

There was one primary flush of Russian thistle and no secondary flushes so the late herbicide treatments were applied to the larger plants only. Russian thistle plants developed slowly because of cool spring temperatures resulting in delayed phenoxy applications to heading wheat which reduced yield. The early treatments of 2,4-D were effective, alone or in combination with sulfonylurea herbicides. Bromoxynil was also highly effective, alone or in combination with MCPA, at either application date. The sulfonylurea herbicides were less effective than anticipated which possibly resulted from sulfonylurea resistant Russian thistle biotypes present in the weed population. Russian thistle did not appear to reduce wheat yield, but would likely become a problem post harvest if not controlled. (Department of Agronomy and Soils, Washington State Univ., Pullman, WA 99164)

Table 1. Application data

Application date	May 10	June 4
Air temperature (F)	62	74
Soil temp. at 2 in. (F)	60	78
Relative humidity (%)	50	48
Wind (mph)/direction	7/E	6/NE
Delivery rate (gal/a)	17	17
Crop	hard red spring wheat	

Table 2. Russian Thistle Control in Spring Wheat

Treatment[1]	Rate[2]	SASKR height	Date of appl.	SASKR control	Wheat yield
	(lb/a)	(inches)		(%)	(bu/a)
check				0	27
triasulfuron	0.013	1-4	5/10	10	28
triasulfuron	0.013	4-6	6/4	15	27
triasulfuron + 2,4-D	0.007 + 0.5*	1-4	5/10	96	26
triasulfuron + 2,4-D	0.007 + 0.5*	4-6	6/4	59	17
thifensulfuron + tribenuron[3]	0.015 + 0.008	1-4	5/10	41	23
thifensulfuron + tribenuron	0.015 + 0.008	4-6	6/4	40	26
thifensulfuron + tribenuron + 2,4-D	0.009 + 0.005 + 0.5*	1-4	5/10	95	25
thifensulfuron + tribenuron + 2,4-D	0.009 + 0.005 + 0.5*	4-6	6/4	36	18
tribenuron	0.016	1-4	5/10	61	26
tribenuron	0.016	4-6	6/4	18	25
tribenuron + 2,4-D	0.008 + 0.5*	1-4	5/10	100	23
tribenuron + 2,4-D	0.008 + 0.5*	4-6	6/4	54	16
chlorsulfuron + metsulfuron[4] + 2,4-D	0.012 + 0.002 + 0.5*	1-4	5/10	100	24
chlorsulfuron + metsulfuron + 2,4-D	0.012 0.002 + 0.5*	4-6	6/4	61	17
pyridate	0.90	1-4	5/10	43	24
pyridate	0.90	4-6	6/4	73	25
2,4-D	1.0*	1-4	5/10	99	27
2,4-D	1.0*	4-6	6/4	84	14
bromoxynil	0.38	1-4	5/10	100	25
bromoxynil	0.38	4-6	6/4	100	24
bromoxynil + MCPA[5]	0.125 + 0.125*	1-4	5/10	97	26
bromoxynil + MCPA	0.125 + 0.125*	4-6	6/4	86	23
MCPA + clopyralid[6]	0.69* + 0.12*	1-4	5/10	38	28
MCPA + clopyralid	0.69* + 0.12*	4-6	6/4	8	28
LSD (0.05)				24	6

[1] All sulfonylurea treatments (2-14) were applied with 0.25 % v/v surfactant.
[2] Rates marked with an * are in lb ae/a; all others in lb ai/a.
[3,4,5,6] Formulated as commercial products of Harmony Extra, Finesse, Bronate, and Curtail M, respectively.

Spring wheat tolerance to wild oat herbicides and selected tank mixes. Ozdemir, C., J.O. Evans, and J.M Torell. An experiment was established to determine the efficacy and crop tolerance of diclofop, difenzoquat, imazamethabenz, and fenoxaprop-ethyl alone and in combination with broadleaf materials.

Herbicides were applied on June 5, 1990 with a bicycle sprayer delivering 16 gal/a at 40 psi. Environmental conditions were: air temperature 26C, soil temperature 22C, relative humidity 27%, wind 3.2 to 8.0 km/hr. from the southwest. The soil was a silt loam (15% sand, 77% silt, 8%clay) with 2.7% organic matter and pH 7.8. Visual evaluations for crop injury were made on July 6. Plots were harvested on August 3, 1990.

Weed control ratings were not conducted due to sparse and erratic weed populations. All herbicide treatments other than difenzoquat showed slight crop injury. Control plots had the highest yield (473.3 g/m^2) and this was not significantly different from fenoxyprop-ethyl (0.0189 kg/ha) and fenoxyprop-ethyl + bromoxynil (0.092 + 0.42 kg/ha). (Utah Agricultural Experiment Station, Logan, UT 84322)

Fremont spring wheat tolerance to selected wild oat herbicides and herbicide combinations.

Treatment	Rate kg ai/ha	Crop Injury 7/5/90	Yield g/m^2
diclofop	0.84	0	348.1b
diclofop	1.12	2	231.1c
difenzoquat	1.12	4	329.1c
difenzoquat	1.40	4	365.9b
imazamethabenz	0.52	2	330.3c
imazamethabenz	0.75	3	279.8c
imazamethabenz	1.12	3	314.9c
fenoxaprop ethyl	0.092	2	353.8b
fenoxaprop ethyl	0.184	1	406.0ab
fenoxaprop ethyl +	0.092	1	379.5b
2,4-D ester	0.28		
diclofop +	0.84	1	367.5b
bromoxynil	0.42		
imazamethabenz	0.52	2	338.2b
bromoxynil	0.42		
control		0	473.3a

Means within columns followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Wild oat control in irrigated spring wheat. Morishita, D. W. and R. W. Downard. A study was established near Paul, Idaho in irrigated spring wheat ('Penewawa') to evaluate several herbicides for wild oat control (AVEFA). Soil type at this location was a silt loam with 1.7% o.m., pH of 7.6, and CEC of 18.8 meq/100 g soil. The experiment was designed as a randomized complete block with four replications. Herbicides were applied broadcast with a six nozzle hand held sprayer equipped with 11001 flat fan nozzles and calibrated to deliver 10 gpa at 38 psi. Additional herbicide application information is shown on Table 1. A visual evaluation for crop injury and wild oat control was taken July 5, 1990. The wheat was harvested August 13, 1990, with a small-plot combine.

All applications of HOE-6025 and HOE-7125 severely injured the wheat but controlled the wild oats 94% or better. Reduced wheat yields reflected the high injury ratings with HOE-6025 and the higher rate of HOE-7125. Although HOE-7125 at 0.66 lb ai/A caused 28% crop injury, wheat yield was 22 bu/A higher than the untreated check. All imazamethabenz treatments except imazamethabenz plus thifensulfuron and tribenuron controlled wild oat 90% or better. These same treatments had higher crop yields than the check. Wild oat control with diclofop alone or in combination with other herbicides ranged from 66 to 80%. Only the diclofop plus bromoxynil treatment yielded higher than the check. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Twin Falls, ID 83301)

Table 1. Herbicide application information.

Application date	5/17/90	6/6/90
Application type	1-3 lf	5-7 lf
Air temperature (F)	68	66
Soil temperature (F)	68	59
Relative humidity (%)	56	72
Wind direction	Northwest	Southwest
Wind velocity (mph)	4	1

Table 2. Wild oat control, crop injury and yield in spring wheat near Paul, Idaho.

Treatment	Rate	Appl date[1]	Crop injury	AVEFA[2] control	Crop yield
	(lb ai/A)		——(%)——		(bu/A)
Check		-	-	-	61
Diclofop + bromoxynil + thinfensulfuron & tribenuron[3]	1.0 + 0.25 + 0.008	5/17	0	66	59
Diclofop + bromoxynil + thinfensulfuron & tribenuron	1.0 + 0.25 + 0.014	5/17	0	66	57
Diclofop + bromoxynil	1.0 + 0.25	5/17	0	78	80
Diclofop + COC[4]	0.75	5/17	3	80	76
Diclofop + COC	1.0	5/17	0	76	73
HOE_6001	0.082	5/17	0	91	85
HOE_6001	0.082	6/6	0	98	93
HOE_6025	0.082	6/6	55	98	46
HOE_6025 + bromoxynil	0.082 + 0.25	6/6	53	99	54
HOE_7125	0.66	6/6	28	98	83
HOE_7125	0.78	6/6	39	94	60
Imazamethabenz[3]	0.41	5/17	0	90	76
Imazamethabenz + thifensulfuron & tribenuron	0.41 + 0.0188	5/17	5	78	69
Imazamethabenz + tribenuron	0.41 + 0.0078	5/17	1	91	83
Imazamethabenz + difenzoquat	0.234 + 0.50	6/6	0	98	89
Difenzoquat[3]	1.0	6/6	0	94	86
LSD (0.05)			13	10	17

[1]Application dates correspond to the following wild oat growth stages; 5/17 = 1 to 3 leaves and 6/6 = 3 to 5 leaves.
[2]AVEFA = WSSA approved abbreviation for wild oat.
[3]These herbicides were applied with 0.5% v/v nonionic surfactant.
[4]COC = crop oil concentrate applied at 1.0 pt/A.

Broadleaf weed control in spring wheat with preemergence surface and postemergence herbicides. Dial, M. J. and D. C. Thill. Two adjacent experiments were initiated to evaluated several herbicides for preemergence and postemergence broadleaf weed control. The experiments were located 4 miles north of Moscow, Idaho. UBIC4243 was applied preemergence surface on April 11 to plots seeded to 'Edwall' spring wheat. DPXR9674 + bromoxynil was applied on June 5 to common lambsquarters (CHEAL), mayweed chamomile (ANTCO), and field pennycress (THLAR) as a postemergence standard treatment. A prolonged rainy period delayed this application resulting in the broadleaf weeds being in an advanced growth stage; common lambsquarters had 5 leaves and was 4 in. tall, mayweed chamomile was 3 to 5 in. tall, and field pennycress was 4 in. tall and blooming. The spring wheat was fully tillered and 7 in. tall.

Adjacent to this experiment, two formulations of dicamba (2 lb ai/gal sodium salt and a 70% water dispersible granule WDG), applied in tank mixture with other broadleaf herbicides, were evaluated for broadleaf weed control and crop injury. The herbicides were applied on June 5. Weed species and growth stage were the same as stated previously.

Herbicide treatments in both experiments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). The plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. Herbicide efficacy was evaluated visually on July 11. Grain was harvested on August 24 with a small plot combine.

Table 1. Application data

Application date		May 15	June 5
Air temperature (F)		50	52
Soil temperature at 2 in. (F)		51	52
Relative humidity (%)		67	78
Wind speed (mph) - direction		1-W	1-W
Soil	pH	5.7	
	OM (%)	3.2	
	CEC (meq/100g soil)	20.5	
	Texture	silt loam	

All herbicides controlled common lambsquarters, mayweed chamomile, and field pennycress equally (Table 2). UBIC4243 did not control wild oat (data not shown). No visual symptoms of crop injury were observed. Broadleaf weed control did not affect grain yield.

All herbicides controlled common lambsquaters, mayweed chamomile, and field pennycress equally (Table 3). Shortening of the crop was observed for all treatments compared to the check (data not shown). Herbicide treatment did not effect grain yield. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control and grain yield with preemergence surface and postemergence herbicides

Treatment[1]	Formulation		Rate	Appl.[2] timing	Control[3] CHEAL	ANTCO	THLAR	Grain yield
			(lb ai/a)		(-----of check-----)			(bu/a)
check					--	--	--	68
UBIC4243	0.83	EC	0.063	PES	95	91	95	68
UBIC4243			0.09	PES	95	94	95	69
UBIC4243			0.125	PES	95	94	95	68
DPXR9674 + bromoxynil + R-11	75 2.00	DF EC	0.0234 0.25 0.25%	POST	95	95	95	66
LSD (0.05)					ns	ns	ns	ns
plants/ft[2]					25	2	3	

[1]R-11 is a nonionic surfactant, rate is expressed as %v/v.
[2]PES = preemergence surface, POST = postemergence.
[3]Visual estimate of percent reduction in population density compared to the check.

Table 3. Broadleaf weed control and grain yield in spring wheat treated with dicamba tank mixtures

Treatment[1]	Formulation		Rate	Control[2] CHEAL	ANTCO	THLAR	Grain yield
			(lb ai/a)	(----% of check----)			(bu/a)
check				--	--	--	78
dicamba +	2.00	SC	0.125	93	95	95	73
MCPA amine	4.00	SC	0.75				
dicamba +	2.00	SC	0.125	94	95	95	75
MCPA amine +	4.00	SC	0.75				
R-11			0.125%				
dicamba +	2.00	SC	0.125	95	95	95	73
DPXR9674 +	75	DF	0.0078				
R-11			0.125%				
dicamba +	70	WDG	0.125	95	95	95	84
MCPA amine	4.00	SC	0.75				
dicamba +	70	WDG	0.125	95	95	95	74
MCPA amine +	4.00	SC	0.75				
R-11			0.125%				
dicamba +	70	WDG	0.125	94	95	95	76
DPXL5300 +	75	DF	0.0078				
R-11			0.125%				
LSD (0.05)				ns	ns	ns	ns
plants/ft^2				19	4	7	

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.

[2]Visual estimate of percent reduction in population density compared to the check.

Sulfonylurea and wild oat herbicide tank mixtures. Barton, D.L. and D.C. Thill. Wild oat control may be reduced when some wild oat herbicides are tank mixed with sulfonylurea herbicides. A study was established in hard red spring wheat (var. 'Newana') near Bonners Ferry, Idaho, in which diclofop, imazamethabenz, difenzoquat, HOE6001, HOE6004-05H, and HOE7125 were applied alone, in combination with CGA131036, or in combination with DPXR9674.

Plots were 10 by 30 feet, arranged in a randomized complete block design, and replicated four times. Herbicides 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 June 5 and June 25 for the 2 to 3 leaf and 4 to 5 leaf treatments, respectively. Wild oat control was evaluated visually at wild oat heading (July 24). Wheat grain was harvested August 16. Due to harvester breakdown, not all wheat grain could be harvested. Therefore, grain yield data was analyzed using the general linear model procedure, least-square means separation ($P < 0.05$).

Table 1. Herbicide application data

Application date	May 26, 1990	June 5, 1990
Wild oat leaf stage	2 to 4	4 to 5
Wheat growth stage	3 to 4 leaf	1 to 2 tiller
Air temperature (F)	70	68
Soil temperature at 2 in. (F)	57	66
Relative humidity (%)	80	68
Wind (mph) - direction	2 - N	2 - S
Soil pH	7.4	
OM %	3.4	
Texture	silty clay loam	

Nine days after treatment (DAT), wheat treated with diclofop, CGA131036 + diclofop, DPXR9674 + diclofop, and CGA131036 + imazamethabenz showed 5% crop injury, while DPXR9674 + imazamethabenz treatments caused 15% crop injury (data not shown). At 20 DAT, CGA131036 + HOE6001 or + HOE7125 showed 5% crop injury. DPXR9674 + HOE6001, DPXR9674 + difenzoquat, and difenzoquat with or without CGA131036 showed 10, 15, and 30% crop injury, respectively.

Imazamethabenz, difenzoquat, HOE6001, or HOE6004-05H applied alone, or in combination with CGA131036 or DPXR9674, controlled wild oat equally (Table 2). Diclofop or HOE7125 applied in combination with CGA131036 or DPXR9674 controlled wild oat less than each applied alone. HOE6004-05H treatments did not control wild oat adequately. Diclofop, imazamethabenz, HOE6001, and HOE7125 applied alone controlled wild oat equally (86% or greater). All treatments with 86% or greater wild oat control had equal grain yields. (Idaho Agriculture Experiment Station, Moscow, Idaho 83843).

Table 2. Wild oat control and grain yield for wild oat herbicide treatments.

Treatment	Rate	Formulation	Applic. timing	AVEFA control[1]	Grain yield[2]
	(lb ai/a)		(leaves)	(% of check)	(lb/a)
check	----	----	----	----	1099 G-I
diclofop	1.0	3 EC	2 to 3	86	4137 A
CGA131036 + diclofop + R-11[3]	0.0134 1.0	75 DF	2 to 3	41	2236 B-G
DPXR9674 + diclofop + R-11	0.0234 1.0	75 DF	2 to 3	50	3164 B-D
imazamethabenz	0.375	2.5 LC	2 to 3	90	3983 A
CGA131036 + imazameth. + R-11	0.0134 0.375		2 to 3	90	4122 A
DPXR9674 + imazameth. + R-11	0.0234 0.375		2 to 3	89	4078 A
difenzoquat	1.0	2 LC	4 to 5	75	2273 B-F
CGA131036 + difenzoquat + R-11	0.0134 1.0		4 to 5	74	2079 C-G
DPXR9674 + difenzoquat + R-11	0.0234 1.0		4 to 5	81	2906 B-E
HOE6001	0.074	0.57 EC	4 to 5	100	4086 A
CGA131036 + HOE6001 + R-11	0.0134 0.074		4 to 5	100	4566 A
DPXR9674 + HOE6001 + R-11	0.0234 0.074		4 to 5	100	4332 A
HOE6004-05H	0.09	.275 EC	4 to 5	27	1261 G-I
CGA131036 + HOE6004-05H + R-11	0.0134 0.09		4 to 5	20	1483 D-H
DPXR9674 + HOE6004-05H + R-11	0.0234 0.09		4 to 5	26	2256 B-G
HOE7125	0.66	3.08 EC	4 to 5	94	3888 A
CGA131036 + HOE7125 + R-11	0.0134 0.66		4 to 5	48	2357 B-F
DPXR9674 + HOE7125 + R-11	0.0234 0.66		4 to 5	55	2387 B-F
check	----	----	----	----	724 H-I
$LSD_{(0.05)}$				15	----
Wild oat density (no. plants/ft^2)				20	

[1] Visual estimate of percent reduction in population density compared to the untreated check.

[2] Grain yield differences using least-square means ($P < 0.05$). Different letters indicate significantly different grain yields.

[3] R-11 nonionic surfactant added at 0.125% v/v.

Wild oat control in spring wheat with aryloxyphenoxy herbicides. Barton, D.L. and D.C. Thill. A study was established in hard red spring wheat (var. '906-R') near Bonners Ferry, Idaho, to determine the efficacy of several aryloxyphenoxy-type wild oat (AVEFA) herbicides at different rates alone or in combination with DPXR9674 and/or bromoxynil. Plots were 10 by 30 feet, arranged in a randomized complete block design, and replicated four times. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Wild oat control was evaluated visually at wild oat heading (July 25). Wheat grain was harvested August 16.

Table 1. Herbicide application data

Application date	May 25, 1990	June 5, 1990
Wild oat leaf (lf) stage	2 to 3	4 to 6
Barley growth stage	3 lf to 1 tiller	3 lf to 2 tiller
Air temperature (F)	45	62
Soil temperature at 2 in. (F)	54	68
Relative humidity (%)	95	64
Wind (mph) - direction	0	2 - NW
Soil pH	7.4	
OM %	3.4	
Texture	silty clay loam	

Wheat treated with diclofop alone, or in combination with bromoxynil or crop oil concentrate had 2 to 5% crop injury 10 days after treatment (DAT). Wheat treated with HOE6001, HOE6025, HOE6025 + bromoxynil, and difenzoquat had 2, 5, 15, and 80% crop injury, respectively, 20 DAT (data not shown). Difenzoquat treated wheat had green and doughy grain at harvest. The grain from these plots was dried 5 days at 150 F and weighed. Difenzoquat is not labelled for use in hard red spring wheat variety '906-R'.

Wild oat control was 93% or greater for all treatments. HOE6001 applied at the 4 to 5 leaf stage controlled wild oat better than at the 2 to 3 leaf stage. Diclofop alone controlled wild oat better than diclofop + bromoxynil + DPXR9674 (0.008 lb ai/a). All herbicide treatments, except difenzoquat, had equal grain yield and were greater than the untreated check. (Idaho Experiment Station, Moscow, Idaho 83843).

Table 2. Wild oat control and wheat yield

Treatment	Rate	Formulation	Applic. timing	AVEFA control[1]	Grain yield
	(lb ai/a)		(leaves)	(% of check)	(lb/a)
check	----	----	----	----	3040
diclofop	1.0	3 EC	2 to 3	97	4182
diclofop +	0.75		2 to 3	96	4087
cocn[2]	1.25%	% v/v			
diclofop +	1.0		2 to 3	94	4163
cocn	1.25%				
diclofop +	1.0		2 to 3	95	4083
bromoxynil	0.25	2 EC			
diclofop +	1.0		2 to 3	93	4245
bromoxynil +	0.25				
DPXR9674	0.008	75 DF			
diclofop +	1.0		2 to 3	95	3946
bromoxynil +	0.25				
DPXR9674	0.014				
HOE6001	0.082	0.576 EC	2 to 3	95	4294
imazamethabenz	0.375	2.5 LC	2 to 3	97	3998
HOE6001	0.082		4 to 6	100	4361
HOE6025	0.082	0.417 EC	4 to 6	99	4070
HOE6025 +	0.082		4 to 6	99	3765
bromoxynil	0.25				
HOE7125	0.66	3.08 EC	4 to 6	98	3959
HOE7125	0.78		4 to 6	99	4344
HOE7125 +	0.78		4 to 6	98	4279
bromoxynil	0.25				
difenzoquat	1.0	2 LC	4 to 6	95	2187
check	----	----	----	----	3026
$LSD_{(0.05)}$				4	658
Wild oat density (no. plants/ft^2)				5	

[1] Visual estimate of percent reduction in population density compared to the untreated check.

[2] Cocn is 'Moract' crop oil concentrate.

Poverty brome control in no-tillage winter wheat. Dial, M. J. and D. C. Thill. Herbicide control of poverty brome (BROST) was evaluated in no-till seeded 'Hawk' winter wheat. Atrazine was applied preplant surface (PPS) on October 10, 1989, and diclofop was applied post plant preemergence surface (PES) on October 16 before winter wheat had emerged. Ethiozin was applied postemergence fall (POST) on November 1, when the winter wheat had 3 leaves, and poverty brome had 2 to 3 fully expanded leaves. Ethiozin also was applied postemergence on March 21, 1990 (ESPRI) to winter wheat that had 3 tillers and was 4 in. tall and the poverty brome had 3 to 5 leaves and was 3 in. tall. The field plot was located south of Lewiston, Idaho.

The atrazine treatment was applied as a broadcast spray before seeding with a 'Yielder' no-till drill equipped with stubble composters. The stubble composters were mounted ahead of each double disk opener to move harvest residue and broadcast applied atrazine away from the front of the openers. This created an area clear of harvest residue and atrazine for the wheat seed.

All herbicide treatments were applied with a self-propelled sprayer calibrated to deliver 27 gal/a at 35 psi and 3 mph (Table 1). The plots were 20 by 50 ft and the treatments were arranged in a randomized complete block design replicated four times.

In a previous experiment (p. 379 1990 WSWS Research Progress Report), when the brome was controlled, wild oat (AVEFA) dominated the plot area. Thus, plots were split and on April 4 one half of each plot was treated with imazamethabenz. The herbicide was applied at 0.47 lb ai/a with a CO_2 pressurized backpack sprayer, calibrated to deliver 10 gal/a at 40 psi and 3 mph. The wild oat had 2 to 4 leaves and the winter wheat was fully tillered (wild oat density was 6 plant/ft^2). Poverty brome and wild oat control were evaluated visually July 5. Grain was harvested on August 2. Grain yield data were analyzed using a randomized complete block split plot design to determine if wild oat and poverty brome control affected grain yield.

Table 1. Application data

Application date	Oct 10	Oct 16	Nov 1	Mar 21	Apr 4
Air temperature (F)	76	63	50	50	55
Soil temperature at 2 in. (F)	71	51	51	60	50
Relative humidity (%)	33	55	40	50	30
Wind speed (mph) - direction	4-W	2-W	6-W	1-W	3-W
Soil pH	5.6				
OM (%)	3.6				
CEC (meq/100g soil)	24.6				
Texture	silt loam				

Poverty brome control was not different among herbicide treatments (Table 2). The spring applied imazamethabenz did not affect poverty brome control. Imazamethabenz controlled wild oat in the treated portion of the plot 90% or greater (data not shown). Grain yield was higher when poverty brome was controlled except in the atrazine treatment. Average grain yield for the imazamethabenz treatment was 46 bu/a compared to 45 bu/a for the non-treated area. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Poverty brome control and grain yield in no-tillage winter wheat

Treatment[1]	Formulation	Rate	Timing	BROST control	Grain yield imazamethabenz with	Grain yield imazamethabenz without
		(lb ai/a)		(% of check)	(bu/a)	(bu/a)
check				--	34	33
atrazine	90 DF	0.5	PPS	85	42	39
diclofop	3 EC	1.0	PES	80	52	49
ethiozin + R-11	50 DF	1.0 0.25%	POST	83	51	54
ethiozin + R-11	50 DF	1.0 0.25%	ESPRI	72	49	47
LSD (0.05)				ns	10	10

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.

[2]Visual estimate of percent reduction in population density compared to the check.

Evaluating crop tolerance of five winter wheat varieties to XRM5064, 2,4-D, and dicamba. Dial, M. J. and D. C. Thill. A randomized complete block, split plot design was used to evaluate crop tolerance of five winter wheat varieties (main plots) to three herbicides applied at two rates (subplots). Bromoxynil applied at 0.56 kg/ha was included as a treated control. XRM5064 is a premix of clopyralid (46 g/L) plus 2,4-D (240 g/L). Certified 'Stephens', 'Hill-81', 'Lewjain', 'Cashup', and 'Daws' winter wheat were seeded September 21, 1989, at 78.5 kg/ha into a conventionally prepared seed bed at the Plant Science Research Farm 4 miles east of Moscow, Idaho. On April 5, 1990, the herbicide treatments were applied to the winter wheat varieties. All varieties were fully tillered and 15 cm tall. The experiment was established on a site with low weed density and no other herbicide treatment or hand weeding was required for weed control. The herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha spray solution at 275 kpa and 4.8 km/hr (Table 1). The plots were 3 by 8 m and the experiment was replicated four times.

Herbage biomass was collected from 1 m of row on June 21, when winter wheat varieties were fully headed and beginning anthesis. Samples were dried and were weighed. On August 9 and 10, mature wheat heads were collected from 1 m of row to determine yield components; spikes per area, kernels per spike and weight per kernel. Grain was harvested on August 13.

Table 1. Application data

Air temperature (C)		18
Soil temperature at 5.08 cm (C)		20
Relative humidity (%)		43
Wind speed (km/hr) - direction		6-W
Soil	pH	5.6
	OM (%)	3.4
	CEC (meq/100g soil)	18.9
	Texture	silt loam

Winter wheat varieties were different for spikes per area, kernels per spike, weight per 100 kernels and grain yield (Table 2). Herbage biomass and test weight were not different among winter wheat varieties. Herbicide treatments affected weight per 100 kernels, but not herbage biomass, spikes per area, and grain yield (Table 3). Kernels per spike and test weight were not affected by herbicide treatment. Kernels per spike ranged from 22 to 25 (ave. 23) and test weight ranged from 682 to 695 kg m^{-3} (ave. 693 kg m^{-3}). A seed per spike variety by herbicide interaction was observed (P = 0.0045, LSD 0.05 = 1.8) (Figure 1). The interaction was explained largely by varietal difference, since the herbicide main effect was not significant. (Agricultural Experiment Station, Moscow, Idaho 83843)

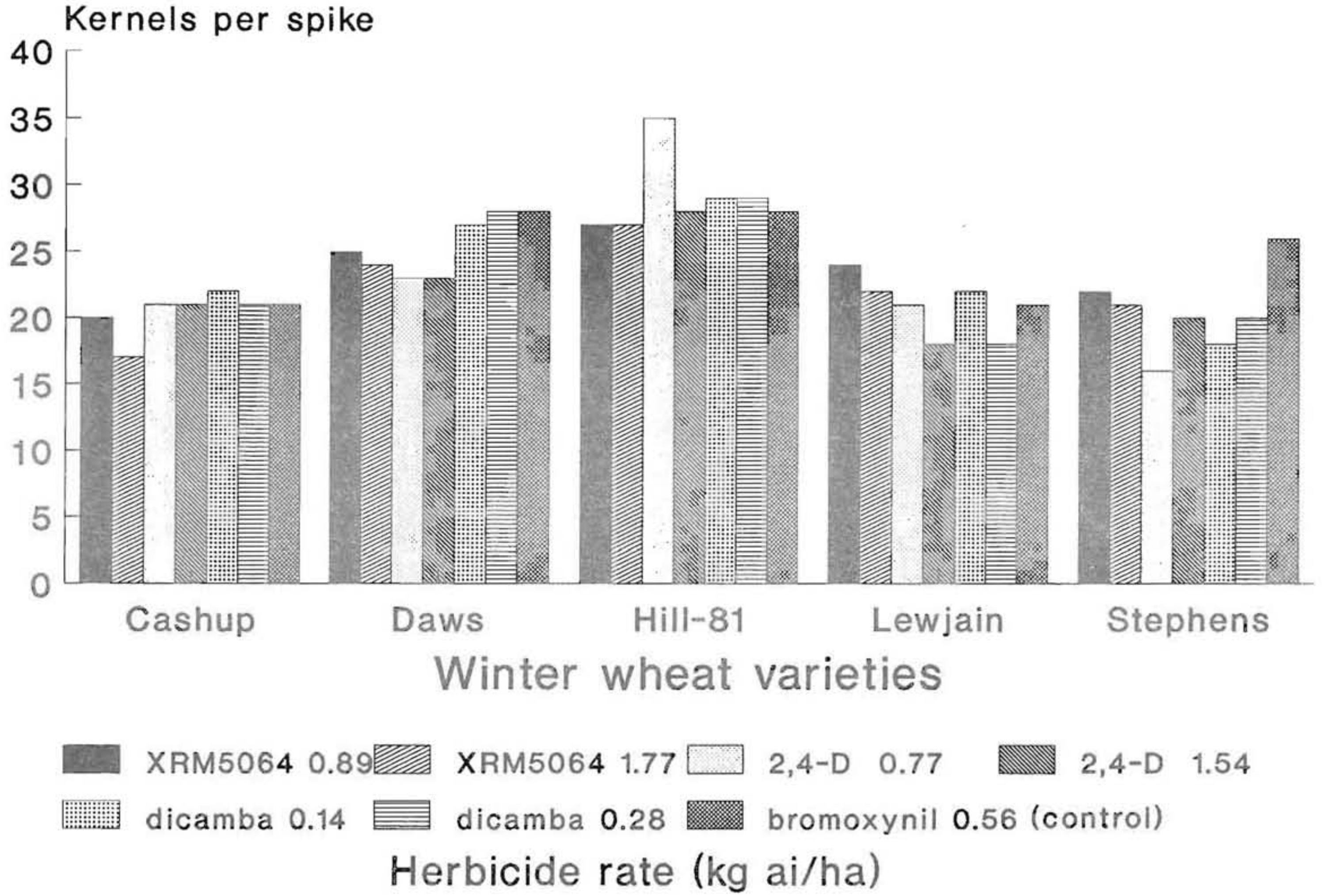
Table 2. Average herbage biomass, yield components and grain yield for five winter wheat varieties treated with XRM5064, 2,4-D, dicamba, and bromoxynil

Variety	Herbage biomass	Spikes area^{-1}	Kernels spike^{-1}	100 Kernel weight	Test weight	Grain yield
	(kg ha^{-1})	(no. m^{-1})	(no.)	(g)	(kg m^{-3})	(kg ha^{-1})
Stephens	107	93	21	4.6	682	5510
Hill-81	94	74	29	3.6	695	5846
Lewjain	94	118	21	3.5	682	6182
Cashup	90	97	21	3.6	695	5375
Daws	96	87	25	3.9	682	5913
LSD (0.05)	ns	12	2	0.1	ns	335

Table 3. Effect of herbicide treatment on yield components of five varieties of winter wheat

Herbicide	Formulation	Rate	Herbage biomass	Spike area^{-1}	100 Kernel weight	Grain yield
	(g/L)	(kg ha^{-1})	(kg ha^{-1})	(no m^{-1})	(g)	(kg ha^{-1})
XRM5064	286 SC	0.89	93	91	3.9	5711
XRM5064		1.77	96	99	3.9	5375
2,4-D	456 SC	0.77	91	88	3.7	5913
2,4-D		1.54	101	97	3.8	5913
dicamba	480 SC	0.14	101	96	3.9	5913
dicamba		0.28	98	100	3.7	5711
bromoxynil (control)	120 EC	0.56	90	89	3.9	5845
LSD (0.05)			ns	ns	0.1	ns

Figure 1. Kernel number per spike of five varieties of winter wheat treated with two rates of XRM5064, 2,4-D, or dicamba



Evaluating clopyralid/2,4-D and difenzoquat tank mixtures for phytotoxicity on Lewjain winter wheat. Dial, M. J. and D. C. Thill. Two rates of clopyralid/2,4-D and difenzoquat were applied alone and in tank mixture to 'Lewjain' winter wheat. Clopyralid and 2,4-D amine tank mixed with difenzoquat also were included in the experiment to determine if clopyralid/2,4-D or either of the components of the formulated product tank mixed with difenzoquat were phytotoxic to Lewjain winter wheat. The experiment was located at the University of Idaho Plant Science Research Station 4 miles east of Moscow, Idaho. The herbicides were applied on April 5 to fully tillered winter wheat. The plot area had low broadleaf weed density. The untreated control and the difenzoquat alone plots were hand weeded to eliminate weed competition. Plots with broadleaf herbicide treatments did not require additional weed control. No wild oat were present in any plot.

Herbicide were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha spray solution at 275 kpa and 4.8 km/hr (Table 1). The plots were 3 by 8 m and treatments were arranged in a randomized complete block design replicated four times.

Wheat herbage biomass was collected June 20, when the winter wheat was fully headed and beginning anthesis. On August 9 mature wheat heads were collected from 1 m of row to determine yield components; spikes per area, kernels per spike, and weight per kernel. Grain was harvested on August 10.

Table 1. Application data

Air temperature (C)		18
Soil temperature at 5.08 cm (C)		19
Relative humidity (%)		48
Wind speed (km/h) - direction		4.8-W
Soil	pH	5.6
	OM (%)	3.4
	CEC (meq/100g soil)	18.9
	Texture	silt loam

Biomass, spikes per area, 100 kernel weight, and grain yield were not effected by herbicide treatment (Table 2). Kernels per spike and test weight also were not effected by any herbicide treatment. Kernel per spike ranged fron 19 to 25 (average = 22). Test weight ranged from 669 to 708 kg m^{-3} (average = 688). (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Effect of clopyralid/2,4-D and difenzoquat alone and in tank mixture on yield components and grain yield of Lewjain winter wheat

Treatment[1]	Formulation	Rate	Herbage biomass	Spikes area^{-1}	100 Kernel weight	Grain yield
	(g L^{-1})	(kg ha^{-1})	(kg ha^{-1})	(no m^{-1})	(g)	(kg ha^{-1})
check	---	----	103	129	3.6	6793
clopyralid/2,4-D + R-11	286 SC	0.88 0.50%	130	131	3.5	6995
clopyralid/2,4-D + R-11		1.77 0.50%	102	107	3.5	6726
difenzoquat + R-11	240 SC	1.12 0.50%	103	108	3.6	7398
difenzoquat + R-11		2.24 0.50%	117	124	3.3	6927
clopyralid/2,4-D + difenzoquat + R-11		0.88 1.12 0.50%	108	132	3.4	6928
clopyralid/2,4-D + difenzoquat + R-11		1.77 2.24 0.50%	102	118	3.7	7130
clopyralid + difenzoquat + R-11	360 SC	0.138 1.12 0.50%	141	114	3.5	7062
clopyralid + difenzoquat + R-11		0.276 2.24 0.50%	105	131	3.5	7130
2,4-D amine + difenzoquat + R-11	480 SC	0.77 1.12 0.50%	112	109	3.4	7600
2,4-D amine + difenzoquat + R-11		1.54 2.24 0.50%	123	140	3.4	6995
LSD (0.05)			ns	ns	ns	ns

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.

Wild oat control with fall and spring applied imazamethabenz. Dial M. J. and D. C. Thill. Fall wild oat control in winter wheat with imazamethabenz was evaluated in field plots 9 miles east of Moscow, Idaho. Three rates of imazamethabenz were applied to 1 to 2 leaf wild oat on October 30, 1989. The 'Stephens' winter wheat had 1 to 3 leaves and was 3 in. tall. On April 19, 1990, diclofop and two rates of imazamethabenz were applied to wild oat with 2 to 3 leaves. Difenzoquat was applied on May 1, alone, as a sequential treatment to two of the fall applied imazamethabenz treatments, and in tank mixture with imazamethabenz to 4 to 5 leaf wild oat. Plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). Treatments were evaluated visually for percent wild oat control July 3, and the grain was harvested August 10.

Table 1. Application data

Wild oat growth stage (leaves)		1 to 2	2 to 3	4 to 5
Air temperature (F)		45	65	60
Soil temperature at 2 in. (F)		50	60	60
Relative humidity (%)		70	70	55
Wind speed (mph) - direction		1-W	1-E	3-E
Soil	pH	5.1		
	OM (%)	2.9		
	CEC (meq/100g soil)	19.0		
	Texture	silt loam		

Wild oat control with imazamethabenz was less than most other treatments when it was applied at 0.375 lb ai/a alone in the fall (Table 2). Other treatments controlled wild oat 90% or more. The wild oat population (7 plants/ft^2) was not competitive and grain yield was not different among treatments. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control and grain yield in winter wheat with fall and spring applied imazamethabenz

Treatment	Formulation	Rate	Appl. Timing	Control AVEFA	Grain yield
		(lb ai/a)	(leaves)	(% of check)	(bu/a)
check			----	--	75
imazamethabenz +	2.5 SC	0.47	1 to 2	92	89
R-11		0.25%			
imazamethabenz +		0.375	1 to 2	84	90
R-11		0.25%			
imazamethabenz +		0.47	1 to 2	92	89
R-11		0.25%			
difenzoquat	2.0 SC	1.00	4 to 5		
imazamethabenz +		0.47	1 to 2	90	74
R-11		0.25%			
difenzoquat		0.75	4 to 5		
imazamethabenz +		0.235	1 to 2	93	82
R-11		0.25%			
difenzoquat		0.50	4 to 5		
imazamethabenz +		0.47	2 to 3	95	96
R-11		0.25%			
imazamethabenz +		0.375	2 to 3	94	90
R-11		0.25%			
diclofop	3.00 EC	1.00	2 to 3	94	94
difenzoquat		1.00	4 to 5	90	76
imazamethabenz +		0.235	4 to 5	90	84
difenzoquat +		0.50			
R-11		0.25%			
LSD (0.05)				7	ns

[1]R-11 is a nonionic surfactant, rate is expressed as %v/v.
[2]Visual estimate of percent reduction in plant population density compared to the check.

Wild oat control with fenoxaprop-base herbicides in winter wheat. Dial, M. J. and D. C. Thill. Wild oat control with fenoxaprop and other wild oat herbicides was evaluated in 'Madsen' winter wheat. The experiment was located 5 miles west of Potlatch, Idaho. Diclofop, imazamethabenz, and HOE6001 were applied to 2 to 4 leaf wild oat on April 16. On May 1, HOE6001, HOE7125 and difenzoquat were applied to 3 to 5 leaf wild oat. The winter wheat was fully tillered and 4 in. tall when the first treatments were applied and 7 in. tall when the later treatments were sprayed.

The herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). The plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. Broadleaf weeds were controlled with DPXR9674 + bromoxynil + R-11 (0.0156 + 0.25 lb ai/a + 0.25 %v/v) on April 18. Percent wild oat control was evaluated visually on July 16 after the wild oat had headed. The grain was harvested on August 8.

Table 1. Application data

Application date	April 16	May 1
Air temperature (F)	72	58
Soil temperature at 2 in. (F)	70	55
Relative humidity (%)	72	60
Wind speed (mph) - direction	4-E	3-E
Soil pH	5.2	
OM (%)	4.1	
CEC (meq/100g soil)	21.0	
Texture	silt loam	

All herbicide treatments applied at the 2 to 4 leaf stage controlled wild oat 89% or greater (Table 2). HOE6001, HOE7125, and difenzoquat alone controlled wild oat 96% or greater when applied to 3 to 5 leaf wild oat. Adding surfactant to difenzoquat unexplainably reduced wild oat control. The wheat in plots treated with HOE7125 was 2 to 3 in. shorter compared to the check and other treatments (data not shown). Compared to the control, grain yield was greater when wild oat were controlled. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control and grain yield with fenoxaprop on winter wheat

Treatment[1]	Formulation		Rate	Appl. Timing	Control[2] AVEFA	Grain yield
			(lb ai/a)	(leaves)	(% of check)	(bu/a)
check					--	115
diclofop	3.00	EC	1.00	2 to 4	91	132
imazamethabenz + R-11	2.5	SC	0.47 0.25%	2 to 4	89	130
HOE6001[3]	0.58	EC	0.074	2 to 4	90	135
HOE7125[3]	3.08	EC	0.66	3 to 5	94	128
HOE6001[3]			0.074	3 to 5	96	133
difenzoquat	2.00	SC	1.00	3 to 5	96	132
difenzoquat + R-11			1.00 0.25%	3 to 5	87	130
LSD (0.05)					5	7
Plants/ft^2					25	

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.
[2]Visual estimate of percent reduction in plant population density compared to the check.
[3]All contain fenoxaprop as the active ingredient for wild oat control.

Wild oat control in winter wheat with imazamethabenz and difenzoquat tank mixtures. Dial, M. J. and D. C. Thill. Imazamethabenz and difenzoquat tank mixtures were evaluated for wild oat (AVEFA) control in winter wheat at two locations near Potlatch, Idaho. The herbicides were applied to wild oat at two growth stages. On April 19, the herbicides were applied to wild oat with 2 to 3 leaves and on May 1 to wild oat with 4 to 5 leaves at both locations. Broadleaf weeds were controlled at both locations with 0.0234 lb ai/a DPXR9674 + 0.125 % v/v R-11 applied on April 18. The herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). The plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. The treatments were evaluated visually for percent wild oat control July 16 after the wild oat had headed. Grain was harvested August 8.

Table 1. Application data

Location	One		Two	
Application date	April 19	May 1	April 19	May 1
Air temperature (F)	46	56	55	60
Soil temperature at 2 in. (F)	45	50	52	59
Relative humidity (%)	80	60	70	65
Wind speed (mph) - direction	2-E	3-E	3-W	4-W
Soil pH	4.8		5.2	
OM (%)	3.4		3.3	
CEC (meq/100g soil)	21.0		17.0	
Texture	silt loam		silt loam	
Variety	Madsen		Stephens	

Wild oat control at the 2 to 3 leaf stage was consistently best with difenzoquat applied alone (Table 2). At the 4 to 5 leaf stage, all wild oat treatments controlled wild oat equally except imazamethabenz + difenzoquat (0.1175 + 0.5 lb ai/a, respectively) at location one. Grain yield was greater for all herbicide treatments compared to the control at location one (17 wild oat plants/ft^2). Controlling wild oat did not improve grain yield at location two (8 wild oat plants/ft^2). (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. The effect of imazamethabenz and difenzoquat tank mixtures on wild oat control and grain yield in winter wheat

Treatment[1]	Formulation		Rate	Timing	Control[2] AVEFA		Grain yield	
			(lb ai/a)	(leaves)	(- % of check-)		(--bu/a--)	
					one	two	one	two
check					--	--	103	98
imazamethabenz	2.5	SC	0.47	2 to 3	84	89	125	112
diclofop	3.0	EC	1.00	2 to 3	91	86	121	106
difenzoquat	2.0	SC	1.00	2 to 3	94	91	130	107
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.235 0.50	2 to 3	79	89	129	103
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.1175 0.50	2 to 3	75	86	121	109
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.31 0.25	2 to 3	78	83	126	110
difenzoquat	2.0	SC	1.00	4 to 5	95	93	119	109
imazamethabenz	2.5	SC	0.47	4 to 5	92	94	129	103
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.235 0.50	4 to 5	89	91	125	112
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.1175 0.50	4 to 5	83	91	127	104
imazamethabenz + difenzoquat	2.5 2.0	SC SC	0.31 0.25	4 to 5	92	94	127	118
LSD (0.05)					7	4	9	ns

[1]Wild oat density at location one and two was 17 and 8 plants/ft^2, respectively.

[2]Visual estimate of reduction in population density compared to the check.

Broadleaf weed control in winter wheat. Dial, M. J. and D. C. Thill. Broadleaf weed control was evaluated in two separate herbicide experiments near Potlatch, Idaho. Three rates of DPXL5300 and one rate of triasulfuron were applied alone and in tank mixture with other herbicides to 'Stephens' winter wheat on April 19, 1990 at location one. The winter wheat had tillered and was 4 in. tall, mayweed chamomile (ANTCO) was 2 in. in diameter, coast fiddleneck (AMSIN) had 4 leaves, and wild buckwheat (POLCO) was just emerging to having 1 true leaf.

Reduced rates of metribuzin tank mixed with DPXR9674 or DPXL5300 were applied to Stephens winter wheat April 10, at location two. The winter wheat had 2 tillers and was 4 in. tall, mayweed chamomile was 3 in. in diameter, coast fiddleneck had 5 to 8 leaves, and interrupted windgrass (APEIN) had 3 to 5 leaves.

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). Treatments were arranged in a randomized complete block design replicated four times. The plots were 10 by 30 ft.

Herbicide efficacy was evaluated at location one on May 14, and July 2. Grain was harvested on August 9. Broadleaf weed control was evaluated at location two on May 11, and interrupted windgrass control was evaluated July 16. Grain was harvested August 28.

Table 1. Application data

Location	one	two
Air temperature (F)	50	52
Soil temperature at 2 in. (F)	50	48
Relative humidity (%)	60	61
Wind speed (mph) - direction	4-W	4-E
Soil pH	5.4	5.1
OM (%)	4.2	4.5
CEC (meq/100g soil)	20.9	14.7
Texture	silt loam	silt loam

The winter wheat crop at location one was highly competitive and all herbicide treatments controlled mayweed chamomile, coast fiddleneck, and wild buckwheat 90% or greater (Table 2). Grain yield was not different among herbicide treatments. All treatments in experiment two controlled mayweed chamomile and coast fiddleneck equally (Table 3). DPXR9674 alone or in tank mixture with metribuzin controlled interrupted windgrass 92% or greater. Interrupted windgrass control was unexplainably reduced when DPXR9674 was tank mixed with bromoxynil. Interrupted windgrass control was less with DPXL5300 treatments compared to DPXR9674 treatments (except bromoxynil). Grain yield was greater than the control for most treatments. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control and grain yield with DPXL5300 and triasulfuron

Treatment[1]	Formulation	Rate	Control[2] ANTCO	Control[2] AMSIN	Control[2] POLCO	Grain yield
		(lb ai/a)	(-----% of check----)			(bu/a)
check			--	--	--	105
DPXL5300+	75 DF	0.0038	95	95	90	120
2,4-D amine	3.8 SC	0.25				
DPXL5300+		0.0050	95	95	91	111
2,4-D amine		0.25				
DPXL5300+		0.0078	95	95	90	118
2,4-D amine		0.25				
DPXL5300+		0.0038	95	95	90	105
MCPA amine	4.0 SC	0.25				
DPXL5300+		0.0050	95	95	93	117
MCPA amine		0.25				
DPXL5300+		0.0078	95	95	95	115
MCPA amine		0.25				
DPXL5300+		0.0038	95	95	95	110
dicamba	2.0 SC	0.125				
DPXL5300+		0.0050	95	95	95	113
dicamba		0.125				
DPXL5300+		0.0078	95	95	95	120
dicamba		0.125				
DPXL5300		0.0078	95	95	95	105
triasulfuron+	75 DF	0.0134	95	95	95	111
2,4-D amine		0.25				
triasulfuron+		0.0134	95	95	95	114
MCPA amine		0.25				
triasulfuron+		0.0134	95	95	95	102
bromoxynil	2.0 EC	0.1875				
triasulfuron+		0.0134	95	95	95	107
dicamba		0.125				
triasulfuron+		0.0134	95	95	95	92
bromoxynil/MCPA	2.0 EC	0.1875				
triasulfuron+		0.0134	95	95	95	115
diuron	80 DF	0.4				
triasulfuron+		0.0134	95	95	95	107
metribuzin	75 DF	0.094				
triasulfuron+		0.0134	95	95	95	112
metribuzin		0.141				
triasulfuron		0.0134	95	95	95	105
LSD (0.05)			ns	ns	ns	ns

[1]All treatments were applied with 0.125% v/v R-11, a nonionic surfactant.

[2]Percent reduction in plant population compared to the check.

Table 3. Broadleaf and annual grassy weed control with reduced-rate metribuzin tank mixtures

Treatment[1]	Formulation		Rate	Control[2] ANTCO	AMSIN	APEIN	Grain yield
			(lb ai/a)	(-----% of check-----)			(bu/a)
check				--	--	--	95
DPXR9674 +	75	DF	0.0234	95	95	92	111
DPXR9674 + bromoxynil	75 2.0	DF EC	0.0234 0.1875	93	96	66	107
metribuzin+ DPXR9674	75 75	DF DF	0.094 0.0141	94	96	93	100
metribuzin+ DPXR9674	75 75	DF DF	0.094 0.0188	95	96	94	115
metribuzin+ DPXR9674	75 75	DF DF	0.141 0.0141	94	95	93	112
metribuzin+ DPXR9674	75 75	DF DF	0.141 0.0188	94	95	93	110
metribuzin+ DPXL5300	75 75	DF DF	0.094 0.0038	84	91	82	107
metribuzin+ DPXL5300	75 75	DF DF	0.094 0.0050	88	95	83	105
metribuzin+ DPXL5300	75 75	DF DF	0.094 0.0078	86	94	83	111
metribuzin+ DPXL5300	75 75	DF DF	0.141 0.0038	89	95	74	107
metribuzin+ DPXL5300	75 75	DF DF	0.141 0.0050	85	95	80	106
metribuzin+ DPXL5300	75 75	DF DF	0.141 0.0078	90	91	81	118
LSD (0.05)				ns	ns	10	11

[1]All treatments were applied with 0.125% v/v R-11, a nonionic surfactant.

[2]Percent reduction in plant population compared to the check.

Broadleaf weed control in winter wheat. Dial, M. J. and D. C. Thill. Several herbicides were evaluated for broadleaf weed control in 'Trez' winter wheat near Plummer, Idaho. UBIC4243, V-23121, imazamethabenz, and diclofop were applied preemergence surface on October 11, 1990 to conventionally seeded winter wheat. A fall postemergence herbicide application was applied October 30 after the winter wheat had 2 fully developed leaves. No weeds were emerged at this time. Early spring herbicide applications were made on May 3, 1990 to fully tillered winter wheat, 2 in. diameter mayweed chamomile (ANTCO), and 4 to 6 leaf coast fiddleneck (AMSIN). The metribuzin application requires wheat to have 2 in. adventitious roots and was delayed until May 19 to allow the winter wheat to recover from the effects of severe frost heaving. At this application date, mayweed chamomile was 4 in. in diameter and the coast fiddleneck had 8 leaves and was 5 in. in diameter. The treatments were arranged in a randomized complete block design replicated four times. Plots were 10 by 30 ft. The herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a spray solution at 40 psi and 3 mph (Table 1). The herbicide treatments were evaluated visually for percent weed control July 3. Winter Wheat was harvested August 15.

Table 1. Application data

Application date	October 21	October 30	May 5	May 19
Air temperature (F)	58	50	60	55
Soil temperature at 2 in. (F)	54	52	51	60
Relative humidity (%)	65	48	71	70
Wind speed (mph) - direction	5-E	3-W	1-E	1-W
Soil pH	5.4			
OM (%)	3.1			
CEC (meq/100g soil)	13.9			
Texture	silt loam			

UBIC4243 applied alone and sequentially with imazamethabenz controlled mayweed chamomile and coast fiddleneck 90% or greater (Table 2). The broadleaf herbicides DPXR9674, chlorsulfuron, and metribuzin also controlled mayweed chamomile and coast fiddleneck. V23121 did not control these broadleaf weeds. Imazamethabenz or diclofop applied alone did not control either weed at any application time. HOE7125 did not control mayweed chamomile or coast fiddleneck adequately when applied at either rate. Grain yield was variable and was not related to weed control. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control and grain yield with different herbicide treatments in winter wheat

Treatment[1]	Formulation		Rate	Appl.[2] time	Control[3] ANTCO	Control[3] AMSIN	Grain yield
			(lb ai/a)		(--% of check--)		(bu/a)
check					--	--	35
UBIC4243	0.83	EC	0.125	PES	90	90	48
V-23121	0.88	FL	0.022	PES	0	0	45
imazamethabenz	2.5	SC	0.47	PES	0	0	46
diclofop	3.00	EC	1.00	PES	0	0	41
diclofop /			1.00	PES	95	95	45
DPXR9674 +	75	DF	0.0234	ESPRI			
bromoxynil +	2.00	EC	0.25				
R-11			0.25%				
UBIC4243 +			0.125	PES	93	95	46
imazamethabenz			0.47	POST			
imazamethabenz			0.47	POST	0	0	38
imazamethabenz +			0.47	POST	91	95	46
chlorsulfuron	75	DF	0.0156				
imazamethabenz /			0.47	POST	95	95	45
DPXR9674 +			0.0234	ESPRI			
bromoxynil +			0.25				
R-11			0.25%				
imazamethabenz			0.47	ESPRI	0	0	39
diclofop			1.00	ESPRI	0	0	42
HOE7125	3.08	EC	0.66	ESPRI	65	69	45
HOE7125			0.78	ESPRI	65	70	42
imazamethabenz +			0.47	ESPRI	95	95	47
DPXR9674 +			0.234				
R-11			0.25%				
imazamethabenz +			0.38	ESPRI	95	95	45
DPXR9674 +			0.0156				
R-11			0.25%				
DPXR9674 +			0.0281	ESPRI	94	90	42
R-11			0.25%				
imazamethabenz			0.47	ESPRI	80	85	41
DPXR9674 +			0.0234				
R-11			0.25%				
metribuzin	75	DF	0.38	2" ADV.	95	95	47
LSD (0.05)					29	30	7

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.

[2]Timing: PES = preemergence fall, POST = postemergence fall to two leaf wheat, ESPRI = early spring, and 2" ADV = 2 in. adventitious roots.

[3]Visual estimate of percent reduction in population compared to the check.

Ivyleaf speedwell control with preemergence surface and postemergence herbicide applications in winter wheat. Dial, M. J. and D. C. Thill. Herbicide control of ivyleaf speedwell (VERHE) was evaluated at two locations in winter wheat in northern Idaho. Three rates of UBIC4243 and V-23121 were applied preemergence surface (PES) on October 12, 1989 to no-till seeded 'Hawk' winter wheat. DPXR9674 tank mixed with bromoxynil was applied March 21, 1990 to ivyleaf speedwell that was 3 in. in diameter as a postemergence standard treatment. This experiment was located south of Lewiston, Idaho.

Ivyleaf speedwell control also was evaluated in conventionally seeded 'Daws' winter wheat near Kendrick, Idaho. Pyridate was applied alone and in tank mixture on March 22 to ivyleaf speedwell 3 in. in diameter and starting to bloom.

Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). The plots were 10 by 30 ft and treatments were arranged in a randomized complete block design replicated four times. The experiment south of Lewiston was evaluated visually for percent ivyleaf speedwell control March 21 and May 10. Plots treated with pyridate and pyridate tank mixtures were evaluated visually for control of ivyleaf speedwell April 13 and April 24. Grain was harvested at Lewiston on August 2, and at Kendrick on August 10.

Table 1. Application data

Location	Lewiston		Kendrick
Application date	October 12	March 21	March 22
Air temperature (F)	60	60	55
Soil temp. at 2 in. (F)	58	59	59
Relative humidity (%)	52	50	65
Wind speed (mph) - direction	3-N	4-N	1-W
Soil pH	5.3		5.2
OM (%)	3.4		4.1
CEC (meq/100g soil)	24.0		23.8
Texture	silt loam		silt loam

UBIC4243 controlled ivyleaf speedwell 80% or greater (Table 2). V-23121 or DPXR9674 + bromoxynil did not control ivyleaf speedwell. Grain yield was 6 to 8 bu/a higher when ivyleaf speedwell was controlled.

Pyridate alone did not control ivyleaf speedwell effectively (Table 3). Tank mixing pyridate with bromoxynil, clopyralid/MCPA, ethiozin, or metribuzin controlled ivyleaf speedwell 85% or greater. Weed control did not affect grain yield. (Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Ivyleaf speedwell control and grain yield with preemergence surface and postemergence herbicides in no-till winter wheat

Treatment[1]	Formulation		Rate	Timing	Control[2] VERHE		Grain yield
			(lb ai/a)		(---% of check---) March 21	May 10	(bu/a)
check					--	--	34
UBIC4243	0.83	EC	0.063	PES	80	83	35
UBIC4243	0.83	EC	0.125	PES	90	87	41
UBIC4243	0.83	EC	0.188	PES	88	87	43
V-23121	0.88	FL	0.0132	PES	0	0	29
V-23121	0.88	FL	0.0176	PES	0	0	31
V-23121	0.88	FL	0.022	PES	0	0	33
DPXR9674 + bromoxynil + R-11	75 2.0	DF EC	0.0234 0.25 0.25%	ESPRI	--	61	31
LSD (0.05)					10	22	7

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.
[2]Visual estimate of percent reduction in population density compared to the check.

Table 3. Ivyleaf speedwell control and grain yield in conventionally seeded winter wheat

Treatment[1]	Formulation		Rate	Control[2] VERHE		Grain yield
			(lb ai/a)	(----% of check----)		(bu/a)
				April 13	April 24	
check				--	--	100
pyridate	3.75	EC	0.67	44	44	98
pyridate + bromoxynil	3.75 2.00	EC EC	0.67 0.25	90	90	93
pyridate + dicamba	3.75 2.00	EC SC	0.67 0.125	45	55	98
pyridate + clopyralid/MCPA	3.75 2.77	EC SC	0.67 0.40	85	85	89
pyridate + ethiozin	3.75 50	EC DF	0.67 0.75	85	90	91
pyridate + metribuzin	3.75 75	EC DF	0.67 0.141	94	93	89
pyridate + triasulfuron + R-11	3.75 75	EC DF	0.67 0.0134 0.125%	54	50	95
pyridate + DPXL5300 + R-11	3.75 75	EC DF	0.67 0.0078 0.125%	0	0	97
pryidate + DPXR9674 + R-11	3.75 75	EC DF	0.67 0.0156 0.125%	61	68	90
pyridate + diuron	3.75 80	EC DF	0.67 0.4	64	63	93
DPXR9674 + R-11	75	DF	0.0234 0.125%	40	46	91
LSD (0.05)				41	46	ns

[1]R-11 is a nonionic surfactant, rate is expressed as % v/v.
[2]Visual estimate of percent reduction in population density compared to the check.

Broadleaf weed control in winter wheat. Dial, M. J., D. C. Thill, and M. Alcocer-Ruthling. Broadleaf weed control was evaluated in a herbicide experiment near Potlatch, Idaho. 2,4-D LVE and MCPA ester were compared with bromoxynil and bromoxynil/MCPA alone and in tank mixture with DPXR9674 or DPXL5300 for mayweed chamomile (ANTCO) control. The herbicide treatments were applied April 20, to 'Stephens' winter wheat with three tillers and mayweed chamomile 2 inches in diameter. 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). Treatments were arranged in a randomized complete block design replicated four times. The plots were 10 by 30 ft.

Mayweed chamomile control and crop injury symptoms were evaluated visually on June 6 and July 16. Grain was harvested September 10.

Table 1. Application data

Air temperature (F)	55
Soil temperature at 2 in.	60
Relative humidity (%)	78
Wind speed-direction (mph)	1-W
Soil pH	4.5
OM (%)	3.9
CEC (meq/100g soil)	20.5
Texture	silt loam

On June 6, all herbicide treatments except DPXR9674 + MCPA ester, MCPA ester alone, and 2,4-D LVE controlled mayweed chamomile 93% or greater (Table 2). At the July 16 evaluation, all herbicide treatments except MCPA ester controlled mayweed chamomile 90% or greater. No visible crop injury symptoms were observed. However, grain yield was less than the control when MCPA or 2,4-D where applied to the wheat. Controlling mayweed chamomile did not increase grain yield compared to the untreated control. (Agricultural Experiment Station, Moscow, Idaho 83843).

Table 2. Broadleaf weed control in winter wheat

Treatment[1]	Formulation	Rate	Control[2] ANTCO June 6	Control[2] ANTCO July 16	Grain yield
		(lb ai/a)	(% of check)		(bu/a)
check					107
bromoxynil/MCPA	2.00 EC	0.375	93	95	108
bromoxynil+	2.00 EC	0.1875	95	94	109
DPXR9674+	75 DF	0.0078			
R-11		0.25%			
bromoxynil+		0.1875	95	95	107
DPXL5300+	75 DF	0.0078			
R-11		0.25%			
bromoxynil+		0.1875	93	94	103
DPXR9674+		0.0156			
R-11		0.25%			
DPXR9674+		0.0156	95	95	104
R-11		0.25%			
DPXL5300+		0.0078	95	93	107
R-11		0.25%			
DPXR9674+		0.0156	86	92	97
MCPA ester+	4.00 EC	0.25			
R-11		0.25%			
MCPA ester		0.75	83	86	97
2,4-D LVE	3.00 SC	0.50	78	92	98
bromoxynil		0.1875	93	91	111
LSD (0.05)			6	4	9
Mayweed chamomile/ft^2			3		

[1]All treatments with DPRXR9674 and DPXL5300 were applied with 0.25% v/v R-11, a nonionic surfactant.

[2]Percent reduction in plant population compared to the check.

Winter wheat and spring barley injury from residual clomazone. Lish, J.M. and D.C. Thill. Clomazone was applied to spring pea in May, 1989 to determine clomazone carryover effects to spring barley and winter wheat in northern Idaho. Application information and effects on pea were reported previously (in *WSWS Research Progress Report*, 1990, pp. 332-333). 'Lewjain' winter wheat and 'Russell' spring barley were planted October 2, 1989 and April 16, 1990, respectively. Wheat and barley chlorosis was evaluated visually on April 17 and June 16, respectively. Grain was harvested at maturity.

Chlorosis from herbicide treatments was the same for wheat and barley (Table). Clomazone at 0.25 lb ai/a and the split application of metribuzin did not cause injury. Clomazone + bentazon injured wheat and barley, but this injury was not as severe as the clomazone + metribuzin treatment or clomazone at 0.5 lb ai/a. Injury was most severe with clomazone at 1 lb ai/a. Wheat yield was variable throughout the experiment due to an uneven population of volunteer triticale. The low wheat yield from the clomazone at 1 lb ai/a treatment was not statistically different from other treatments. Barley treated with clomazone at 1 lb ai/a yielded less than other treatments except clomazone at 0.5 lb ai/a. Barley was harvested from two replications only because of poor stand due to complications while seeding. (Idaho Agricultural Experiment Station, Moscow, Idaho)

Table. Clomazone carryover to winter wheat and spring barley

		Wheat		Barley	
Treatment	Rate	Injury	Yield	Injury	Yield
	lb ai/a	%	lb/a	%	lb/a
control	--	0 a[1]	4348 a	0 a	2713 a
clomazone	0.25	0 a	4056 a	0 a	2810 a
metribuzin (pre) + metribuzin (post)	0.25 0.15	0 a	5067 a	0 a	2815 a
clomazone + bentazon	0.38 0.75	16 b	4321 a	9 b	2796 a
clomazone + metribuzin	0.38 0.25	26 c	4371 a	23 c	2400 a
clomazone	0.50	26 c	4121 a	38 c	2394 ab
clomazone	1.00	40 d	3319 a	67 d	1859 b

[1]Means followed by the same letter within a column are not different according to Duncans Multiple Range test (p = 0.05).

Non-target effects from clomazone. Westra, P. and W. Stump. Since clomazone was labeled for chemical fallow weed control in 1988 the potential exists for non-target movement and damage to adjacent crops. Four field studies were conducted to investigate the potential drift and volatility of clomazone and the effect on non-target wheat.

Study one involved the application of clomazone at 0.025, 0.05, 0.10, 0.20, 0.30, 0.40, and 0.50 lb ai/a in 15 gpa to growing winter wheat. The study was conducted at two field sites one sprayed October 5, 1989 with wheat in the 5 leaf stage the other November 16, 1989 wheat being in the 3 to 4 leaf stage. All treatments caused some level of chlorosis ranging from 10 to 80% plant tissue affected in the first study and 10 to 60% in the second study. Percent chlorosis increased with rate. Plots were visually rated for stand reduction in early May and differences were noted between study sites. Greater stand reduction occurred at the first site with up to 80% stand loss at the 0.50 lb ai/a rate. The second study which had better moisture conditions, had stand losses up to 50% at the high rate. Plots were taken to yield in the second study but yields were not significantly different from the check.

In study two, clomazone movement due to wind effects and subsequent injury to wheat was investigated. Clomazone at a rate of 0.75 lb ai/a was applied to a 10 by 120 foot strip of winter wheat in the 5 leaf stage. The study was conducted at two sites, one sprayed on October 5, 1989 the other on November 14, 1989. Each time a 10 to 15 mph cross-wind existed at time of application. Clomazone type injury was noted within a week of application with wheat chlorosis present 45 to 50 feet downwind from application point. Percent chlorosis at application point was 50 to 70% with injury levels decreasing to less than 10% at 50 feet from application. Yields were taken in the second study by sampling wheat in 12.5 foot increments downwind from application point. Yields were reduced by 50% in area nearest application with 20% reduction at 25 feet, 10% at 37 feet and no yield reduction at 50 feet.

Study three examined rainfall effects on clomazone volatility and subsequent injury to wheat. Clomazone was applied in a 10 by 10 foot area in standing wheat at a rate of 0.75 lb ai/a then 0.5 inches of water was applied to the sprayed area. Chlorosis of the wheat was observed only in the herbicide applied area.

Study four investigated non-target effects from clomazone volatility on various crop species. Clomazone was applied at a rate of 0.75 lb ai/a to a 20 by 20 foot area of fallow ground. Immediately after application a 8 by 8 foot platform with flats of radish, sunflower and wheat plants were placed 36 inches above the sprayed area, check plants were placed 100 yards away. After 10 hours, plants were transferred to the greenhouse for evaluation. After 2 weeks, the only injury noted was minor chlorosis on 2 radish plants.

Results indicate non-target injury to wheat can occur due to wind drift. Plants however, typically recover with no negative impact to yield unless plants were directly in the spray path or within 15 feet. No injury was observed due to volatilization drift.

Wild oats control with imazamethabenz plus difenzoquat. Zamora, D.L. Wild oats control in winter wheat (var. 'Stephens') with tank mixes of imazamethabenz plus difenzoquat were tested near Johnson, Washington and Grangeville, Idaho. Soils at both locations were silt loams with 3% organic matter. Applications were made with a CO_2 pressurized backpack sprayer, delivering 20 gpa at 32 psi and 3 mph. The experiments were randomized complete block designs with four replications. Plots were 7 by 25 ft. Treatments were applied on May 5, 1990 at both locations.

Wild oats at Johnson had 2 to 5 leaves at application; wild oat density was 6/ft². The air temperature at application was 60F, soil temperature was 50F, and the relative humidity was 60%. Weed control was visually evaluated on June 7. Wild oats at Grangeville had 5 to 7 leaves and 3 tillers at application; wild oat density was 3/ft². The air temperature at Grangeville was 65F, soil temperature was 55F, and the relative humidity was 50%. Weed control was visually evaluated on July 9.

Reduced rates of imazamethabenz plus difenzoquat (regardless of the ratio) controlled wild oats as well as imazamethabenz alone at Johnson (Table 1) and Grangeville (Table 2). Imazamethabenz plus difenzoquat (0.234 + 0.75 lb ai/a) controlled more wild oats (96%) at Grangeville than difenzoquat (1.0 lb ai/a) alone (91%). (American Cyanamid Company, 4525 Cochees Way, Boise, ID 83709)

Table 1. Wild oats control at Johnson, WA

Treatment[1]	Rate	Wild oats
	(lb ai/a)	(% of check)
imazamethabenz	0.47	91
difenzoquat	0.63	88
difenzoquat	0.75	84
difenzoquat	1.0	88
imazamethabenz + difenzoquat	0.156 + 0.75	92
imazamethabenz + difenzoquat	0.234 + 0.5	88
imazamethabenz + difenzoquat	0.234 + 0.75	89
LSD (0.05)		N.S.

[1]All treatments included a nonionic surfactant at 0.25% volume to volume

Table 2. Wild oats control at Grangeville, ID

Treatment[1]	Rate	Wild oats
	(lb ai/a)	(% of check)
imazamethabenz + DPX-R9674	0.47 + 0.023	95
difenzoquat + DPX-R9674	0.75 + 0.023	94
difenzoquat + DPX-R9674	1.0 + 0.023	91
imazamethabenz + difenzoquat + DPX-R9674	0.234 + 0.5 + 0.023	95
imazamethabenz + difenzoquat	0.234 + 0.75	92
imazamethabenz + difenzoquat + DPX-R9674	0.234 + 0.75 + 0.023	96
LSD (0.05)		4

[1]All treatments included a nonionic surfactant at 0.25% volume to volume

Downy brome control in winter wheat. Miller, S.D. and J.M. Krall. Plots were established under dryland conditions at the Research and Extension Center, Archer, Wyoming to evaluate the efficacy of herbicide treatments for downy brome control in winter wheat. Plots were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Preplant treatments were applied, winter wheat (var. Buckskin) seeded and preemergence treatments applied September 7, 1989 (air temp. 65F, relative humidity 84%, wind NE at 10 mph, sky partly cloudy and soil temp. - 0 inch 88F, 2 inches 72F and 4 inches 64F). Early postemergence treatments were applied September 25, 1989 (air temp. 65F, relative humidity 20%, wind NW at 10 mph, sky clear and soil temp. 0 inch 85F, 2 inches 64F and 4 inches 54F) to 2-leaf winter wheat and emerging downy brome. Postemergence treatments were applied October 6, 1989 (air temp. 50F, relative humidity 68%, wind S at 10 mph, sky clear and soil temp. - 0 inch 62F, 2 inches 44F and 4 inches 42F) to 4-leaf winter wheat and 2 to 3-leaf downy brome. The soil was a loam (51% sand, 27% silt and 22% clay) with 1.4% organic matter and pH 7.5. Visual weed control and crop damage evaluations were made April 12, plant height measured July 2 and plots harvested July 26, 1990. Downy brome (BROTE) infestations were moderate but variable throughout the experimental site.

Winter wheat injury and stand reductions were substantial (33 to 98%) with CGA-136872 applied preplant, preemergence and postemergence or with clomazone and SMY-1500 applied preemergence. Downy brome control with SMY-1500 ranged from 70 to 100% depending on rate and time of application. Winter wheat yields correlated directly to downy brome control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1759)

Downy brome control in winter wheat.

Treatment[1]	Rate lb ai/A	Winter wheat[2] Inj %	SR %	Height inches	Yield bu/A	BROTE Control[3] %
Preplant						
triallate	1.0	0	7	30	26	80
triallate	1.5	0	10	30	26	85
diclofop	1.25	0	0	30	25	73
SMY-1500	1.0	0	5	31	27	90
CGA-136872	0.036	40	52	18	9	98
clomazone	0.125	0	0	31	27	92
clomazone	0.25	3	5	30	26	95
Preemergence						
triallate	1.0	0	3	30	25	67
triallate	1.5	0	3	31	26	77
diclofop	1.25	0	7	30	25	60
SMY-1500	1.0	35	62	23	9	100
CGA-136872	0.036	73	98	11	0	98
clomazone	0.125	33	47	23	9	92
clomazone	0.25	67	85	15	1	98
Early postemergence						
CGA-136872+X-77	0.036+0.25%	80	95	11	0	100
SMY-1500	0.75	0	0	31	26	70
SMY-1500	1.0	0	0	31	28	87
SMY-1500	1.25	0	3	31	27	87
Postemergence						
SMY-1500	1.0	0	0	32	28	82
SMY-1500+metribuzin	1.0+0.063	0	5	31	27	90
SMY-1500	1.25	0	3	31	28	85
SMY-1500+metribuzin	1.25+0.063	0	10	30	27	92
weedy check	- - - - -	0	0	31	23	0

[1]Treatments applied September 7, September 25 and October 6, 1989.
[2]Winter wheat injury (Inj) and stand reduction (SR) visually evaluated April 12, plant height measured July 2 and plots harvested July 26, 1990.
[3]Downy brome control visually evaluated April 12, 1990.

Antagonism of postemergence grass herbicides by pyridate applied as a tank-mix. Brewster, Bill D., Don L. Kloft, and Arnold P. Appleby. Pyridate and postemergence grass herbicides are being investigated for use in peppermint, seedling alfalfa, and seedling clover in Oregon. Tank-mixing pyridate with the grass herbicides would make the application more economical. A trial was conducted to evaluate the effect of tank mixing pyridate on the performance of four postemergence grass herbicides.

Two rows each of nine grasses were seeded across each plot in a trial at the Hyslop research farm near Corvallis. When the herbicides were applied, the wheat, Italian ryegrass, oats, and downy brome had three to five tillers, while the other grasses had three to four leaves. The experimental design was a randomized complete block with four replications and 2.5-m by 7.5-m plots. The herbicides were applied in a spray volume of 234 L/ha at 172 kPa through XR 8003 flat fan tips. Evaluations conducted 1 month after herbicide application are included in the table.

Besides the grasses listed in the table, Kentucky bluegrass, barnyardgrass, and green foxtail were evaluated. The only reduction in performance of the grass herbicides with pyridate on these three species was a slight antagonism on sethoxydim. Sethoxydim was antagonized more by pyridate on most of the other species as well, but all herbicides appeared to be slightly antagonized on several species. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331)

Effect of pyridate on grass control by postemergence grass herbicides

		Grass control											
		Wheat		Italian ryegrass		Proso millet		Large crabgrass		Oats		Downy brome	
Herbicide[1]	Rate	NP[2]	P	NP	P	NP	P	NP	P	NP	P	NP	P
	(kg a.i./ha)	(%)											
quizalofop-P	0.11	98	97	100	95	100	99	100	94	100	99	100	100
fluazifop-P	0.21	93	84	88	70	100	99	99	100	100	100	100	100
sethoxydim	0.31	70	50	97	76	100	95	98	89	100	50	35	0
UBI C4874	0.14	96	93	94	79	100	99	100	99	100	97	100	100
check	0	0	--	0	--	0	--	0	--	0	--	0	--

[1]Crop oil concentrate added to all treatments at 2.3 L/ha.
[2]NP = no pyridate, P = pyridate tank-mixed at a rate of 1.0 kg a.i./ha.

Control of ALS resistant and susceptible kochia with various herbicides. Westra, P and D.J. Tonks. Since the introduction of ALS inhibitor herbicides, which are highly effective for weed control, several weed species have developed resistance in a few years. One example of a resistant weed is kochia which is an extremely competitive weed in small grains. Methods need to be developed to control this resistant weed while providing adequate control of other weed species.

In 1990, two field tests were conducted to test the response of kochia to herbicides which could be used in small grain/fallow systems. Metsulfuron at 0.03 lb ai/A, imazapyr at 1.5 lb ai/A, sulfometuron at 0.09 lb ai/A, 2,4-D + dicamba at 0.5 + 0.5 lb ai/A, glyphosate + dicamba at 0.57 + 0.25 lb ai/A, glyphosate at 0.56 lb ai/A, and dicamba at 0.5 lb ai/A were applied to two areas: one which had no previous history of ALS inhibitor herbicide use, located near Windsor, CO, and the other where kochia had developed resistance to ALS inhibitor herbicides, located near Arriba, CO. An amine formulation of 2,4-D was also applied at Arriba. Herbicides were applied with a CO_2 powered backpack sprayer which delivered a volume of 13 gpa at 20 psi through 11001 LP flat fan nozzles. Each experiment was arranged as a randomized complete block with plot size of 10 by 30 feet. The kochia at Arriba was treated when the plants were .5 to 1 inch tall, and at Windsor when kochia was approximately 12 inches tall. Plant densities at Arriba were 150-200 plants per square foot, and at Windsor were 20-50 plants per square foot.

Treatments containing dicamba provided good to excellent control of resistant kochia, located at Arriba, ranging from 75 to 90% control, while glyphosate alone gave poor control at 13%. The poor control of kochia provided by glyphosate was due to the small size of the kochia at the time of treatment, not to any detectable resistance to glyphosate. Metsulfuron, imazapyr, and sulfometuron gave 0% control in the resistant kochia. Susceptible kochia at Windsor was controlled by all herbicide treatments at 88% or higher except for 2,4-D amine. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Control of resistant and susceptible kochia in fallow.

Treatment	rate lb ai/A	Arriba (resistant)	Windsor (susceptible)
		--(% control)--	
metsulfuron	0.03	0	88
imazapyr	1.5	0	92
sulfometuron	0.09	0	100
2,4-D + dicamba	0.5 0.5	90	92
glyphosate + dicamba	0.57 0.25	75	88
glyphosate	0.56	13	96
dicamba	0.5	87	93
2,4-D amine	0.5	-	63
check		0	0
LSD (0.05)		4	6

PROJECT 4

EXTENSION, EDUCATION, AND REGULATORY

BOB PARKER - CHAIRPERSON

TOM WHITSON - CHAIRPERSON - ELECT

Newly reported weed species; potential weed problems in Idaho. Old, R.R., F.E. Northam, and R.H. Callihan. The distributions of weed species submitted from all sources for identification by weed science diagnostic personnel, and of weed species otherwise called to our attention, were examined to discover changes in distribution records. The distributions were categorized into three groups: (I) those not previously reported in floras or other documents to exist in the Pacific Northwest; (II) those not previously documented for Idaho, although present in the Pacific Northwest (Hitchcock and Cronquist, Flora of the Pacific Northwest, 1973); (III) those previously reported in Idaho, wherein the known range of the species has been expanded to other counties due to 1990 field observations. None of the species new to Idaho were found to be new records for the Pacific Northwest (Idaho, Oregon and Washington) in 1990. Six species were found to be new records for Idaho in 1990. Extensions of the ranges of several species that have been present in Idaho for several years were also recorded. Several species of plants not previously reported in Idaho were observed during 1990 and were considered to possess the potential to become problem weeds. All such species are included in this report. Thirty-one species, including the six species new to Idaho, were found to be new records for individual counties in 1990. The reporting period for these data was November 30, 1989 to November 30, 1990. The following lists cite the scientific name, Weed Science Society of America code and common name (if available), family name and location of each new record. Additional data are maintained on permanent file.

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

NONE REPORTED.

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

1. Anchusa azurea Mill. (ANCIT) Italian bugloss; Boraginaceae; near old packing sheds in Mesa, Adams Co.

2. Cirsium utahense Petr. (CIRUT) Utah thistle; Asteraceae; located at end of South Fork Salmon road, Valley Co.

3. Descurainia californica (Gray) Schulz. (DESCA) California tansymustard; Brassicaceae; west of Lake Cleveland, Cassia Co.

4. Euphorbia crenulata Engelm. (EPHCR) beetle spurge; Euphorbiaceae; in pasture, Boundary Co.

5 Ranunculus sardous Crantz. (RANSA) hairy buttercup; Ranunculaceae; in pastures in Buhl, Twin Falls Co.

6. Reseda lutea L. (RESLU) yellow mignonette; Resedaceae; north of Aberdeen, Bingham Co.

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

1. Agropyron triticeum Gaertn. (AGRTR), (= Eremopyrum triticeum) annual wheatgrass; Poaceae; lawn in Caldwell, Canyon Co.

2. Ambrosia tomentosa Nutt. (FRTSO), skeletonleaf bursage; Asteraceae; lawn in Jerome (northernmost record in Idaho), Jerome Co.[2]

3. Anchusa arvensis (L.) Bieb. (LYCAR), small bugloss; Boraginaceae; cropland in Fremont Co.[4]

4. Atriplex heterosperma Bunge. (ATXHE), no name listed; Chenopodiaceae; on CRP land outside of Grangeville, Idaho Co.

5. Bryonia alba L. (BYOAL), white bryony; Cucurbitaceae; found in yard in Malad, Oneida Co.[1,2,3,4,5]

6. Carduus acanthoides L. (CRUAC), plumeless thistle; Asteraceae; cropland in Nez Perce Co; also 100 feet SW of Junction of Radio Tower Service road and Ridge road, Moscow, Latah Co.[1,2,5]

7. Carduus nutans L. (CRUNU), musk thistle; Asteraceae; pasture in Nez Perce Co.[2]

8. Crepis capillaris (L.) Wallr. (CVPCA), smooth hawksbeard; Asteraceae; on hillsides in pasture north of Kingston, Shoshone Co.[5]

9. Cynodon dactylon (L.) Pers. (CYNDA), bermudagrass; Poaceae; in bluegrass/bentgrass lawn north of Administration Bldg. on U of I campus, Moscow, Latah Co.[2,3]

10. Eragrostis minor Host., little lovegrass; Poaceae; growing along 8th st. near intersection of 8th st. and 21st Ave. in Lewiston, Nez Perce Co. This species was incorrectly reported as E. barrelieri Daveau. in the 1985 and 1986 progress reports.

11. Eragrostis pectinacea (Michx.) Nees. (ERAPE), tufted lovegrass; Poaceae; found in crack in street curb at intersection of Blaine St. and Hwy 8 NE in Moscow, Latah Co.[4]

12. Euphorbia esula L. (EPHES), leafy spurge; Euphorbiaceae; roadside 3 1/2 miles NE of Mohler, Lewis Co.[1,2]

13. Euphorbia supina Raf. ex Boiss (EPHMA), spotted spurge; Euphorbiaceae; U of I campus, Moscow, Latah Co.[3]

14. Galiopsis tetrahit L. (GAETE), common hempnettle; Lamiaceae; found in oat field, Kootenai Co. Sent in as an I.D. from Kootenai county in 1989.[3]

15. Galium pedamontanum (GALPE), foothills bedstraw; Rubiaceae; heavily infested pasture, Clearwater Co.[3,5]

16. _Galium verum_ L. (GALVE), yellow bedstraw; Rubiaceae; pasture south of Burley on Goose Creek, Minidoka Co.[5]

17. _Hypochaeris radicata_ L. (HRYRA), spotted catsear; Asteraceae; pasture in Coeur d'Alene, Kootenai Co.[1,3,4]

18. _Isatis tinctoria_ L. (ISATI), dyers woad; Brassicaceae; pasture 9 1/2 miles north and 2 miles east of Shoshone, Lincoln Co.

19. _Knautia arvensis_ (L.) T.Coult. (KNAAR), bluebuttons, field scabious; Dipsacaceae; along roadside pasture in Fairfield, Camas Co.[4]

20. _Lythrum salicaria_ L. (LYTSA), purple lythrum, Lythraceae; roadside pasture in Sandpoint, Bonner Co.[2,4]

21. _Potentilla argentea_ L. (PTLAG), silvery cinquefoil; Rosaceae; driveway of Neumeyers Mill on County road 24, Boundary Co.

22. _Silene conoidea_ L. (SILCD), cone catchfly, Caryophyllaceae; next to rape plots in Lewis Co, also found in Nez Perce Co.

23. _Sonchus arvensis_ L. (SONAR), perennial sowthistle; Asteraceae; roadside in Benewah Co.

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

1 WSWS 1985 Progress Report
2 WSWS 1986 Progress Report
3 WSWS 1987 Progress Report
4 WSWS 1988 Progress Report
5 WSWS 1989 Progress Report

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

Plants submitted for identifications or verification during the reporting period November 30, 1989 to November 30, 1990 are listed below. These data are from identification requests submitted to weed identification personnel by county extension agents and county weed superintendents. Over 1150 plant species have been identified for these two groups during the past six years (see also WSWS Progress Reports for 1985-1989). Forty specimens were identified only to genus and over 500 specimens submitted from other sources are not included. Although data from these two groups over the past five years are generally indicative of their educational needs, many samples are submitted because of unusual circumstances, such as novelty, growth stage, sample condition, or sample inadequacy, that call for specialist capabilities. This program continues to grow in both extension and non-extension usage; there were about five times more requests this past year than the first year (1985) of the program. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843).

Identification	County	Date
Abutilon theophrasti, Malvaceae	Gooding	09/17/90
Acer saccharinum, Aceraceae	Ada	04/25/90
Achillea millefolium, Asteraceae	Bonneville	07/11/90
Aglonema commutatum, Araceae	Ada	12/15/89
Agropyron cristatum, Poaceae	Ada	04/25/90
Agropyron repens, Poaceae	Ada	04/25/90
Agropyron triticeum, Poaceae	Canyon	04/26/90
Agrostis exarata, Poaceae	Latah	08/02/90
Agrostis exarata, Poaceae	Lewis	07/13/90
Amaranthus albus, Amaranthaceae	Teton	08/26/90
Ailanthus altissima, Simaroulaceae	Ada	11/05/90
Amaranthus powellii, Amaranthaceae	Bingham	01/09/90
Ambrosia acanthicarpa, Asteraceae	Franklin	10/03/90
Ambrosia tomentosa, Asteraceae	Jerome	10/11/90
Amsinckia lycopsoides, Boraginaceae	Fremont	11/01/90
Anaphalis margaritacea, Asteraceae	Shoshone	09/19/90
Anchusa arvensis, Boraginaceae	Fremont	06/22/90
Anchusa azurea, Boraginaceae	Adams	06/28/90
Antennaria microphylla, Asteraceae	Blaine	07/10/90

Anthriscus scandicina, Apiaceae	Latah	04/19/90
Apera interrupta, Poaceae	Lewis	05/17/90
Apera interrupta, Poaceae	Nez Perce	06/04/90
Apocynum androsaemifolium, Apocynaceae	Kootenai	09/26/90
Arabis hirsuta, Brassicaceae	Fremont	06/18/90
Arabis holboellii, Brassicaceae	Valley	05/17/90
Arctium minus, Asteraceae	Canyon	06/08/90
Artemisia ludoviciana, Asteraceae	Ada	04/25/90
Asperugo procumbens, Boraginaceae	Minidoka	05/14/90
Aster campestris, Asteraceae	Canyon	09/17/90
Aster campestris, Asteraceae	Canyon	10/18/90
Atriplex heterosperma, Chenopodiaceae	Idaho	10/03/90
Barbarea orthoceras, Brassicaceae	Bonner	05/29/90
Berberis vulgaris, Berberidaceae	Latah	06/27/90
Berteroa incana, Brassicaceae	Camas	07/17/90
Brassica campestris, Brassicaceae	Gem	05/24/90
Brassica campestris, Brassicaceae	Canyon	10/18/90
Brassica nigra, Brassicaceae	Gem	06/21/90
Bromus carinatus, Poaceae	Lewis	07/13/90
Bromus commutatus, Poaceae	Kootenai	06/27/90
Bromus commutatus, Poaceae	Idaho	09/13/90
Bromus inermis, Poaceae	Ada	05/30/90
Bromus mollis, Poaceae	Boundary	06/26/90
Bromus secalinus, Poaceae	Nez Perce	06/04/90
Bromus tectorum, Poaceae	Bonneville	07/13/90
Bromus tectorum, Poaceae	Ada	10/17/90
Bryonia alba, Cucurbitaceae	Minidoka	06/18/90
Bryonia alba, Cucurbitaceae	Oneida	06/27/90
Bryonia alba, Cucurbitaceae	Butte	09/28/90
Campanula rapunculoides, Campanulaceae	Caribou	06/22/90
Campanula rapunculoides, Campanulaceae	Bonneville	07/19/90
Campsis radicans, Bignoniaceae	Ada	10/18/90
Cannabis sativa, Moraceae	Lewis	09/14/90
Cardaria draba, Brassicaceae	Valley	07/17/90
Cardaria pubescens, Brassicaceae	Bingham	05/31/90
Carduus acanthoides, Asteraceae	Clearwater	09/20/90
Carduus pycnocephalus, Asteraceae	Idaho	06/18/90
Carduus pycnocephalus, Asteraceae	Latah	11/13/90
Carpinus betulus, Betulaceae	Ada	08/07/90
Carthamus tinctoria, Asteraceae	Canyon	07/25/90
Carum carvi, Apiaceae	Custer	06/29/90
Centaurea cyanus, Asteraceae	Gem	03/23/90
Centaurea maculosa, Asteraceae	Lewis	06/29/90
Centaurea maculosa, Asteraceae	Ada	08/01/90
Centaurea repens, Asteraceae	Boundary	06/18/90
Centaurea repens, Asteraceae	Bonneville	10/19/90
Centaurium umbellatum, Gentianaceae	Bonner	08/06/90
Cerastium viscosum, Caryophyllaceae	Nez Perce	04/04/90
Cerastium vulgatum, Caryophyllaceae	Ada	12/15/89
Chaenactis douglasii, Asteraceae	Payette	05/29/90
Chaenactis douglasii, Asteraceae	Owyhee	06/07/90
Chaenactis douglasii, Asteraceae	Fremont	06/18/90
Chaenactis douglasii, Asteraceae	Adams	06/28/90
Chaenomeles japonica, Rosaceae	Ada	11/05/90
Chaenomeles sinensis, Rosaceae	Ada	10/01/90

Chenopodium foliosum, Chenopodiaceae	Adams	09/24/90
Chenopodium murale, Chenopodiaceae	Canyon	06/04/90
Chorispora tenella, Brassicaceae	Cassia	06/22/90
Chrysanthemum leucanthemum, Asteraceae	Latah	04/19/90
Chrysopsis villosa, Asteraceae	Gem	08/31/90
Chrysothamnus viscidiflorus, Asteraceae	Cassia	06/22/90
Cichorium intybus, Asteraceae	Ada	04/25/90
Cicuta douglasii, Apiaceae	Boundary	09/10/90
Cirsium arvense, Asteraceae	Ada	04/20/90
Cirsium arvense, Asteraceae	Camas	07/27/90
Cirsium arvense, Asteraceae	Boundary	08/10/90
Cleome platycarpa, Capparidaceae	Gem	06/08/90
Cleome serrulata, Capparidaceae	Minidoka	08/07/90
Comandra umbellata, Santalaceae	Adams	05/09/90
Conium maculatum, Apiaceae	Ada	05/07/90
Conyza canadensis, Asteraceae	Twin Falls	05/18/90
Conyza canadensis, Asteraceae	Bonneville	07/11/90
Conyza canadensis, Asteraceae	Idaho	09/10/90
Coreopsis atkinsoniana, Asteraceae	Ada	07/24/90
Crataegus douglasii, Rosaceae	Ada	08/06/90
Crepis acuminata, Asteraceae	Boundary	06/26/90
Crepis capillaris, Asteraceae	Kootenai	08/08/90
Crepis occidentalis, Asteraceae	Lincoln	05/29/90
Cynoglossum officinale, Boraginaceae	Butte	06/18/90
Cynoglossum officinale, Boraginaceae	Canyon	07/03/90
Dactylis glomerata, Poaceae	Ada	05/30/90
Daucus carota, Apiaceae	Ada	12/15/89
Descurainia californica, Brassicaceae	Cassia	08/10/90
Digitaria sanguinalis, Poaceae	Ada	07/24/90
Digitaria sanguinalis, Poaceae	Lewis	08/21/90
Dipsacus sylvestris, Dipsacaceae	Nez Perce	04/02/90
Draba verna, Brassicaceae	Ada	04/25/90
Echinochloa crus-galli, Poaceae	Idaho	10/04/90
Echinochloa crus-galli, Poaceae	Idaho	10/04/90
Echinops ritro, Asteraceae	Ada	09/24/90
Elymus glaucus, Poaceae	Nez Perce	07/24/90
Epilobium glandulosum, Onagraceae	Butte	11/21/90
Epilobium minutum, Onagraceae	Cassia	08/06/90
Epilobium paniculatum, Onagraceae	Nez Perce	04/18/90
Epilobium paniculatum, Onagraceae	Ada	07/17/90
Eragrostis cilianensis, Poaceae	Canyon	10/04/90
Erigonum vimineum, Polygonaceae	Jefferson	04/27/90
Eriophyllum lanatum, Asteraceae	Cassia	08/06/90
Euphorbia crenulata, Euphorbiaceae	Boundary	09/10/90
Euphorbia esula, Euphorbiaceae	Caribou	06/08/90
Euphorbia esula, Euphorbiaceae	Lewis	07/10/90
Euphorbia serpyllifolia, Euphorbiaceae	Lincoln	07/11/90
Euphorbia serpyllifolia, Euphorbiaceae	Adams	10/04/90
Festuca ovina, Poaceae	Ada	05/23/90
Festuca ovina, Poaceae	Lewis	07/13/90
Festuca rubra, Poaceae	Kootenai	07/17/90
Festuca rubra, Poaceae	Boundary	08/23/90
Festuca scabrella, Poaceae	Latah	05/23/90
Franseria discolor, Poaceae	Bonneville	07/11/90
Franseria discolor, Poaceae	Bonneville	07/19/90

Galium boreale, Rubiaceae	Lewis	05/18/90
Galium pedamontanum, Rubiaceae	Clearwater	09/15/90
Galium verum, Rubiaceae	Minidoka	07/24/90
Gaura parviflora, Onagraceae	Ada	06/27/90
Gaura parviflora, Onagraceae	Ada	09/28/90
Geranium pusillum, Geraniaceae	Gem	03/23/90
Geum triflorum, Rosaceae	Idaho	07/03/90
Gilia aggregata, Polemoniaceae	Ada	03/06/90
Gilia aggregata, Polemoniaceae	Bonneville	07/20/90
Glycyrrhiza lepidota, Fabaceae	Ada	04/25/90
Gnaphalium microcephalum, Asteraceae	Idaho	09/19/90
Gnaphalium palustre, Asteraceae	Adams	08/06/90
Gnaphalium palustre, Asteraceae	Kootenai	08/20/90
Gnaphalium uliginosum, Asteraceae	Kootenai	07/20/90
Grindelia squarrosa, Asteraceae	Cassia	06/22/90
Grindelia squarrosa, Asteraceae	Valley	08/26/90
Helenium autumnale, Asteraceae	Canyon	08/15/90
Hesperis matronalis, Brassicaceae	Ada	05/15/90
Hesperis matronalis, Brassicaceae	Lewis	06/21/90
Hieracium cynoglossoides, Asteraceae	Cassia	08/06/90
Hieracium pratense, Asteraceae	Latah	07/13/90
Hieracium pratense, Asteraceae	Shoshone	08/28/90
Hordeum leporinum, Poaceae	Canyon	03/19/90
Hordeum leporinum, Poaceae	Ada	04/25/90
Hordeum leporinum, Poaceae	Ada	05/11/90
Hydrangea querifolia, Hydrangeaceae	Ada	07/26/90
Hypericum perforatum, Hyperiaceae	Canyon	04/25/90
Hypochaeris radicata, Asteraceae	Kootenai	07/20/90
Isatis tinctoria, Brassicaceae	Lincoln	06/06/90
Knautia arvensis, Dipsacaceae	Camas	07/24/90
Lactuca serriola, Asteraceae	Shoshone	08/28/90
Lamium amplexicaule, Lamiaceae	Caribou	04/05/90
Lamium purpureum, Lamiaceae	Canyon	04/18/90
Lamium purpureum, Lamiaceae	Shoshone	05/29/90
Lathyrus bijugatus, Fabaceae	Latah	05/11/90
Ledum glandulosum, Ericaceae	Ada	04/20/90
Lepidium campestre, Brassicaceae	Adams	05/09/90
Lepidium campestre, Brassicaceae	Idaho	07/19/90
Lepidium latifolium, Brassicaceae	Bingham	05/31/90
Lepidium montanum, Brassicaceae	Butte	06/22/90
Lepidium virginicum, Brassicaceae	Valley	08/13/90
Lepyrodiclis holosteoides, Caryophyll.	Nez Perce	03/23/90
Linaria dalmatica, Scrophulariaceae	Latah	06/27/90
Linaria vulgaris, Scrophulariaceae	Teton	11/13/90
Linum perenne, Linaceae	Cassia	06/22/90
Lithospermum ruderale, Boraginaceae	Blaine	05/07/90
Lithospermum ruderale, Boraginaceae	Fremont	05/29/90
Lolium multiflorum, Poaceae	Kootenai	06/27/90
Lolium multiflorum, Poaceae	Boundary	10/11/90
Lolium perenne, Poaceae	Ada	04/17/90
Lolium perenne, Poaceae	Ada	05/23/90
Lolium perenne, Poaceae	Ada	06/22/90
Lomatium dissectum, Apiaceae	Lincoln	06/22/90
Lomatium triternatum, Apiaceae	Lewis	05/18/90
Luzula campestris, Juncaceae	Nez Perce	05/20/90

Lychnis alba, Caryophyllaceae	Boundary	05/23/90
Lychnis alba, Caryophyllaceae	Bonneville	07/11/90
Lycium halimifolium, Solanaceae	Idaho	11/08/90
Lythrum salicaria, Lythraceae	Ada	04/25/90
Lythrum salicaria, Lythraceae	Ada	07/17/90
Lythrum salicaria, Lythraceae	Boundary	09/04/90
Lythrum salicaria, Lythraceae	Power	09/20/90
Lythrum salicaria, Lythraceae	Bonner	09/26/90
Mentzelia albicaulis, Loasaceae	Owyhee	06/11/90
Mentzelia albicaulis, Loasaceae	Owyhee	06/19/90
Mentzelia laevicaulis, Loasaceae	Camas	09/17/90
Mimulus guttalus, Scrophulariaceae	Minidoka	07/03/90
Mimulus guttalus, Scrophulariaceae	Lewis	07/30/90
Montia perfoliata, Portulaceae	Ada	04/25/90
Morus alba, Moraceae	Canyon	09/13/90
Myosotis micrantha, Boraginaceae	Lewis	05/29/90
Nicotiana attenuata, Solanaceae	Power	08/29/90
Nicotiana attenuata, Solanaceae	Camas	09/17/90
Oenothera caespitosa, Onagraceae	Bannock	05/30/90
Oenothera strigosa, Onagraceae	Ada	08/26/90
Oenothera strigosa, Onagraceae	Shoshone	08/28/90
Onopordum acanthium, Asteraceae	Ada	06/01/90
Ornithogalum umbellatum, Liliaceae	Latah	03/06/90
Ornithogalum umbellatum, Liliaceae	Ada	04/17/90
Oxalis corniculata, Oxalidaceae	Canyon	04/06/90
Oxalis corniculata, Oxalidaceae	Ada	06/22/90
Pedicularis contorta, Scrophulariaceae	Cassia	08/06/90
Penstemon deustus, Scrophulariaceae	Gem	04/26/90
Penstemon palmerii, Scrophulariaceae	Canyon	06/08/90
Phacelia hastata, Hydrophyllaceae	Butte	06/18/90
Phlox longiflora, Polemoniaceae	Lewis	06/29/90
Pinus nigra, Pinaceae	Ada	10/02/90
Pinus sylvestris, Pinaceae	Ada	08/06/90
Poa bulbosa, Poaceae	Bonneville	07/19/90
Poa bulbosa, Poaceae	Ada	10/17/90
Poa pratensis, Poaceae	Ada	05/30/90
Polygonum amphibium, Polygonaceae	Gem	10/01/90
Polygonum aviculare, Polygonaceae	Custer	06/29/90
Polygonum convolvulus, Polygonaceae	Ada	06/18/90
Polygonum cuspidatum, Polygonaceae	Gem	03/15/90
Polygonum cuspidatum, Polygonaceae	Gem	04/26/90
Polygonum cuspidatum, Polygonaceae	Canyon	05/07/90
Polygonum cuspidatum, Polygonaceae	Ada	06/04/90
Polygonum cuspidatum, Polygonaceae	Latah	08/21/90
Populus deltoides, Salicaceae	Ada	04/25/90
Potentilla argentea, Poaceae	Boundary	06/06/90
Prunella vulgaris, Lamiaceae	Latah	05/11/90
Prunus domestica, Rosaceae	Ada	06/29/90
Prunus emarginata, Rosaceae	Ada	08/06/90
Prunus mahaleb, Rosaceae	Ada	08/08/90
Prunus marginata, Rosaceae	Ada	06/29/90
Pyrus calleryana, Rosaceae	Ada	11/19/90
Ranunculus repens, Ranunculaceae	Nez Perce	06/28/90
Ranunculus uncinatus, Ranunculaceae	Bonneville	07/11/90
Rhamnus alnifolia, Rhamnaceae	Ada	07/17/90

Rhus diversiloba, Anacardiaceae	Ada	05/24/90
Ribes aureum, Grossulariaceae	Ada	04/25/90
Rorippa islandica, Brassicaceae	Kootenai	06/28/90
Rubus discolor, Rosaceae	Nez Perce	10/19/90
Rubus laciniata, Rosaceae	Canyon	09/05/90
Rumex salicifolius, Polygonaceae	Ada	04/25/90
Rumex venosus, Polygonaceae	Canyon	04/10/90
Sanguisorba minor, Rosaceae	Ada	05/03/90
Sanguisorba minor, Rosaceae	Kootenai	05/23/90
Sanguisorba minor, Rosaceae	Cassia	06/22/90
Sanguisorba occidentalis, Rosaceae	Latah	04/19/90
Saponaria officinalis, Caryophyllaceae	Ada	04/25/90
Scabiosa atropurpurea, Dipsacaceae	Bannock	11/05/90
Sclerochloa dura, Poaceae	Latah	05/23/90
Senecio integerrimus, Asteraceae	Idaho	05/17/90
Senecio serra, Asteraceae	Bonner	05/29/90
Senecio serra, Asteraceae	Latah	06/26/90
Setaria viridis, Poaceae	Caribou	07/27/90
Setaria viridis, Poaceae	Idaho	10/22/90
Silene conoidea, Caryophyllaceae	Lewis	08/18/90
Sisymbrium altissimum, Brassicaceae	Ada	04/09/90
Sisymbrium altissimum, Brassicaceae	Ada	04/25/90
Sisymbrium loeselii, Brassicaceae	Bonneville	07/11/90
Sisyrinchium inflatum, Iridaceae	Latah	04/02/90
Solanum dulcamara, Solanaceae	Bonneville	07/20/90
Solidago canadensis, Asteraceae	Custer	06/29/90
Spergularia rubra, Caryophyllaceae	Adams	08/06/90
Sporobolus cryptandrus, Poaceae	Bannock	03/19/90
Sp robolus cryptandrus, Poaceae	Ada	08/13/90
Stipa comata, Poaceae	Minidoka	06/18/90
Symphytum officinale, Boraginaceae	Nez Perce	06/22/90
Taeniatherum caput-medusae, Poaceae	Ada	10/17/90
Thelypodium integrifolium, Brassicaceae	Power	05/04/90
Thelypodium integrifolium, Brassicaceae	Minidoka	07/24/90
Thermopsis montana, Fabaceae	Bannock	05/29/90
Thermopsis montana, Fabaceae	Bannock	05/30/90
Thlaspi arvense, Brassicaceae	Valley	05/14/90
Thlaspi arvense, Brassicaceae	Butte	05/25/90
Tragopogon pratensis, Asteraceae	Ada	07/17/90
Valeriana edulis, Valerianaceae	Bear Lake	05/31/90
Verbascum blattaria, Scrophulariaceae	Gem	05/07/90
Verbena bracteata, Verbenaceae	Ada	04/25/90
Verbena bracteata, Verbenaceae	Boundary	07/03/90
Verbena bracteata, Verbenaceae	Idaho	10/16/90
Veronica anagallis-aquatica, Scrophul.	Cassia	06/22/90
Veronica biloba, Scrophulariaceae	Cassia	06/22/90
Veronica officinalis, Scrophulariaceae	Benewah	09/12/90
Viburnum edule, Caprifoliaceae	Latah	09/26/90
Viburnum lantana, Caprifoliaceae	Ada	06/18/90
Vicia villosa, Fabaceae	Gem	03/23/90
Viola arvensis, Violaceae	Idaho	05/14/90
Xanthium spinosum, Asteraceae	Idaho	09/27/90

PROJECT 5

WEEDS OF AQUATIC, INDUSTRIAL, AND NONCROP AREAS

DAVID SPENCER - CHAIRPERSON

VANELLE CARRITHERS - CHAIRPERSON - ELECT

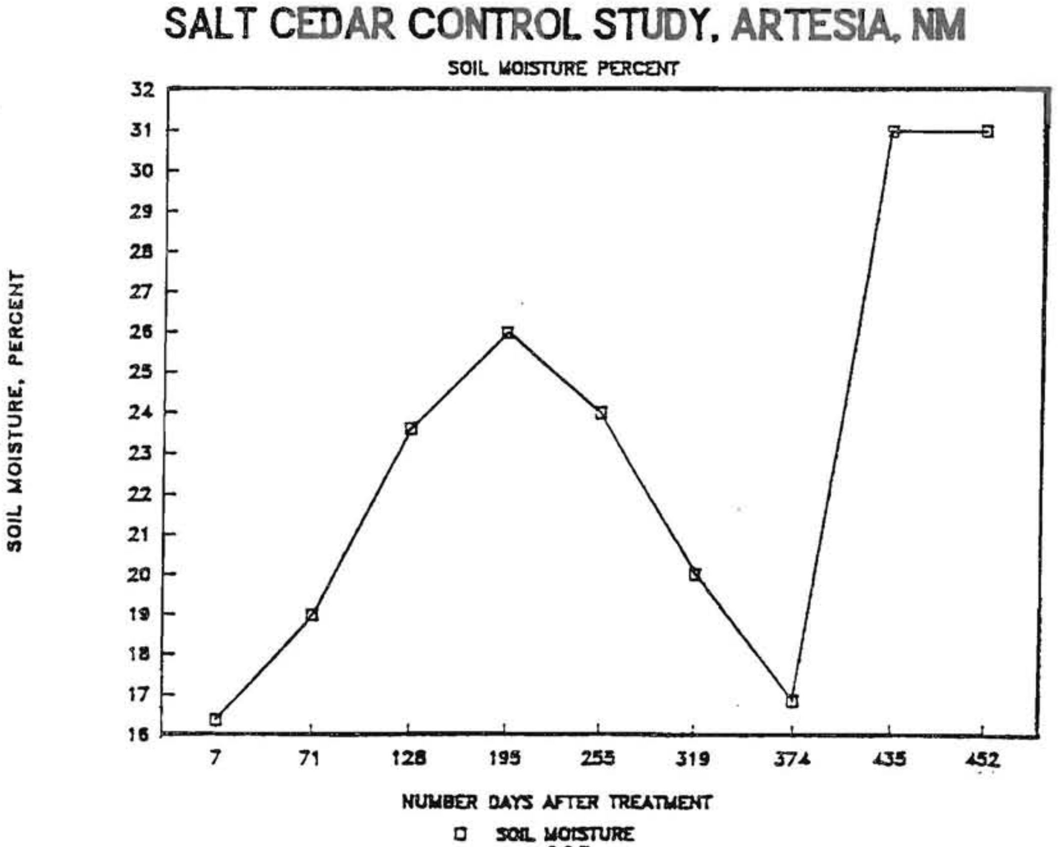
Saltcedar (tamarix sp.) control with imazapyr   Duncan, Keith W.. Saltcedar is an introduced phreatophyte which occupies millions of acres of riparian areas throughout the southwestern United States. Saltcedar's ability to not only colonize riparian areas rapidly but also to change its environment by salt exudaton often results in monoculture stands of the exotic phreathophyte.

Saltcedar growing in two 5.26 ha dry lakes near Artesia, NM were aerially sprayed with a fixed-winged aircraft on August 8, 1989. Imazapyr was applied at 1.1 kg/ha in a total volume of 65.4 L/ha with 0.25% v/v of Activator surfactant and 0.25% v/v Na/control. The two 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 have been taken and soil moisture determined at approximate 60 day intervals since August 15, 1989.

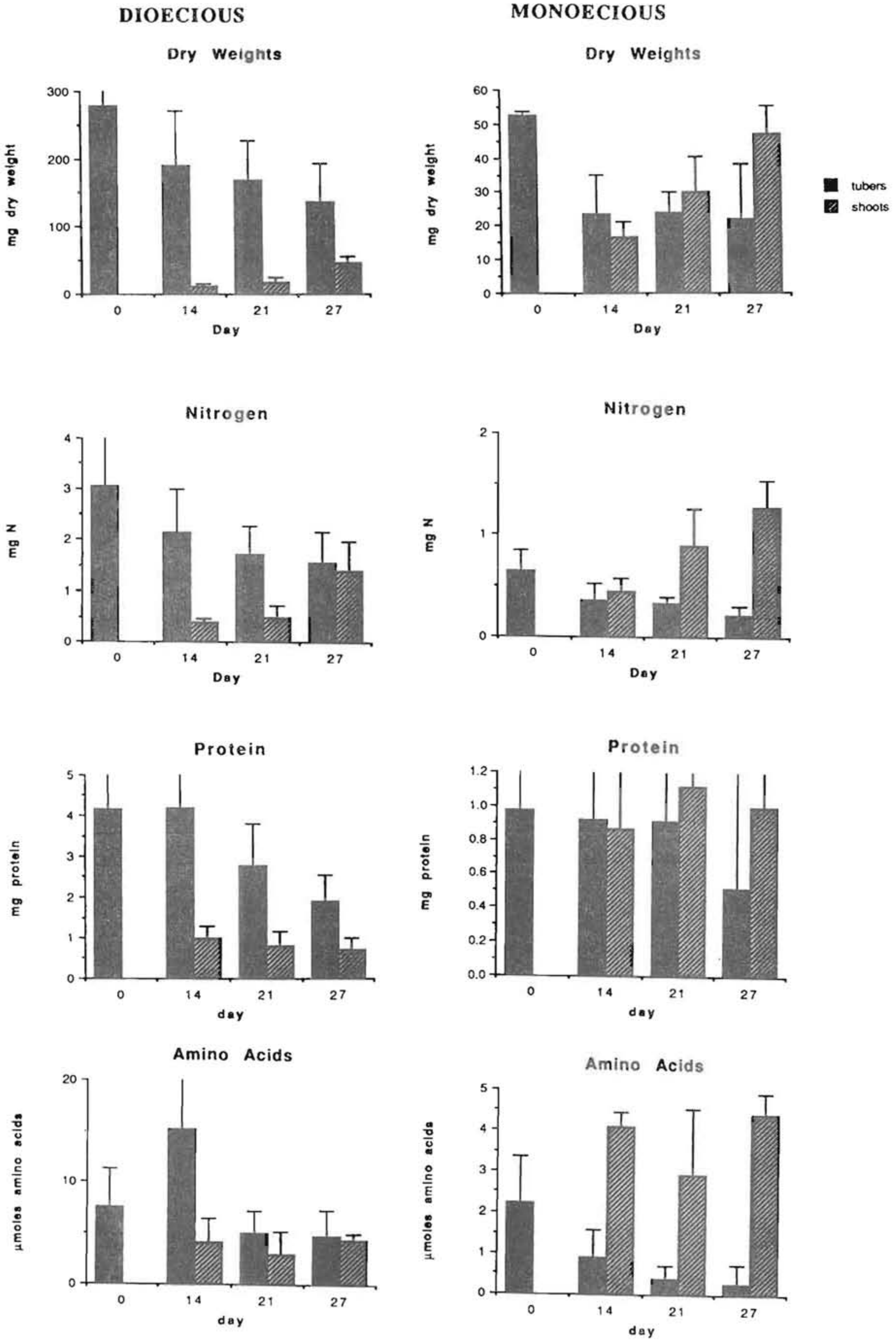
A graph of the data indicates soil moisture at 5.8 m depth was approximately 16.4% on August 15, 1989. The moisture content increased during the winter to a high of 26% in February, 1990, then declined throughout the spring and summer as irrigation of agronomic crops occurred in the area. Soil moisture on August 15, 1990, was similar to soil moisture on August 15, 1989, 16.9% vs 16.4% respectively. An attempt was made to collect soil samples on October 16, 1990. However, the attempt was abandoned when it was determined that the water table had apparently risen to the point where water occupied the bottom 0.9 m of the hole. The hole dept was 6.4 m, making the water level at 5.5 m below the soil surface. Attempts will henceforth be made to measure the dept to the water table.

Saltcedar canopy reduction and topkill was estimated on August 28, 1990, to be 99% and 95%, respectively. (Coop. Ext. Serv., New Mexico Univ., Artesia, NM 88201).



Distribution of nitrogen between shoots and subterranean turions of hydrilla during sprouting. Ryan, F.J. and D.L. Holmberg. The content of total nitrogen, free amino acids and soluble protein was determined for hydrilla sprouting from turions, a period of rapid growth. Subterranean turions of both monoecious dioecious biotypes were planted in a 90% peat, 10% sand mixture in 4 X 4 X 6 cm pots. Three or four turions were planted in each pot. Pots were placed in two 40 L containers in a controlled photoperiod chamber with equal numbers of monoecious and dioecious plants in each container. The chamber was maintained at 24 C (day), 20 C (night) with a 12 h photoperiod (approximately 100 microEinsteins/ m^2 s photosynthetic flux density at the soil surface). Ten plants of each biotype were harvested on day 0, 14, 21 and 27. Plants were separated into turions, shoots and leaves, and roots when appropriate. On day 27, ten plants of each biotype were excised at the hydrosoil surface and regrowth was harvested after 10 days. Plant parts were frozen in liquid N_2, lyophilized and homogenized. Analysis for carbon and nitrogen was conducted on a commercial carbon, hydrogen, nitrogen analyzer. Soluble protein was determined with bicinchoninic acid after extraction of the tissue with 100 millimolar tris(hydroxymethyl)aminomethane hydrochloride, pH 7.8. Free amino acids were determined with ninhydrin after extraction of the tissue into 95% ethanol.

The figure shows dry weights, total nitrogen, total amino acids and total soluble protein at the stated times for turions and shoots and leaves. Values are means, and standard deviations are shown by the error bars. The left column contains the data for the dioecious biotype and the right column that for the monoecious. Roots were present in the monoecious plants after day 14, and in the dioecious after day 21. Roots did not comprise more than 10% of the dry weight or total nitrogen, and data from them has not been included here. Nitrogen, protein and amino acids were mobilized into developing leaves and stems much more rapidly in the monoecious plants than in the dioecious. The dioecious plant retained more reserve material in the turion during the early stage of development. As a consequence, it more readily grew back after a harvest on day 27; the dry weight of above ground biomass after 10 days' regrowth was 41.1 mg for the dioecious plant but only 3.6 mg for the monoecious. (USDA-ARS Aquatic Weed Research Laboratory, Botany Dept., U. California, Davis, CA 95616-8537)


DIOECIOUS
MONOECIOUS
Dry Weights
mg dry weight
Day
tubers
shoots
Nitrogen
mg N
Protein
mg protein
day
Amino Acids
µmoles amino acids

Non-crop weed control evaluation. Cudney, D.W. and J.S. Reints. A non-crop weed control trial was established on the University of California Experiment Station in January of 1990 to evaluate newer herbicides compared to those in common use in the area. The plots were established in an area which had been cleared of brush and weeds and disked to a depth of 6 inches. The soil was a sandy loam with approximately 0.75 percent organic matter. Wheat was sown and harrowed into the soil to a depth of 3 inches. Eleven herbicide treatments and an untreated check plot were then established as 10 by 25 foot plots and replicated four times. The herbicide treatments consisted of isoxaben at 2 and 4 lbs ai/a, isoxaben plus oryzalin at 1 + 3 and 2 + 6 lbs ai/a, tebuthiuron at 8 lbs ai/a, diuron at 8 lbs ai/a, bromacil at 4 lbs ai/a, sulfometuron methyl at 0.25 lbs ai/a, simazine at 8 lbs ai/a, linuron at 2 lbs ai/a, and dichlobenil at 4 lbs ai/a. Applications were made with a CO_2 backpack, constant pressure, sprayer at a spray volume of 30 gallons per acre. Plots then received 0.5 inches of water applied as a sprinkler irrigation to incorporate the herbicides and to initiate weed germination. Winter rainfall was low, about 6.5 inches after the plots were established. Weed counts were made on May 11 and weed evaluations were made on October 15, 1990.

Weed counts were made in each plot four months after herbicide application. Wheat counts were higher in the isoxaben and isoxaben plus oryzalin plots. A similar trend, although not statistically significant, was noted for wild oat, filaree, and Russian thistle. Percent weed control evaluations were made 9 months after application. Percent weed control was also lowest for isoxaben and isoxaben plus oryzalin treatments for wheat. Vegetation will be removed from the plots and they will be lightly harrowed prior to the rainy season. Further evaluations will be made in 1991.

Non-crop weed control evaluations
at Riverside, California

		5/11/90				10/15/90	
		-----------weeds per plot------------				% Control	
Herbicide	lbs/ai/A	Wheat	Wild Oats	Filaree	Russian Thistle	Wheat	Russian Thistle
isoxaben	2.0	134.75	21.50	5.25	0	30	98
isoxaben	4.0	109.50	27.50	1.50	2.00	35	88
isox + oryzalin	1.0 + 3.0	201.00	10.50	25.50	3.75	45	100
isox + oryzalin	2.0 + 6.0	151.75	12.75	5.75	2.25	40	85
tebuthiuron	8.0	0	0	0	0	75	98
diuron	8.0	8.25	0	0	0	100	100
bromacil	4.0	0	0	0	0	100	100
sulfometuron	0.25	0.75	0	3.75	0	100	100
simazine	8.0	0	0	0	0.25	100	100
linuron	2.0	3.0	1.75	0	0	98	95
dichlobenil	4.0	1.0	0	0	0	100	100
check	---	151.00	81.75	44.00	37.25	10	15
LSD 5%		70.0238	NS	17.8702	16.4422	28	18

Evaluation of Ada County Idaho kochia (*Kochia scoparia* L.) collections for sulfonylurea resistance. Thompson, C.R. and D.C. Thill. Gene Ross, Ada County weed control officer, and staff collected kochia seed from ten sites during March and April, 1990. Concerns were that kochia was inadequately controlled with sulfonylurea herbicides.

Kochia collection #1 was made near I-84 and Eagle road. The kochia was growing in a fence line adjacent to the road right-of-way. No herbicides had been applied to the area by the county staff. Collection #2 was made east of Jericho on the property of Steve Michaels. This property was sprayed with chlorsulfuron and sulfometuron in 1986, imazapyr in 1987, sulfometuron and imazapyr in 1988, and 2,4-D butoxyethylester/ 2,4-D acid and dicamba in 1989. The kochia from site #2 was not controlled with the sulfonylurea herbicides. Collection #3 was made from the Miller property. The property was sprayed with imazapyr in 1986. A second collection (#3 A) of seed was made at this site in April because the quantity of the March collected seed was not adequate to conduct the study. Collection #4 was made on the Norco property which had been sprayed in 1983 with amitrol in the spring and bromacil/diuron in the fall. Collection #5 was made at Willowbrook and Meridian road on Bews property. In 1987, 2,4-D was applied to the area. Collection #6 was made at 9930 Fairview on Bews property. Four additional samples (#6 A-D) were taken from this site in April because of suspected resistance. The county has no record of spraying this site with a herbicide. Collection #7 was made near Production Road on a roadside property owned by Larry Williams and Idaho Timber. This site had been sprayed with sulfometuron, chlorsulfuron, and 2,4-D. Dates were not provided. Collection #8 was a composite of seed from several plants gathered from the Maple Grove to Fairview location. This site was approximately 0.4 miles from site #6, 9980 Fairview. There was no record of herbicide application to the Maple Grove to Fairview site. Kochia plants collected from site #9, Pine and Linder, contained no seed thus, were not evaluated. Collections 10 A-E were gathered from five individual plants from the Western Dairyman Creamry Inc. (WDCI) at Taylor and Meridian. This site was treated with atrazine in the late 1960's and early 1970's and 2,4-D in some of the years following, dates not specifically documented.

The Idaho kochia collections, NDM (susceptible kochia from Minot, ND), and K-8 (sulfonylurea resistant kochia from Reeder, ND) were planted in greenhouse potting mix in flats in individual rows March 23 (March collections) or May 9, 1990 (April collections). Plants in each flat were sprayed with a herbicide treatment. Treatments were replicated twice. Sulfometuron and chlorsulfuron were applied at 0.25 oz ai/a to 0.5 to 0.75 inch tall kochia with a greenhouse sprayer delivering 15 gpa at 40 psi on April 4 and sulfometuron was applied at 0.25 oz ai/a to 0.25 to 0.75 inch kochia on May 18. Herbicide treatments were applied with X-77 at 0.25% v/v. An untreated control treatment was included in the experiment. Final evaluations were made on April 19 (March collections) and June 1 (April collections).

Kochia collections # 2, 5, 6, 6 A-D, 7, and 10 A-E contained plants resistant to 0.25 oz ai/a of chlorsulfuron or sulfometuron. The Ada county collections referred to as "resistant" contained 10 to 68% susceptible plants indicating that the kochia populations are not homozygous for the resistant trait. Collections #3, 4, and 8 had one to two plants survive the herbicide treatment which is equivalent to approximately 3 to 6% of the population based on the seed provided. The #4 site is located approximately 0.25 miles of the #7 site which contained resistant kochia. Kochia plants from the #7 site probably were blown to the #4 site.

The development of resistant kochia populations at sites #2 and #7 could be predicted because sulfonylureas were applied previously. Resistant kochia populations at sites #5, #6, and #10 are more difficult to explain since only 2,4-D was applied to site #5, no herbicides were applied on site #6 and atrazine and 2,4-D were applied to site #10. This does not rule out herbicide application by someone else or that resistant kochia plants may have blown in from other sites. (Idaho Experiment Station, Moscow, Idaho 83843).

Ada County, Idaho, kochia collection response to postemergence applied chlorsulfuron and sulfometuron.

Collection	Location description	Collection response chlorsulfuron (plants survived/plants emerged)	Collection response sulfometuron (plants survived/plants emerged)
#1	I-84 & Eagle Rd.	susceptible (0/27)	susceptible (0/31)
#2	East of Jericho (Steve Michaels)	resistant (20/25)	resistant (28/31)
#3 A[1]	(Millers)		susceptible (2/31)
#4	(Norco)	susceptible (1/36)	susceptible (1/28)
#5	Willowbrook & Meridian Rd. (Bews)	resistant (28/35)	resistant (28/37)
#6	9930 Fairview (Bews)	resistant (7/12)	resistant (15/20)
#6 A[1]	9930 Fairview (Bews)		resistant (4/5)
#6 B[1]	9930 Fairview (Bews)		resistant (15/18)
#6 C[1]	9930 Fairview (Bews)		resistant (17/27)
#6 D[1]	9930 Fairview (Bews)		resistant (6/9)
#7	Production Rd. (Williams and Idaho Timber)	resistant (35/67)	resistant (36/86)
#8[1]	Maple Grove to Fairview		susceptible (1/30)
#10 A[1]	WDCI		resistant (28/42)
#10 B[1]	WDCI		resistant (29/36)
#10 C[1]	WDCI		resistant (31/40)
#10 D[1]	WDCI		resistant (30/33)
#10 E[1]	WDCI		resistant (16/29)
K-8	Reeder, ND	resistant (all surv.)	resistant (all surv.)
NDM	Minot, ND	susceptible (all died)	susceptible (all died)

[1] Second collection and treatment; WDCI = Western Dairyman Creamery Inc.

PROJECT 6

BASIC SCIENCES: ECOLOGY, BIOLOGY, PHYSIOLOGY,

GENETICS, AND CHEMISTRY

CHARLOTTE EBERLEIN - CHAIRPERSON

TRACY STERLING - CHAIRPERSON - ELECT

A survey of diclofop-resistant Italian ryegrass. Brewster, Bill D., Don L. Kloft, Susan Aldrich-Markham, John Leffel, Gale Gingrich, Mark Mellbye, and Arnold P. Appleby. Italian ryegrass has developed resistance to diclofop-methyl in the Willamette Valley of Oregon. A survey was conducted to determine the extent of resistance. Seeds were collected from 64 fields in six counties where diclofop-methyl had failed to completely control Italian ryegrass. The seeds were sown in 7.5-cm-square pots and the plants were grown outdoors. The stand was thinned to four plants per pot. A diclofop-susceptible commercial Italian ryegrass strain was included in the experiment for comparison.

The trial design was a randomized complete block with three replications. On October 1, 1990 diclofop-methyl was applied at 0, 0.14, 0.28, and 1.1 kg a.i./ha. The Italian ryegrass had two leaves when treated. The spray volume was 234 L/ha applied at 172 kPa through XR 8003 spray tips.

Three weeks after treatment the plants were harvested at the soil surface and fresh weights were obtained and were converted to percent of check for comparison with the commercial strain. Sixty-one of the 64 Italian ryegrass collections were less susceptible ($p = 0.05$) to diclofop-methyl than was the commercial strain. Fifty-four of the 64 collections treated with diclofop-methyl at 1.1 kg/ha had fresh weight means that did not significantly differ from their untreated control (see table). However, the average of these fifty-four means was only 85% of their untreated controls. There were seven collections that had fresh weight means significantly higher than the commercial ryegrass and significant differences between their untreated controls and the 1.1 kg/ha rate of diclofop-methyl. The average of these seven diclofop-treated means was 30% of the untreated control with a range of 0 to 64%. There were diclofop-resistant collections in each of the six counties with the majority of the collections from the two counties with the greatest wheat acreage. (Department of Crop and Soil Science, Oregon State University, Corvallis, Oregon 97331)

Number of collections and fresh weights of Italian ryegrass that were significantly ($p = 0.05$) more resistant than commercial Italian ryegrass to diclofop-methyl

Diclofop rate	Collections with no difference[1] between treatment and check: No. of collections	Fresh weight	Collections with difference between treatment and check: No. of collections	Fresh weight	Commercial ryegrass fresh weight
(kg a.i./ha)		(% of check)		(% of check)	(% of check)
0.14	56	93	5	44	6
0.28	55	87	6	40	2
1.1	54	85	7	30	0

[1] $p = 0.05$

Control of diclofop-resistant Italian ryegrass in winter wheat. Brewster, Bill D., Don L. Kloft, Arnold P. Appleby, Susan Aldrich-Markham, and Gale Gingrich. Italian ryegrass has historically been the most significant weed problem in winter wheat in the Willamette Valley of Oregon.

The development of diclofop-resistant Italian ryegrass in recent years has once again made this a major production problem. Sequential applications of triallate followed by diuron and triallate followed by metribuzin were compared with diuron followed by diclofop-methyl in two wheat fields infested with diclofop-resistant Italian ryegrass.

The trials were designed as randomized complete blocks with four replications and 2.5 m by 7.5 m plots. The spray volume was 234 L/ha delivered through XR 8003 flat fan tips at 172 kPa. The triallate was incorporated by hand-raking in two directions. Visual evaluations that were conducted in April are included in the table.

The triallate treatments were more effective at both locations than was diuron followed by diclofop-methyl. Triallate followed by metribuzin was significantly more effective than triallate followed by diuron at one location and caused less visible injury to the wheat. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331)

Wheat injury and Italian ryegrass control in fields infested with diclofop-resistant Italian ryegrass

Herbicide	Rate	Timing[1]	Wheat injury: Marion County	Wheat injury: Polk County	Italian ryegrass control: Marion County	Italian ryegrass control: Polk County
	(kg a.i./ha)		(%)			
diuron/ diclofop	1.8/ 1.1	1 leaf/ EPOE	5	0	83	0
triallate/ diuron	1.4/ 1.8	PEI/ EPOE	3	5	96	76
triallate/ metribuzin	1.4/ 0.6	PEI/ POE	0	0	96	90
check	0		0	0	0	0

[1] PEI applied October 12, 1989
1 leaf applied October 25, 1989
EPOE applied November 21, 1989; 2-3 leaf wheat, 1-3 leaf ryegrass
POE applied February 26, 2990; 3-4 tiller wheat, 3 tiller ryegrass

Biological differences in pennyroyal (*Mentha pulegium L.)* populations. Chambers, Henrietta L. Three Willamette Valley Oregon populations of pennyroyal exhibit different chromosome numbers and these directly influence their pollen and seed production. Pennyroyal grows in large populations in low pastureland and other wet, disturbed sites in the Willamette Valley. At present it is not considered to be a serious pest. However, the discovery that some populations produce viable seed and others do not, might be important if control of the species is considered necessary. Populations from Benton, Lane, and Linn Counties had chromosome numbers of 2n=20, 30, and 40, respectively. The diploid (20) and tetraploid (40) populations are pollen and seed fertile, while the triploid (30) population produces no pollen or seed. Examination of herbarium specimens from Curry, Douglas, Lane, and Linn Counties revealed either a high percentage of normal pollen or developing seeds. A preliminary seed germination experiment showed 21% germination in Fall 1990 collections from the diploid population, and 35.5% germination of similar age seeds collected from the tetraploid population. These results are shown in the Table below. (National Clonal Germplasm Repository, 33447 Peoria Road, Corvallis, OR 97333).

NCGR No.	Origin (County)	2n Chromosome No.	Pollen Abortion (%)	Seed Production	Germination (no pretreat-ment) (%)
MEN 2	Benton	20	4	Normal*	21.0
MEN 549	Lane	30	100	None	-
MEN 577	Linn	40	15	Normal*	35.5

* A high percentage of flowers produce the maximum four nutlets. Each nutlet is a 1-seeded fruit, here referred to as a seed.

Chemotaxonomy of leafy spurge (Euphorbia esula) with pyrolysis-mass spectrometry-pattern recognition. Torell, J.M., J.O. Evans, R.V. Valcarce, and G.G. Smith. A study of leafy spurge (Euphorbia esula L.) was conducted using Curie-point pyrolysis-electron ionization mass spectrometry coupled with multivariate pattern recognition. The objective of this study was to expand the scope of inference by analyzing several populations not included in previous studies.

Latex samples were collected from greenhouse-grown plants into 400 µL of dimethylacetamide, sonicated for 30 min and centrifuged for five min. Ten-µL portions of the suspension were placed on continuously rotating 510 C Curie-point pyrolysis wires that were heated by an infrared lamp to dry. Samples were pyrolyzed at 510 C for ten s in a helium atmosphere and the pyrolyzate was analyzed in a mass spectrometer with the following mass spectrometric conditions: electron energy 14ev, trap current 50 mA, separator temperature 255 C, source temperature 295 C, mass range scanned 20 to 200, scanning speed 300 amu/s, and total scan time 20 s. The total mass spectra acquired for each sample during the scan time were averaged to produce a single pyrolysis mass spectrum that was less dependent on temporary variations in experimental conditions. Spectra were compiled into a data matrix and data were normalized. The normalized data were analyzed by hierarchical cluster analysis and principal components analysis.

Hierarchical cluster analysis indicated the presence of five main groups. Euphorbia cyparissias and a European accession from Alland, Austria clustered out from the E. esula group as was expected based on their divergent morphology. Factor analysis indicated a similar pattern of variation. These results are consistant with previous experiments and provide further support for the use of analytical pyrolysis-pattern recognition as a biochemical tool for characterization of weed biotypes. (Utah Agricultural Experiment Station, Logan, UT, 84322)

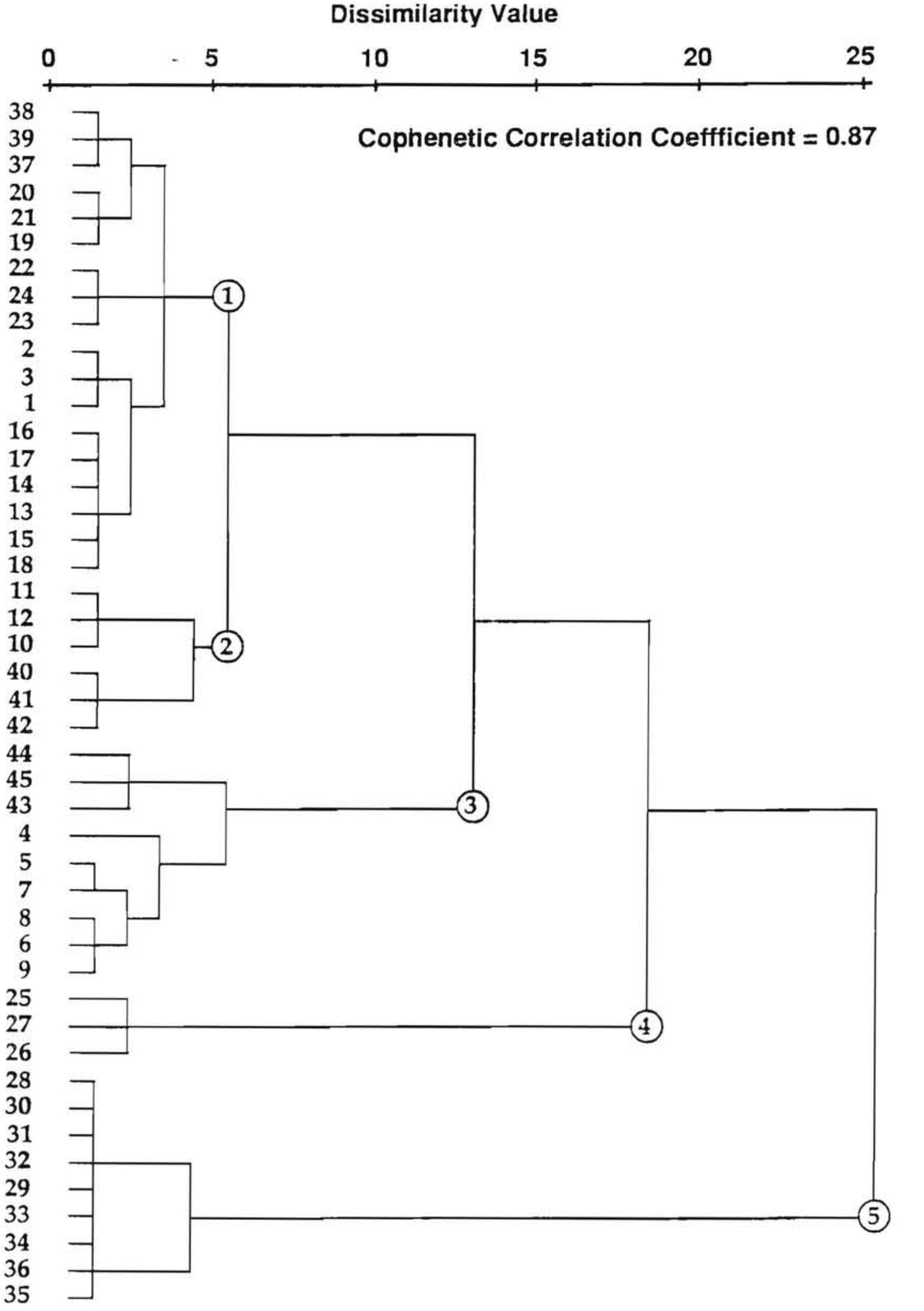


Figure 1. Dendrogram constructed from hierarchical cluster analysis of pyrolysis data.

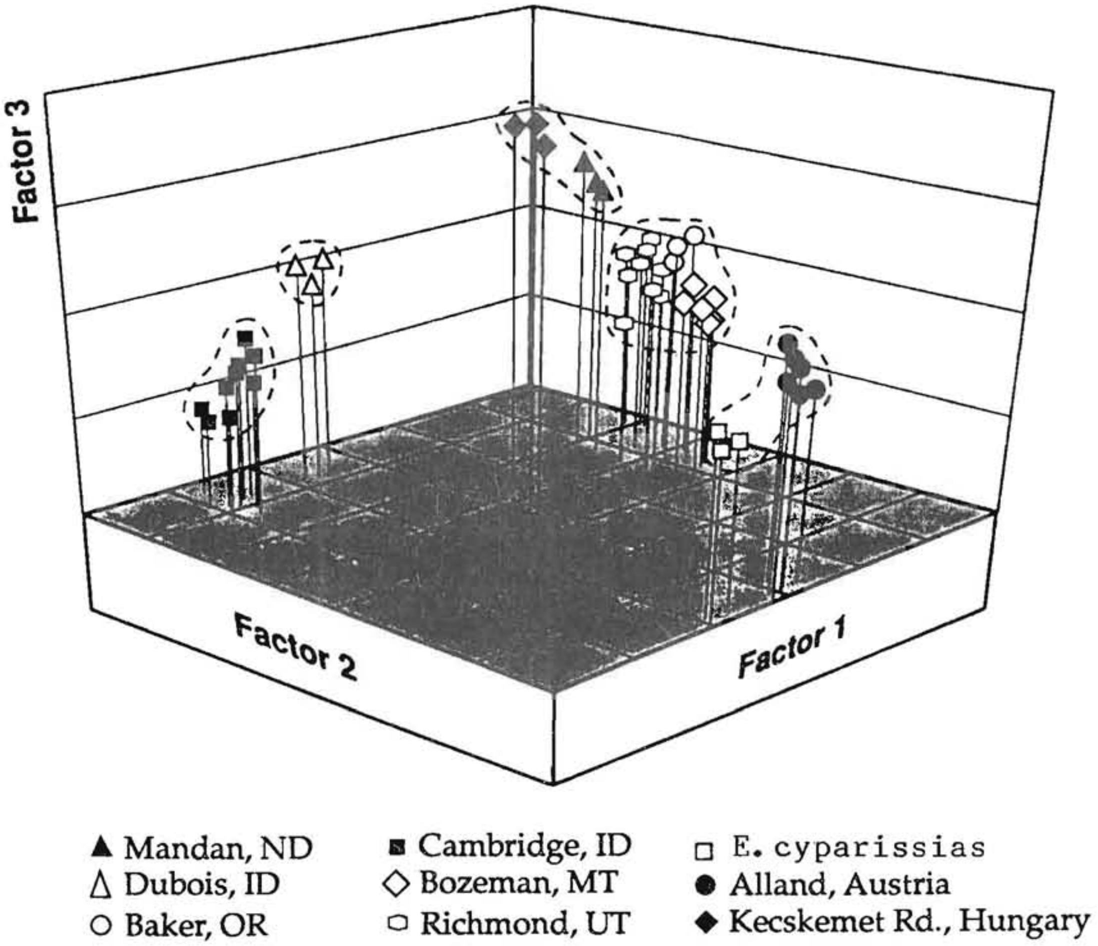


Figure 2. First three factors from principal components analysis of pyrolysis data.

Control of diclofop-resistant wild oats in winter wheat. Brewster, Bill D., Don L. Kloft, Mark Mellbye, Susan Aldrich-Markham, and Arnold P. Appleby. Trials were conducted in two wild oat-infested wheat fields in the Willamette Valley of Oregon following complaints by growers that diclofop-methyl had not been effective. The experimental design was a randomized complete block with four replications and 2.5-m by 7.5-m plots. Herbicides were applied in a spray volume of 234 L/ha through XR 8003 spray tips at a pressure of 172 kPa.

The Polk County site was treated on December 13, 1989; the wheat was in the three-leaf stage and the wild oats had one to three leaves. The Linn County site was treated on March 20, 1990. This site had three-tiller wheat and one- to three-tiller wild oats. Visual evaluations of crop injury and wild oat control that were conducted on May 1, 1990, are included in the table.

Diclofop-methyl was ineffective on the wild oats at both locations. Imazamethabenz was the most effective treatment at the Linn County site and was nearly as effective as fenoxaprop-P-ethyl at the Polk County site. There was a large difference in performance of fenoxaprop-P-ethyl between the two sites and additional research is underway to substantiate this observation. None of the treatments caused visible wheat injury. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331)

Wheat injury and wild oat control with herbicides in two fields infested with diclofop-resistant wild oats

Herbicide	Rate	Polk County	Linn County	Polk County	Linn County
		Wheat injury		Wild oat control	
	(kg a.i./ha)	(%)			
diclofop-methyl	1.1	0	0	15	0
imazamethabenz	0.53	0	0	93	80
fenoxaprop-P-ethyl	0.08	0	0	99	20
check	0	0	0	0	0

Cross-resistance of diclofop-resistant wild oats. Brewster, Bill D. and Don L. Kloft. Wild oats in some western Oregon wheat fields have not been adequately controlled by diclofop-methyl in commercial applications and field trials. Other research at Oregon State University has shown that diclofop-resistant Italian ryegrass is also resistant to certain other herbicides. Wild oats from one such field were transplanted into 10-cm by 10-cm pots to test for cross-resistance to other postemergence herbicides. 'Cayuse' oats at the same growth stage were transplanted for comparison. 'Cayuse' oats were selected because of their relative genetic uniformity and known susceptibility to several postemergence grass herbicides.

Transplants were maintained in the greenhouse for 5 days before the herbicides were applied. The trial design was a randomized complete block with three replications. Herbicides were applied with a greenhouse track-sprayer fitted with a 95015E flat fan spray tip. The spray volume was 250 L/ha delivered at 260 kPa. The plants were subirrigated and kept under artificial light. Two weeks after treatment the plants were harvested at the soil surface and fresh weights were obtained. The trial was repeated.

A summary of the results from the two trials averaged across the four herbicide rates is in the table. Wild oats were less effectively controlled than 'Cayuse' oats by all herbicides except fenoxaprop-P. These data indicate that cross-resistance of diclofop-resistant wild oats to other postemergence grass herbicides is probable. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331)

Fresh weight of wild oats and 'Cayuse' oats following applications of herbicides

Herbicide[2]	Fresh weight[1]	
	Wild oats	'Cayuse' oats
	(% of check)	
diclofop	75 A	12 B
fluazifop-P	46 A	4 B
quizalofop	39 A	6 B
fenoxaprop-P	21 A	19 A
sethoxydim	36 A	19 B
clethodim	14 A	1 B

[1]Values are averages of four herbicide rates and two trials; means followed by the same letter with a herbicide are not different. (p = 0.05) according to Duncan's multiple range test.
[2]Herbicide rates (kg a.i./ha); diclofop = 0.25, 0.5, 1.0, 2.0; fluazifop-P, quizalofop, fenoxaprop-P, sethoxydim, clethodim = 0.025, 0.05, 0.1, 0.2. Crop oil concentrate was added to each treatment at 2.3 L/ha.

Seed viability development in field sandbur. Anderson, R. L. Field sandbur (*Cenchrus incertus* M. A. Curtis) is a difficult-to-control weed infesting corn. It is also prevalent on roadsides and field borders. Mowing operations on roadsides or tillage operations to destroy severely-infested crop areas can reduce field sandbur population in the soil seedbank, and thus lessen the infestation in subsequent years. Knowledge of seed viability development is needed to ensure that such operations are performed before viable seed is produced. The purpose of this study was to determine when seed viability develops in field sandbur.

Burs from field sandbur growing in an irrigated corn canopy were collected once a week from the boot stage until seed maturity. Growth stage of the parent plants was determined for each date of bur collection. One hundred burs were collected from five sites for each date. The burs were stored for six weeks in a greenhouse maintained at 32:18 C (day:night) temperatures, then at room temperature (20-23 C) until viability tests were conducted in January. One hundred seeds were removed from the burs (2 to 3 seeds per bur) from each site for each date and tested for germination at 25:20 C day:night temperature with the rolled-towel method. Viability of seeds that did not germinate was determined with tetrazolium.

Viability development of field sandbur seed increased with maturity (See Table). However, viable seed was produced early in plant development. When burs were collected from plants where the inflorescence was fully emerged but before anthers were extruding from the burs, 24% of the seeds were viable. This indicates that fertilization and seed development proceeded after removal from the plant. Because field sandbur has a high seed production potential, even a low viability percentage on destroyed plants could contribute significant additions to the soil seedbank. Producers need to time their control action (tillage or mowing) to occur before the inflorescence emerges to ensure that seed produced by the controlled plants is not viable. (USDA-ARS, Akron, CO 80720).

Table. Seed viability at several growth stages in field sandbur.

		Seed viability		
Date of harvest	Growth stage	Germinating	Viable but nongerminating	Total viable
		(%)		
July 20	Boot	0	0	0
July 27	Head 1/2 emerged	0	0	0
Aug 3	Head fully emerged	2	22	24
Aug 10	Anthesis	9	43	52
Aug 17	Milk	6	84	90
Aug 24	Early dough	10	87	97
Aug 31	Hard dough	9	85	94
Sep 7	Mature	18	79	97
LSD (0.05)		6	11	11
CV (%)		76	17	16

Uptake and Translocation of Picloram in Apparently Resistant and Known Susceptible Yellow Starthistle. Prather, T.S., P. Fuerst and R.H. Callihan. Picloram is not as effective on yellow starthistle in a field near Dayton, Washington as it is in other areas. The physiological reason for this apparent resistance has not been determined. An uptake and translocation study was conducted to offer insight into how these plants avoid the effects of picloram.

Seeds of known susceptible (S) and apparently resistant (R) yellow starthistle were germinated at 25 C. When radicle lengths averaged 2 cm, eight R and eight S plants were planted into 5 cm pots containing 'sunshine' potting mix. The plants were grown under fluorescent 'gro' lights at 20 C. After reaching the six leaf stage, the plants were transplanted into 10 cm pots.

All sixteen plants were removed from the potting mix when they reached the 18-rosette leaf stage. Their roots were washed, and each plant was transferred to a flask containing 500 ml of aerated hydroponic growth media 24 hours prior to application of picloram. Picloram was sprayed on four R and four S plants at 0.21 kg ai/ha using a greenhouse sprayer delivering 160 L/ha. One cm^2 on the 14^{th} leaf (counted from the shoot tip) of each plant was covered during the application. Ten 20-ul droplets of ^{14}C-picloram (2.1 ug), which equalled the dosage applied to the rest of the plant, was applied to the covered area. Additionally, 4 R and 4 S yellow starthistle plants received a root application of ^{14}C-picloram (217 ug) to the hydroponic solution, (equivalent to the amount of picloram applied to the surface of a 10 cm pot). A total of 500,000 decays per minute (DPM) of ^{14}C-picloram were applied to each plant by either foliar or root treatments. The sixteen plants were arranged in four randomized complete blocks for analysis.

Twenty-four hours after treating the plants, they were harvested. The foliar-treated plants were divided into four morphological sections: 1) above the treated leaf (including shoot tip), 2) the treated leaf, 3) below the treated leaf including stem tissue, and 4) the roots. The root-treated plants were divided into roots and leaves. All experimental blocks of plants could not be processed at one time so three blocks were placed in cold storage (1-2 days) at 0-4 C and covered with cellophane to slow evaporation and transpiration until they could be processed. Each treated leaf was washed with MeOH for 15 seconds followed by a H_2O rinse for an additional 15 seconds. Aliquots from all hydroponic solutions and water rinses were counted in a scintillation counter . The MeOH rinses were counted after the MeOH was evaporated using N_2 gas. The volume of hydroponic solution was recorded 24 hours after picloram application and transpiration was calculated as the difference between this and the original volume (500 ml). The area of each leaf was measured, and each plant part was air-dried and weighed. The stem and root tissue samples were then oxidized and the $^{14}CO_2$ was trapped. The fibrous roots were subsampled because of the large amount of root tissue. Samples under 0.3 g were oxidized on a 2 minute cycle and samples under 0.5 g were oxidized on a 3 minute cycle. Samples over 0.5 g were split and oxidized separately.

The data were analyzed by analysis of covariance with block, biotype, and morphological category as the independent variables and the amount of water transpired (initial minus final hydroponic solution volume) as the covariate. The dependent variables were total DPM's per morphological position and DPM's per morphological position per g of dry weight. The data were skewed towards the smaller DPM counts, requiring a natural logarithmic transformation to normalize the data. The covariate analysis required mean separation using a least squares mean technique.

Recovery of radioactivity was considered acceptable (Table 1). There were no differences in total ^{14}C uptake between the R and S plants for either the foliar or root treatments (Table 2). There was a trend towards more uptake for the root treated-susceptible plants, indicating an area which needs further investigation to determine if absorption is important for resistance.

More ^{14}C translocated out of the treated leaves of the R plants than in the S plants (Table 3). Forty percent less radioactivity (on a per gram dry weight basis, DPM/g) was found in treated leaves of the R plants than in the treated leaves of the S plants. The radioactivity present in tissue above the treated leaf was slightly higher in the R accession but did not differ significantly between biotypes. In the leaf tissue below the treated leaf, more radioactivity (DPM/g) was found in the R plants. More total radioactivity (DPM) was found in the roots of the R plants but there were no differences in DPM/g of root tissue.

Yellow starthistle plants which received picloram from the hydroponic solution had the same amounts of radioactivity in the roots, regardless of accession. However, the R plants had 79% less radioactivity in the leaves (both DPM and DPM/g) than in the S plants (Table 4).

The differences in radioactivity found in plant tissues of the two yellow starthistle accessions were not attributed to differences in shoot or root uptake of picloram. This suggests an internal mechanism responsible for resistance in the R plants. The R plants appeared to translocate more radioactivity basipetally, from leaves, than did the S plants. More radioactivity was translocated from the roots to the foliage in the S plants.

The translocation patterns for ^{14}C-picloram applied to roots and shoots suggest the R plants translocate picloram basipetally where the picloram is metabolized and/or sequestered. This would account for the downward movement from a foliar application in the resistant biotype and the lack of acropetal movement from a root application. (Idaho Agriculture Experiment Station, Moscow, ID 83843 and Department of Agronomy and Soils, Washington State University, Pullman, WA 99164)

Table 1. Average radioactivity applied to and recovered from both roots and leaves of yellow starthistle plants.

Biotype	H_2O transpired	Radioactivity applied	Radioactivity unabsorbed	Radioactivity absorbed[1]	Recovery
	(ml)	(DPM)	(DPM)	(DPM)	(%)
Root treatment					
R	67	494,000	420,000	62,600	98
S	76	494,000	360,000	85,300	90
Foliar treatment					
R	76	500,000	449,000	38,600	98
S	106	500,000	448,000	42,600	98

[1]Absorbed values were corrected for a 92% oxidation efficiency.

Table 2. Total radioactivity absorbed by the R and S biotypes.

Treatment	Biotype	Transpiration	Radioactivity[1]	
		(ml)	(DPM)	(DPM/g)
Root	R	66	52,700	188,000
	S	76	77,000	428,000
Foliar	R	78	37,600	354,000
	S	106	34,000	384,000

[1]Values are geometric means, adjusted with a covariate.

Table 3. Radioactivity recovered from plant parts following foliar treatment with ^{14}C-picloram.

Biotype	Location	Radioactivity[1]	
		(DPM)	(DPM/g)
R	above	1,000	16,000
S	above	600	10,000
R	treated	14,000	112,000 **
S	treated	20,000	184,000 **
R	below	500	2,800 *
S	below	300	1,400 *
R	root	10,300 ***	30,300
S	root	5,200 ***	39,600

[1]Values are geometric means, adjusted with a covariate.
* Accessions significantly different at P>0.10.
** Accessions significantly different at P>0.06.
*** Accessions significantly different at P>0.04

Table 4. Radioactivity recovered from roots and leaves of plants which received a root application of picloram.

Biotype	Location	Radioactivity[1]	
		(DPM)	(DPM/g)
R	leaves	400 *	4,100 *
S	leaves	1,900 *	19,400 *
R	roots	46,200	79,100
S	roots	52,700	84,600

[1]Values are geometric means, adjusted with a covariate.
* Accessions significantly different at P>0.001.

PROJECT 7

ALTERNATIVE METHODS OF WEED MANAGEMENT

BARBRA MULLIN - CHAIRPERSON

BOB CALLIHAN - CHAIRPERSON - ELECT

Sheep grazing for weed control in seedling alfalfa. Bell, C. E. and J. N. Guerrero. A research project is underway to evaluate the efficacy of sheep grazing as compared to standard weed control methods in seedling alfalfa. The experiment is being conducted at the University of California Imperial Valley Research and Extension Center, Holtville, California.

The trial is a modified randomized complete block design, with two blocks and three replications per block. Alfalfa was sown and irrigated on October 25, 1989. Plot size was 0.04 ha (22m by 18m). Treatment one was grazing by sheep, four sheep per plot, from January 30, 1990 until February 22, 1990. Treatment two was EPTC at 3.9 kg/ha applied on October 6, 1989, incorporated by disc to 15 cm, plus 2,4-DB at 1.1 kg/ha and sethoxydim at 0.31 kg/ha applied on December 21. Treatment four was untreated. Herbicide applications were made at 323 l/ha carrier volume at 276 kPa with 8004 flat fan nozzles.

All plots were sampled on January 25, 1990 before sheep were brought in. Five random, $0.25m^2$ quadrat samples were taken per plot. In each sample, alfalfa and weeds were separated by species, counted, and weighed after drying at 54°C for 72 hours. Weeds present were; London rocket, volunteer wheat (*Triticum aestivum* L), little mallow, littleseed canarygrass, prickly lettuce, wild beet (*Beta maritima* L), nettleleaf goosefoot, annual sowthistle, and rescuegrass. After the sheep had finished grazing, all plots were mown, the hay baled, and taken from the field. The field was irrigated on March 8. The sampling protocol was repeated on April 20, 1990. Biomass samples were collected on May 11, June 18, and August 20, 1990.

Treatment two controlled all weeds present very well (>95%). Treatment three controlled most weeds well, except volunteer wheat. The data presented in the table below represent the first year of a three year trial. (University of California Cooperative Extension, Holtville, CA 92250.)

Alfalfa and weed density and biomass as affected by weed control method in the Imperial Valley of California

Treatment	Jan 25		April 20		May 11	June 18	Aug 20
	Density (#) and Biomass (gm)/m^2						
	#	gm	#	gm	gm	gm	gm
1. Sheep grazing							
Alfalfa	318	193	323	135	178	328	154
Weeds	12	56	6	37	2	0	0
2. EPTC, 2,4-DB, sethoxydim							
Alfalfa	366	111	318	159	221	328	160
Weeds	1	1	2	35	0	0	0
3. 2,4-DB, sethoxydin							
Alfalfa	315	96	309	137	204	309	117
Weeds	9	28	7	87	1	0	0
4. Untreated							
Alfalfa	374	116	245	118	212	317	145
Weeds	34	76	8	72	1	0	0

Sheep as a biological tool to reduce the risk cattle poisoning from larkspur. Ralphs, M.H. and J.E. Bowns. Sheep are more resistent to larkspur poisoning than are cattle, and may be used as a tool to graze larkspur prior to cattle turn-in to reduce the risk of cattle poisoning. Larkspur is most toxic in the early growth stages and declines in toxicity with maturation. To be an effective management tool, sheep must graze larkspur early in the growth cycle to reduce either larkspur availability or acceptability to cattle grazing afterwards. The objective of this study was to measure sheep utilization of three species of larkspur at three growth stages (vegetative, bud, and flower) at five locations: waxy larkspur at Sheridan, MT; duncecap larkspur at Oakley, ID; and tall larkspur at Ferron, Salina, and Cedar City, UT. Sites were selected where sheep would graze larkspur patches at the designated growth stages in their normal grazing pattern of the allotment.

Utilization of waxy larkspur, at the bud stage, varied among years (14-73% of heads and 0-44% of leaves grazed). Use of tall larkspur increased as the plant matured from the vegetative to flower stage (0-5% of heads and leaves grazed in the vegetative stage, to 29-50% of heads and 25-48% of leaves in the flower stage). Use of duncecap larkspur was high during the vegetative stage (55% of heads and 29% of leaves grazed) due to the closed herding practices. Utilization in the bud and flower stage ranged from 56-79% of heads and 21-31% of leaves.

Sheep will not consistently graze larkspur early in its growth cycle. However, through closed herding practices or bedding sheep on larkspur patches, they can be compelled to graze larkspur and reduce its availability; or trample larkspur thus reducing its acceptability to cattle. (USDA/ARS Poisonous Plant Research Laboratory, Logan, UT 84321)

Interplanting oats into established alfalfa. Lanini, W.T. and W.E. Bendixen. Generally, maintaining a solid alfalfa canopy prevents weed germination, weed growth, or both. However, alfalfa stands naturally thin with age or other stresses, preventing rapid canopy closure; they are more sensitive to weed invasion at this time. The objective of this study was to evaluate interseeding of oats into established alfalfa, as a means of improving the crops competitive ability against weeds and its effect on hay yield.

In 1990, oat interseeding trials were established to evaluate seeding method - broadcast versus drilled seed. Also compared were nitrogen rate and application timing, 0 lb/a, 30 lbs/a, 60 lbs/a (each at planting) or 30 lbs/a at planting and 30 lbs/a in early March. 'Montezuma' oats was sown at 50 lbs/acre in all oat plots. The 1990 trial was planted on December 11, 1989 in a randomized complete block design, with four replications. Ammonium nitrate (34-0-0) was used for nitrogen. Oat treatments were compared to paraquat treatments, cultivation (each applied the same day as oat interseeding), or an untreated check. Weed cover in each plot, was visually assessed in randomly placed quadrats (0.5 m^2) prior to each harvest. Yield determinations were made using a flail type forage harvester, which cut a 6 ft by 20 ft section from the center of each plot. Forage was then weighed. Subsamples were taken for moisture determination and the conversion of harvest weight to dry weight was made.

In April, weed cover, primarily composed of winter annuals, was reduced in almost all instances by interseeding oats into alfalfa compared to untreated plots (table 1). In July and August, weed cover, primarily summer annuals, was greatest in paraquat treated plots compared to all others (table 1). Paraquat effectively controlled weed growth through the first cutting, but summer weeds were not controlled by the early application. Cultivation did not change weed cover relative to untreated.

First cutting yields were increased by the addition of oats relative to all non-oat treatments (table 2). Broadcast planting appeared visually to be superior to drilling oat seed, but yield data indicated no differences. Rate and timing of nitrogen application to oats also failed to have a significant effect on yields. Paraquat treatments reduced yields relative to untreated or cultivated plots. (Department of Botany, University of California, Davis, 95616, and Cooperative Extension, Santa Barbara County, 93455)

Table 1. Weed cover in 1990 relative to treatment at Santa Ynez, California

	Treatment[1]	Weed Cover (%) Mar 8	Apr 16	Jul 7	Aug 21
1	Oat - Broadcast + 30 lb/a N	3.75	12.50	11.25	4.00
2	Oat - Drilled + 30 lb/a N	2.75	17.50	2.50	4.25
3	Oat - Drilled + 0 lb/a N	1.00	18.75	2.50	3.25
4	Oat - Drilled + 60 lb/a N	1.75	16.25	7.50	4.00
5	Oat - Drilled + 30+30 lb/a N	1.50	21.25	15.00	4.50
6	Paraquat 0.5 lb ai/a	1.25	18.75	32.50	12.25
7	Cultivated Check	1.25	28.75	8.75	5.75
8	Untreated Control	3.00	33.75	10.00	5.75
	LSD .05	ns	14.00	16.20	6.20

[1] Montezuma oat seeded at 50 lbs/a in all oat plots.

Table 2. Yields in 1990 at each cutting relative to treatment at Santa Ynez, California

Treatment[1]	Forage Yields (Tons/acre) Apr 25	Jun 4	Jul 7	Aug 21	Oct 10	Total
Oat- Broadcast + 30 lb/a N	1.64	1.74	1.67	1.79	1.58	8.42
Oat- Drilled + 30 lb/a N	1.45	1.64	1.81	1.96	1.34	8.20
Oat- Drilled + 0 lb/a N	1.49	1.82	1.84	1.87	1.46	8.48
Oat- Drilled + 60 lb/a N	1.47	1.85	1.84	1.86	1.54	8.56
Oat- Drilled + 30+30 lb/a N	1.50	1.70	1.75	1.78	1.44	8.17
Paraquat 0.5 lb ai/a	0.53	1.50	1.68	1.60	1.50	6.82
Cultivated Check	0.92	1.80	1.82	1.84	1.40	7.77
Untreated Control	0.86	1.76	1.83	1.70	1.54	7.70
LSD .05	0.27	0.22	ns	0.20	ns	0.66

[1] Montezuma oat seeded at 50 lbs/a in all oat plots.

Preemerge and Postemerge Organic Weed Control in Corn. Westra, P., E.E. Schweizer, and D. Lybecker. Large scale field research was initiated in May 1990 to assess the use of a rotary hoe versus a flex drag harrow for preemergence weed control in irrigated corn. A standard cultivator versus an in-row organic corn cultivator were compared for postemergence weed control. The study had 4 replications with plots 10 ' wide by 200 ' long. The research was conducted under field conditions in three large research blocks. Fall 1989 soil samples were extracted for determination of the number of weed seeds present by genus and species for all weeds. Based on these weed seed counts, all plots were characterized into three categories; low, moderate, and high weed potential. Assessment of weed control and corn stand effects from each tillage operation in each plot was accomplished by counting the number of corn plants, and all the weeds by genus and species in a 7" by 5' band over the corn row at 10 positions in each research plot.

The rotary hoe and chain drag harrow were of approximately equal effect in providing preemerge weed control in corn. Using these implements up to the 9 leaf stage of corn produced corn plants that were torn and bent over shortly after the tillage operations, but corn stand and corn yield were not adversely affected by even late tillage operations with these implements.

Pre-cultivation weed stands were 40 - 50 weeds per 50 feet of corn row. Using no herbicide, the weed population within the corn row was reduced 96% following one flex drag harrowing and two cultivations with the organic in-row cultivator. The standard cultivator was ineffective for in-the-row weed cultivation, while the organic in-row cultivator was highly effective for weed control. Corn grain yields were obtained in all plots, as well as final weed counts at corn harvest.

In a separate study where a standard cultivator and the in-row cultivator were used over a standard soil applied herbicide selected by the computer bioeconomic model, there was no difference in weed stands. The soil applied herbicide effectively controlled weeds in the corn row. Thus it appears that specialized, in-row cultivators have the potential for providing effective organic weed control in corn.

Postemergence harrowing for green foxtail control in spring wheat and barley. Fay, P.K., B.S. Muller, and E.R. Gallandt. Green foxtail (SETVI) is becoming more troublesome in small grains in Montana. Research plots were established to determine the effect of postemergence harrowing on green foxtail density in spring wheat and barley. 'Pondera' spring wheat and 'Piroline' spring barley were seeded with a grain drill 2 inches deep on May 19, 1989 at the Post Research Farm, Bozeman, MT at a seeding rate of 80 lb/A in rows 6 inches apart. The plots were 7 ft by 25 ft long with 6 replications. One treatment received fenoxaprop (3EC) at a rate of 0.46 lb a.i./A on June 22, 1989 using a CO_2 back pack sprayer operated at 40 psi in 14.5 gpa. The leaf stage of green foxtail was counted at 50 untreated locations through the experimental area on the dates shown (Table 1). The harrowed treatments were harrowed perpendicular to the seeded rows with a single section of a fixed tine harrow was pulled through the plots once with a garden tractor at a speed of 8.0 miles per hour. Green foxtail density was measured by counting the number of plants per m^2 in 6 random locations per plot on September 7, 1989. Crop yields were taken on the same day using a small plot combine.

Postemergence harrowing for green foxtail control has been used in the past by farmers in North Dakota. It is described as a "don't look back technique" because of the extreme apparent damage from harrowing. The immediate effect on the crop was distressing however, recovery was rapid since it was difficult to tell where harrowing was done one week after treatment. Older farmers in North Dakota claim that spring wheat can be harrowed up to three times while barley can only tolerate the treatment once. They also claim that the technique only works on small green foxtail plants at the 1 to 3-leaf stage. They feel best results occur when harrowing is done on hot, dry, windy days.

The best control of green foxtail by harrowing was achieved when the crop was harrowed twice however control was only about 50% (Table 2). The only treatment which provided effective control was the herbicide application. While conditions during the trial were dry, green foxtail plants emerged over a very long period of time so harrowing was not accomplished at the optimal time (Table 1).

Green foxtail plants at the two leaf stage may be very vulnerable to this technique because the seed reserve is spent by that time and the above ground biomass is weakly connected to the root system. At this same stage wheat and barley plants are firmly anchored in the soil so plant detachment by harrowing could be quite selective. We observed that common lambsquarters (*Chenopodium album*) and redroot pigweed (*Amaranthus retroflexus*) control was excellent following harrowing. While the results obtained here were unsatisfactory, more research is justified in an attempt to make this technique work. (Montana Agric. Exp. Sta., Bozeman, MT 59717).

Table 1. Relative leaf stage of green foxtail on four dates.

Date	Green foxtail leaf stage 1.0	2.0	3.0	4.0	5.0	6.0
	%					
6-12-89	21	61	18	--	--	--
6-19-89	9	27	33	25	6	--
6-22-89	5	20	7	23	32	13
6-26-89	13	31	16	12	14	8

Table 2. Green foxtail density per m^2 and crop yields on 9-7-89[1].

Treatment	Date of Treatment	Green foxtail plants (m^2)		Crop Yield	
		Spring Wheat	Spring Barley	Spring Wheat	Spring Barley
		No.		Bu/A	
Harrowed once	6-12-89	129.2a	94.5b	23.1a	29.3a
Harrowed twice	6-12-89 & 6-19-89	62.7c	56.2c	20.7a	22.2a
Harrowed once	6-19-89	107.8b	96.2b	18.6a	25.6a
Harrowed once	6-26-89	130.8a	117.7ab	26.4a	30.8a
Herbicide	6-22-89	5.8d	5.3d	21.3a	30.0a
Control	---	128.2a	126.2a	23.3a	27.4a

[1] Means within columns followed by the same letter are not significantly different at the 5% level using LSD.

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Orchardgrass.......................6, 24
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Spruce, white......................53, 56, 60, 64
Sugarbeet..........................126, 228, 230, 232, 234
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Timothy, common....................6, 24
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Watermelon.........................113, 198, 199
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Wheat, spring......................240, 246, 249, 251, 324
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Wheatgrass, crested cv. Ephraim.....16, 24
Wheatgrass, crested or desert cv. Hycrest....16, 86
Wheatgrass, crested cv.Nordan.......16
Wheatgrass, intermediate............16
Wheatgrass, intermediate cv. Rush...24
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Wheatgrass, pubescent...............16, 24
Wheatgrass, Siberian................16
Wheatgrass, slender.................86
Wheatgrass, streambank..............16, 24, 86
Wheatgrass, tall....................16
Wheatgrass, thickspike..............86
Wheatgrass, western.................24, 86
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HERBICIDE INDEX
(by common name or code designation)

This table was compiled from approved nomenclature adopted by the Weed Science Society of America (Weed Science 35(5):1986) and the herbicide handbook of the WSSA (5th edition). "Page" refers to the page where a report about the herbicide begins; actual mention may be on a following page.

Common Name or Designation	Chemical Name	Page
acifuorfen	5-[2-chloro-4-(trifluoromethyl)phenoxyl]-2-nitrobenzoic acid	162
alachlor	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide	160, 187, 191
atrazine	6-chloro-N-ethyl-N'-(1-methyl-ethyl)-1,3,5-triazine-2,4- diamine	16, 60, 176, 177, 179, 181, 185, 187, 189, 191, 205, 253
benefin	N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine	102
bensulide	O,O-bis(1-methylethyl)S-[2-[(phenylsulfonyl)amino]ethyl] phosphorodithioate	102, 113
bentazon	3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide bromoxynil 3,5-dibromo-4-hydroxybenzonitrile	127, 133, 160, 162, 172, 213, 221, 276
bromoxynil	3,5-dibromo-4-hydroxybenzonitrile	127, 131, 133, 135, 138, 143, 151, 153, 155, 157, 176, 177, 179, 240, 242, 244, 246, 251, 255, 266, 269, 271, 274
CGA-131036	N-(6-methoxy-4-methyl-1,3,5-triazin-2-yl-aminocarbonyl-2-(2-chloroethoxy)benzenesulfonamide)	249
CGA-136872	2-[[[[[4,-6-bis(difluoromethoxy)-2-pyrimidinyl[amino]carbonyl]amino]sulfonyl]benzoic acidmethylester	29, 33, 177, 181, 185, 189, 279
chlorsulfuron	2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino] carbonyl]benzenesulfonamide	2, 14, 20, 27, 29, 33, 79, 84, 90, 94, 240, 269, 300

Common Name or Designation	Chemical Name	Page
clethodim	(E,E)-(±)-2-[1-[[(3-chloro-2-propenyl) oxy]imino] propyl]-5- [2-(ethylthio) propyl]-3-hydroxy-2-cyclohenen-1-one	118, 119, 135, 234
clomazone	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone	101, 117, 149, 276, 277, 279
clopyralid	3,6-dichloro-2-pyridinecarboxylic acid	2, 8, 16, 20, 24, 27, 29, 33, 40, 43, 47, 49, 88, 90, 92, 153, 155, 157, 177, 228, 230, 232, 240, 255, 258, 271
clopyralid plus 2,4-D		33
cyanazine	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methyl propanenitrile	172, 176, 177, 181, 187, 189, 191, 197, 199, 219, 221
cycloate	S-ethyl cyclohexylethylcarbamothioate	230
desmedipham	ethyl [3-[[(phenylamino)carbonyl] oxy]phenyl]carbamate	228, 230, 232
dicamba	3,6-dichloro-2-methoxybenzoic acid	2, 6, 8, 10, 14, 38, 40, 43, 47, 49, 71, 74, 88, 92, 143, 155, 157, 159, 176, 177, 179, 181, 185, 187, 189, 191, 205, 210, 212, 246, 255, 271, 282
dichlobenil	2,6-dichlorobenzonitrile	298
diclofop	(±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid	145, 147, 151, 153, 213, 236, 238, 242, 244, 249, 251, 253, 260, 262, 264, 269, 279, 303, 304, 309, 310
diethatyl	N-(chloroacetyl)-N-(2,6-diethylphenyl)glycine	230,
difenzoquat	1,2-dimethyl-3,5-diphenyl-1H-pyrazolium	145, 147, 153, 155, 242, 244, 249, 251, 258, 260, 262, 264, 278

Common Name or Designation	Chemical Name	Page
dithiopyr	S,S-Dimethyl-2-(difluoromethyl)-4-(2_methylpropyl)-6-(trifluoromethyl)pyridinedicarbothioate	102
diuron	N'-(3,4-dichlorophenyl)-N,N-dimethylurea	141, 266, 271, 298, 304
DPX-79406	(2-[[[[[4,6-dimethoxypyrimidin-2-yl]aminocarbonyl]]aminosulfonyl]]N,N-dimethyl pyridinecarboxamide) +N-[4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-3-(ethylsulfonyl)-2-pyridine sulfonamide	179, 181, 183, 185, 189, 191
DPX-E9636	N-[(4,6-dimethoxypyrimidin-2-yl)aminocarbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide	129, 191
DPX-G8311	chlorsulfuron + metsulfuron(5:1)	29, 33
DPX-L5300	methyl 2-[[[[N-(4-methoxy-6-methyl-1,3,5-triazin-2-yl) methylamino]carbonyl]amino]sulfonyl]benzoate	20, 27, 143, 155, 157, 202, 246, 266, 271, 274, 278
DPX-PE 350-2	not available	197
DPX-R9674	DPX-M6316 + DPX-L5300(2:1)	157, 246, 249, 251, 269, 271, 274, 278
DPX-V9360	(2-[[[[[4,6-dimethoxypyrimidin-2-yl]amino carbonyl]]aminosulfonyl]]N-N-dimethyl pyridine carboxamide)	174, 176, 177, 179, 183, 185, 189
Enquik	monocarbamide dihydrogensulfate	195
EPTC	S-ethyl dipropylcarbamothioate	109, 111, 165, 168, 170, 317
ethalfluralin	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine	165, 170, 172, 213, 221
ethiozin	4-amino-6-(1,1-dimethylethyl-3-(ethylthio)-1,2,4-triazin-5(4H)-one (ethyl metribuzin)	253
ethofumesate	(±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate	230

Common Name or Designation	Chemical Name	Page
fenoxaprop	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid	151, 153, 226, 238, 242, 309, 310, 323
fluazifop	(±)-2-[4-[[5-(trifluoromethyl)-2pyridinyl]oxy]phenoxy]propanoic acid	60, 118, 162, 193, 234, 281
fluazifop-P	(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid	310
fluometuron	N,N-dimethyl-N'-[3-(trifluoromethyl)phenyl]urea	199
fluorochloridone	3-chloro-4-(chloromethyl)-1-[3-(trifluoromethyl)phenyl]-2-pyrrolidinone	224
fluroxypyr	4-amino-3,5-dichloro-6-fluro-2-pyridyloxy acetic acid	4, 73, 82, 84, 90, 157
fosamine	ethyl hydrogen (aminocarbonyl)phosphonate	79
glufosinate	ammonium(3-amino-3-carboxypropyl)methyl phosphinate	195, 198, 207
glyphosate	N-(phosphonomethyl)glycine	22, 24, 29, 33, 48, 53, 56, 60, 64, 79, 82, 86, 96, 103, 191, 195, 198, 202, 205, 207, 210, 212, 282
hexazinone	3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione	53, 60, 64, 141
HOE-46360	2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid	135, 234, 236
HOE-6001	not available	145, 236, 244, 249, 251, 262
HOE-6025	not available	153, 244, 251
HOE-6025-05H	not available	249
HOE-7125	not available	145, 236, 244, 249, 251, 262, 269

Common Name or Designation	Chemical Name	Page
imazamethabenz	($\pm$)methyl-6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate	145, 147, 151, 153, 155, 242, 244, 249, 251, 253, 260, 262, 264, 269, 278, 309
imazapyr	($\pm$)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol- 2-yl]-3-pyridinecarboxylic acid	43, 49, 53, 56, 60, 64, 295
imazethapyr	($\pm$)-2-[4,5-dihydro-4-methyl-4-(methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecar-boxylic acid	119, 125, 127, 131, 133, 135, 138, 141, 160, 162, 165, 168, 172, 174, 213, 215, 216, 219, 221, 282
isoxaben	N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide	102, 298
linuron	N'-(3,4-dichlorophenyl)-N-methoxy-N- methylurea	215, 216, 298
MCPA	(4-chloro-2-methylphenoxy)acetic acid	153, 155, 157, 172, 221, 240, 246, 266, 271, 274
MCPA amine		143
MCPB	4-(4-chloro-2-methylphenoxy) butanoic acid	172, 221
metham	methylcarbamodithioic acid	110, 113, 230
methyl bromide	bromomethane	113
metolachlor	2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(2-methoxy-1-methyl-ethyl)acetamide	160, 165, 168, 170, 172, 181, 185, 187, 213, 215, 216, 219, 221, 224
metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one	117, 131, 141, 172, 213, 219, 221, 224, 266, 269, 276, 279, 304
metsulfuron	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoic acid	2, 12, 14, 20, 27, 36, 43, 47, 49, 79, 84, 90, 94, 240, 282
MON-13202	not available	197, 199
MSMA	monosodium salt of MAA	197
nicosulfuron	not available	129

Common Name or Designation	Chemical Name	Page
norflurazon	4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H) pyridazinone	111, 141, 199
oryzalin	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide	102, 298
oxadiazon	3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one	102
oxyfluorfen	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene	106, 131, 238,
pantera	not available	234
paraquat	1,1'-dimethyl-4,4'bipyridinium ion	96, 131, 181, 195, 198, 320
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	82, 102, 117, 133, 160, 165, 168, 172, 177, 181, 187, 189, 195, 199, 213, 215, 216, 219, 221, 224
phenmedipham	3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate	228, 230, 232
picloram	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	2, 4, 6, 8, 10, 14, 16, 20, 24, 27, 29, 33, 36, 38, 40, 43, 47, 49, 68, 71, 73, 74, 77, 80, 81, 88, 92, 155, 212, 312
primisulfuron	3-[4,6-bis(difluroromethoxy)-pyrimidin-2-yl]-1-(2-methoxy-carbonyl-phenylsulfonyl)urea	174, 176
prodiamine	N^3,N^3-di-N-propyl-2,4-dinitro- 6-(trifluoromethyl)-m-phenylenediamine	141
prometryn	N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine	195, 199
pronamide	3,5-dichloro(N-1,1-dimethyl-2-propynyl)benzamide	121

Common Name or Designation	Chemical Name	Page
pyridate	O-(6-chloro-3-phenyl-4-pyridazinyl)-S-octylcarbamothiate	104, 127, 145, 172, 176, 177, 191, 240, 271, 281
quizalofop	(±)-2-[4[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid	96, 162, 193, 213, 221, 234, 281, 310
RO173664	[(isopropylideneamine)oxy)ethyl-d-(+)-2-[p-[(6-chloro-2-quinoxalinyl)oxy] phenoxy] propionate	193
SAN 582 H	not available	172, 213, 221
SC-0224	trimethylsulfonium carboxymethyl-amino-methyl phosphonate	210
sethoxydim	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	118, 119, 121, 135, 193, 213, 215, 221, 234, 281, 310, 317
simazine	6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine	298
SMY-1500	see ethiozin	279
sulfometuron	2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid	20, 27, 53, 60, 64, 74, 77, 126, 198, 202, 282, 298, 300
sulfosate	glyphosate trimecium	86, 96, 103, 195, 198, 202
tebuthiuron	N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea	36, 84, 90, 298
thiameturon	3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid	278
thifensulfuron	3-[[[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid	151, 240, 244
triallate	S-(2,3,3-trichloro-2-propenyl)bis(1-methylethyl)carbamothioate	172, 213, 219, 221, 279, 304
triasulfuron	see CGA-131036	29, 33, 143, 202, 240, 266, 271

Common Name or Designation	Chemical Name	Page
tribenuron	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]carbonyl]amino]sulfonyl]benzoic acic	151, 240, 244
triclopyr	[3,5,6-trichloro-2-pyridinyl)oxy] acetic acid	36, 40, 43, 49, 84, 88, 90, 92
triclopyr amine		56
triclopyr ester		53, 64
trifluralin	2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine	102, 116, 117, 123, 165, 168, 170, 172, 199, 213, 221, 224
2,4-D	(2,4-dichlorophenoxy)acetic acid	2, 6, 8, 10, 12, 29, 33, 40, 43, 47, 49, 53, 60, 64, 68, 71, 73, 74, 77, 86, 92, 151, 153, 155, 157, 159, 176, 191, 202, 210, 212, 240, 242, 255, 258, 266, 274, 282
2,4-D amine		56, 80, 143
2,4-DB	4-(2,4-dichlorophenoxy)butanoic acid	125, 127, 133, 135, 138, 317
2,4-D LVE		81, 84, 88, 90, 94
UBI C4243	not available	172, 202, 213, 219, 221, 246, 269, 271
UBI-119738	not available	202
UBI-C4874	not available	172, 213, 281
V-53482	not available	199
V-23121	not available	269, 271

ABBREVIATIONS USED IN THIS REPORT

μl....................................microliter
"....................................Inches
% ....percent
+....................................Plus
/....................................Per
>....................................Greater than
A or a..............................acre
a.i or ai............................active ingredient
ae....................................acid equivalent
ALS..................................acetolactase
AMAPO..............................*Amaranthus powellii*
AMARE..............................redroot pigweed
amu..................................atomic mass units
ANTCO..............................*Anthemis cotula*
appl..................................application
AVEFA..............................wild oats
Avg..................................average
brom..................................bromoxynil
BROTE..............................downy brome
BRWR................................Bozoisky russian wildrye
bu/A..................................bushels per acre
BWR..................................Magnar basin wildrye
C......................................degree(s), Celsius
CAPBP..............................*Capsella bursa-pasturis*
Caryophyll. ....Caryophyllaceae
CEC..................................cation exchange capacity
CHEAL..............................common lambsquarters
CIRAR..............................Canada thistle
clop..................................clopyralid
cm....................................centimeter
CO....................................Colorado
CO_2..................................carbon dioxide
COC..................................crop oil concentrate
Cr....................................Craigmont, Idaho
CRP..................................Conservation reserve program
Cu....................................Culdesac, Idaho
cwt..................................hundred weight
d......................................day
DAT..................................days after treatment
desm..................................desmedipham
dica..................................dicamba
dife..................................difenzoquat
DPM..................................disintegrations per minute
DPM/g................................disintegrations per minute per gram
EC....................................emulsifiable concentrate
ECHCG..............................*Echinochloa cris-galli*
EPOE..................................early postemergence
ERACN..............................stinkgrass
etha..................................ethalfluralin
ev....................................electron volts
F......................................degree(s), Fahrenheit
feno..................................fenoxaprop
ft....................................foot
ft^2..................................square foot
g......................................gram
gal....................................gallon
gals..................................gallons
gm....................................grams
gpa..................................gallons per acre
h or hr..............................hour

ha..................................hectare
HCWG................................Hycrest crested wheatgrass
HELAN...............................common sunflower
I-84................................Interstate-84
imaz................................imazethapyr
in..................................inch(s)
inj.................................injury
Jun.................................June
KCHSC...............................kochia
kg..................................kilogram (s)
kPa.................................kilopascal(s)
L...................................liter
L-77................................Silwet surfactant
LACSE...............................*Lactuca serriola*
lb..................................pound
lbs.................................pounds
lf..................................leaf
LOLMU...............................Italian ryegrass
LP..................................low pressure
LSD.................................least significant difference
LVE.................................low volatile ester
m...................................meter(s)
m^2...................................square meter
mA..................................milliamps
MAT.................................Months after treatment
MBG.................................Bromar mountain bromegrass
MeOH................................methanol
meq.................................milliequivalent
meto................................metolachlor
mg..................................milligram
ml..................................milliliter
Mo..................................Moscow, Idaho
mph.................................miles per hour
N...................................nitrogen
N-P-K-S.............................Nitrogen, phosphorus, potassium, sulfur
N.S. or n.s. ....not significant
N/A.................................Not applicable
N_2..................................nitrogen
NE..................................Northeast
No..................................Number
OC..................................oil concentrate
ocd.................................dash
OCS.................................Sunit
om..................................organic matter
oz..................................Ounces
p...................................pints
p...................................probability level
P or p..............................probability
PANMI...............................proso millet
PEI.................................preemergence incorporated
pen.................................pendimethalin
phen ....phenmedipham
PIA.................................Plant Introduction Accession
plt.................................Plants
pm..................................packaged mix
POE.................................postemergence
POLCO...............................wild buckwheat
PoPI................................Post-plant incorporated
post................................post-emergent
ppi.................................preplant incorporated
ppmw................................parts per million weight
pre.................................preemergence
psi.................................pounds per square inch

R....................................resistant
s....................................second
S or surf............................surfacant
S....................................susceptible
SARWR................................Synthetic A russian wildrye
SASKR................................Russian thistle
SBG..................................Regar meadow bromegrass
SBWG.................................Sodar streambank wheatgrass
Scrophyl. ....Scrophulariaceae
SE...................................Southeast
Sept.................................September
seth.................................sethoxydim
SETLU................................yellow foxtail
SETVI................................green foxtail
SINAR................................wild mustard
SOLSA................................*Solanum sarrachoides*
SONAL................................*Sonchus oleraceus*
SOSLA................................hairy nightshade
sq...................................square
SR...................................stand reduction
SSYOF................................*Sysmbrium officinale*
surv.................................survived
SWG..................................Prior slender wheatgrass
t....................................application times
t/A..................................tons per acre
temp.................................temperature
trif.................................trifluralin
TSWG.................................Critana thickspike wheatgrass
ULV..................................ultra-low-volume
v/v..................................volume per volume
W....................................West
WP...................................wettable powder
wt...................................Weight
WWG..................................Rosana western wheatgrass