An Evaluation of Herbicides For Control of Wild Oats In Barley

Efficacy, Phytotoxicity, and Barley Variety Susceptibility Studies

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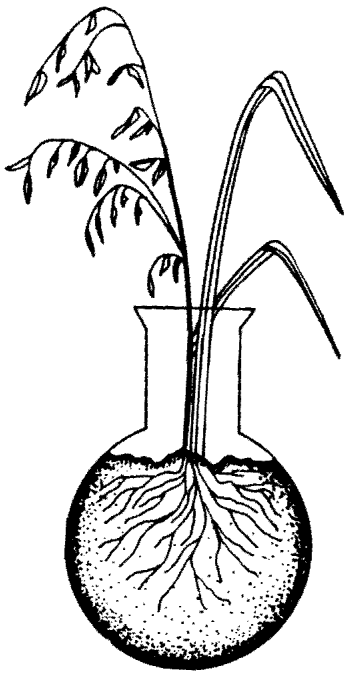

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Abstract

The control of wild oats (*Avena fatua* L.) in Alaskan spring-planted barley was investigated in a series of experiments conducted from 1981-1984. Rates and times of applications of triallate (a preemergence, soil-incorporated herbicide), diclofop, barban, and difenzoquat (postemergence herbicides) were investigated in relation to control of wild oats and barley yield in 1981-1982. Because of very high wild oats populations, none of the herbicides controlled wild oats to the point of allowing a barley harvest.

Generally, wild oats were best controlled when herbicides were applied at an early growth stage and at the highest application rates. Control of wild oats with triallate was the same whether incorporated using parallel or perpendicular passes of a spike-tooth harrow. In 1983-84 both single herbicide treatments and combinations of herbicides were studied. Barban, diclofop, and difenzoquat were applied alone or with triallate applied in the fall or spring in emulsifiable concentrate or granular formulation. Wild oats population levels were lower in these 2 years, and applications of even single herbicides provided good wild oats control.

Of the individual herbicides, diclofop provided the best control of wild oats. In general, when triallate was applied in conjunction with diclofop, barban, or difenzoquat, control of wild oats was better and higher barley yields were obtained than when a single wild oats herbicide was applied. When triallate was applied in the fall, the granular formulation provided better control of wild oats than the emulsifiable formulation. In a study of the response of eight barley varieties ('Eero', 'Paavo', 'Galt', 'Otra', 'Otal', 'Datal', 'Lidal', 'Weal') to high rates and late times of application of the four herbicides, none of the varieties were differentially susceptible. Diclofop decreased heights of all varieties and decreased test weights.

Introduction

Wild oats (*Avena fatua* L.) is the most serious weed of cultivated land in the prairie provinces of Canada (Sharma and Vanden Born 1978). Estimates of annual crop loss due to wild oats competition, herbicide, and dockage costs are as high as $500 million in Canada and between $300 and $500 million in the United States (Sharma 1979). Wild oats are a persistent weed in small grains because its seeds ripen and are shed before the grain crop ripens and because some seeds may be dormant in the soil for long periods (Sharma and Vanden Born 1978).

In Alaska, wild oats are not now widespread. A few infestations have been reported in the Matanuska Valley, Fairbanks, and Delta Junction farming areas. However, where wild oats have become established in Alaska, they appear to thrive. Total loss of barley crops due to wild oats have occurred at the University of Alaska-Fairbanks Agricultural and Forestry Experiment Station Farm when herbicides were not used.

Since wild oats will likely become a major weed problem in barley fields in Alaska, work was begun in 1981 to determine the effects on barley and wild oats of four herbicides approved for wild oat control: triallate[1] (preplant incorporated) and difenzoquat[2], diclofop[3], and barban[4] (postemergence herbicides). The specific objectives were to:

1) determine optimum rates and times of application for each herbicide individually,

2) compare wild oats control with individual herbicides to herbicide combinations, and

3) determine whether there is differential susceptibility between barley varieties to injury by the various wild oat herbicides.

[1]Trade name: Fargo (Monsanto Agricultural Products Co.)
[2]Trade name: Avenge (American Cyanamid Co.)
[3]Trade name: Hoelon (American Hoechst Corp.)
[4]Trade name: Carbyne (Velsicol Chemical Co.)

Materials and Methods

All studies were carried out at the Agricultural and Forestry Experiment Station farm at Fairbanks. The soil was Tanana silt loam (nonacid pergelic cryaquept) with pH 7.0 and 4.1 percent organic matter. All herbicide applications were made with a backpack plot sprayer using CO_2 as a propellant. All plots were 10 ft × 40 ft. Plots were located on sites where wild oat herbicides had not been used previously and where wild oat infestations were known to occur. Herbicide rates tested were generally .5, 1, and 2 times the rate recommended by the manufacturer for high wild oat densities.

Herbicide-Rate and Time-of-Application Study

1981

The experiment was laid out as a randomized complete block design with twenty-three herbicide treatments and a weedy control in each of four blocks. The plots received a broadcast fertilizer application of 200 lb/A of 10:20:20 and were disked once. Triallate (EC formulation) was then applied to the appropriate plots at 1.25 lb/A and was incorporated using either two parallel or two perpendicular passes with a spike-tooth harrow. Galt barley was planted in rows 7 in apart at a rate of 70 lb/A on May 13. Barban was applied at .12 or .25 lb/A at the 2-leaf, 3-leaf, or 5-leaf stage of wild oats (May 27, June 5, June 17, respectively). Diclofop was applied on the same dates at either 0.47, 0.94, or 1.87 lb/A. Difenzoquat was applied when wild oats had three or five leaves at 0.62 or 0.89 lb/A. All herbicides were applied at 30 psi pressure, dispensing 25.1 gal/A. Bromoxynil was applied June 5 at 0.25 lb/A to control broadleaf weeds in all plots except those sprayed with diclofop, because of a known antagonistic effect of diclofop and broadleaf herbicides (O'Sullivan et al. 1977). Diclofop plots were sprayed with bromoxynil on June 9. On August 3 the wild oats and barley in a 10.8 ft^2 quadrat were harvested from each plot. Wild oats and barley were then separated, dried, and weighed.

1982

The design and procedure for the 1982 experiment was basically the same as that in 1981 with the following exceptions: 1) triallate was incorporated only with parallel harrowing but two different application rates were evaluated: 1.25 and 2.5 lb/A; 2) Barban was applied at 0.25 and 0.5 lb/A and was only applied at the 2- and 3-leaf stages of wild oats; 3) nonionic sulfactant (x-77) was added to difenzoquat at the rate of 0.37 oz/gal. Galt barley was planted May 17. Herbicide application took place on June 8, 15, and July 2 at the 2, 3 and 5-leaf stages of wild oats. Biomass samples were obtained from 10.8 ft^2 quadrats on August 12. Diclofop and difenzoquat were applied at 30 psi (24.4 gal/A volume) while barban was applied at 45 psi (16.6 gal/A volume).

Herbicide Combination Study

1983

On October 1, 1982, following disking, triallate was applied to appropriate plots either in granular (1.5 lb/A) or emulsifiable (0.6 lb/A) form and was incorporated to 2 in using a single pass of a p.t.o.-driven rototiller. In the spring, the plots were fertilized with a broadcast application of 400 lb/A of 20:10:10 and disked once. Emulsifiable or granular triallate was applied to the spring-treated plots on May 12, 1983, at the same rates as the fall-treated plots and incorporated using a rototiller (2-in depth). Lidal barley was planted with a grain drill (7 in row spacings) at 70 lb/A of germinable seed.

Diclofop (0.9 lb/A) and barban (0.25 lb/A) were applied to the appropriate plots at the 2-leaf stage of wild oats on June 1. Difenzoquat (1.0 lb/A) was applied with nonionic surfactant at the 3- to 4-leaf stage on June 8. Metribuzin was applied June 13 at 0.5 lb/A at the 2- to 3-tiller stage of barley to control broadleaf weeds. Diclofop, difenzoquat, and metribuzin were applied at 30 psi (23.4 gal/A) while barban was applied at 45 psi (16.6 gal/A).

On August 5, biomass samples (2.7 ft^2) were obtained and wild oats population and height were determined. The center 4.6 ft of each plot

was harvested using a plot combine on August 11.

The experiment was a randomized complete block design with nineteen herbicide treatments, a weedy control, and five blocks.

1984

The study performed in 1982-83 was repeated in 1983-84. Fall treatments of triallate were applied and incorporated on September 28, 1983. A broadcast application of 200 lb/A 10:20:20 was applied on May 11. The spring application of triallate, its incorporation, and planting of 'Lidal' barley occurred on May 16, 1984. Diclofop and barban were applied on June 4 when wild oats were in the 1.5- to 2-leaf stage. Difenzoquat was applied when wild oats had 3 to 5 leaves on June 8. Metribuzin was applied on June 13.

Herbicide-Treatment and Barley-Variety Study

This study was performed in an area where wild oats were not present. A broadcast application of 400 lb/A 20:10:10 fertilizer was made on May 12. Following a double disking, triallate (emulsifiable concentrate) was applied to appropriate plots at 0.62 lb/A and was incorporated using perpendicular passes of a spike-toothed harrow. Eight barley varieties (Paavo, Lidal, Datal, Eero, Galt, Otra, Otal, and Weal) were planted at 72 lb/A of germinable seed on May 16. Barban was applied at 0.5 lb/A on June 8 when barley was in the 2- to 3-leaf stage and wild oats in other studies were in the 2-leaf stage. Diclofop was applied at 1.9 lb/A on June 15 (barley 4 leaves, wild oats 3 leaves). Difenzoquat was applied at 1.0 kg/ha on July 2 when wild oats in other plots had 5 leaves, and the barley was in the boot stage. Bromoxinyl was used at 0.36 lb/A to control broadleaf weeds.

Average barley height and number of tillers was determined on July 21. Plots were harvested August 25 using a plot combine.

The experiment employed a factorial design with barley varieties and herbicides (including a weedy control) as main treatments. The experiment included three replications (randomized blocks).

Results

Herbicide-Rate and Time-of-Application Study

1981

Rate-and-timing treatments with herbicides did not significantly affect total barley dry weight, barley population, or wild oat population. However, these treatments did have a significant effect on the total dry weight produced by wild oats (table 1). The following treatments decreased wild oats dry weight significantly (LSD, $\alpha = .05$) below that of the control (ordered from the most- to the least-effective treatment): diclofop: 1.9 lb/A applied at the 3-leaf stage; difenzoquat: 0.6 lb/A applied at the 5-leaf stage; diclofop: 0.94 lb/A at the 3-leaf stage; difenzoquat, 0.9 lb/A at the 5-leaf stage; diclofop: 1.9 lb/A at the 2-leaf stage (table 2, next page). Wild oats control did not differ between parallel incorporation of triallate and perpendicular incorporation. None of the treatments provided adequate control of wild oats as there was no barley yield due to competition provided by the large wild oats population.

Table 1. Analysis of variance results, 1981 herbicide-rate and time-of-application study.[1]

Dependent variable	Blocks (df=3)	Herbicide treatment (df=23)	R^2
Barley			
Total dry weight	**	NS	0.44
Population	*	NS	0.30
Individual dry weight	**	NS	0.37
Wild oats			
Total dry weight	**	**	0.60
Population	**	NS	0.46
Individual dry weight	**	*	0.52

[1]NS=not significant at the 5% level.
* =significant at the 5% level.
** =significant at the 1% level.

Table 2. The effect of herbicides, at various treatment rates and growth stages of wild oats, 1981.

Treatment	Rate	Wild oats stage	Barley		Wild oats	
			Total dry weight	Population	Total dry weight	Population
	(lb/A)	(no. leaves)	(g/ft²)	(no/ft²)	(g/ft²)	(no/ft²)
Triallate[1]	1.25		12.8	8.3	19.6	11.1
Triallate[2]	1.25		17.3	7.2	17.9	5.8
Triallate[3]	1.25		10.8	6.9	28.6	14.2
Triallate[4]	1.25		12.8	6.3	29.2	12.0
Difenzoquat	0.62	3	11.1	6.2	31.2	16.3
Difenzoquat	0.62	5	22.7	8.9	12.2	9.1
Difenzoquat	0.90	3	14.7	8.0	16.7	17.4
Difenzoquat	0.90	5	11.6	7.1	13.9	15.5
Barban	0.12	2	14.7	4.5	28.6	10.9
Barban	0.12	3	12.2	7.0	39.7	19.0
Barban	0.12	5	13.3	6.6	34.0	12.4
Barban	0.25	2	21.0	7.3	18.1	18.8
Barban	0.25	3	15.6	9.5	34.6	28.6
Barban	0.25	5	9.6	7.5	34.3	20.4
Diclofop	0.47	2	14.2	7.2	30.3	18.8
Diclofop	0.47	3	12.8	7.1	27.8	22.0
Diclofop	0.47	5	15.9	6.5	23.0	7.3
Diclofop	0.94	2	16.7	6.5	21.0	6.6
Diclofop	0.94	3	19.0	6.9	12.8	8.3
Diclofop	0.94	5	9.4	6.8	19.6	18.1
Diclofop	1.87	2	12.8	5.5	14.7	12.1
Diclofop	1.87	3	21.8	8.1	4.3	4.5
Diclofop	1.87	5	9.4	4.9	19.6	21.6
Control			11.9	4.6	29.5	7.3
LSD			NS[5]	NS	13.0	NS

[1]Preplant, incorporated with harrow: parallel (emulsifiable concentrate formulation).
[2]Preplant, incorporated with harrow: perpendicular (emulsifiable concentrate formulation).
[3]Pre-emergent, incorporated with harrow: parallel (emulsifiable concentrate formulation).
[4]Pre-emergent, incorporated with harrow: perpendicular (emulsifiable concentrate formulation).
[5]NS = not significant at the 5% level.

1982

The rate-and-timing treatments had a significant effect on total barley dry weight; barley height; and population, total dry weight, and height of wild oats (table 3). The number of wild oat plants in 1982 (212/ft² in the control) was much higher than in 1981 (7/ft² in control plots) and again none of the herbicides provided sufficient control to warrant harvesting the barley for seed yield (table 4). The following herbicides (in decreasing levels of control) reduced the number of wild oat plants below the level in the control plots: diclofop: 1.9 lb/A at the 2-leaf stage; diclofop: 0.94 lb/A at the 2-leaf stage; diclofop: 1.9 lb/A at the 3-leaf stage; triallate: 2.5 lb/A; barban: 0.5 lb/A at the 2-leaf stage; difenzoquat: 0.9 lb/A at the 3-leaf stage; diclofop: 0.94 lb/A at the 3-leaf stage; triallate: 1.25 lb/A; difenzoquat: 0.62 lb/A at the 3-leaf stage (table 4). All of the treatments except barban when applied at the 3-leaf stage reduced wild oat dry weights below that of the control. In general, wild oat control was better at higher rates and at the earliest application times. This was especially true of barban, which was no better than the control when applied after the 2-leaf stage of wild oats, regardless of rate. Barley dry weights were increased above the control only in the triallate, barban (0.50 lb/A at the 2-leaf stage), diclofop (0.94 lb/A at the 2-leaf stage), and difenzoquat (0.9 lb/A at the 3-leaf stage) plots. Barley height, was significantly greater than the control only in the triallate-treated plots (table 4, next page).

Table 3. Analysis of variance results, 1982 herbicide-rate and time-of-application study.[1]

Dependent variable	Blocks (df=3)	Herbicide treatment (df=23)	R^2
Barley			
Total dry weight	*	***	0.62
Population	NS	NS	0.32
Height	**	***	0.59
Wild oats			
Total dry weight	*	***	0.86
Population	NS	***	0.74
Height	*	***	0.65

[1]NS=not significant at the 5% level.
* =significant at the 5% level.
** =significant at the 1% level.
*** =significant at the 1% level.

Table 4. The effect of herbicides at various treatments and growth stages of wild oats, 1982.

Treatment	Rate	Wild oats stage	Barley Total dry weight	Barley Population	Barley Height	Wild oats Total dry weight	Wild oats Population	Wild oats Height
	(lb/A)	(no. leaves)	(g/ft²)	(no/ft²)	(in)	(g/ft²)	(no/ft²)	(in)
Triallate[1]	1.25		14.7	16.8	26.7	27.5	118.1	31.3
Triallate[1]	2.50		28.9	19.3	28.0	16.4	39.6	32.7
Difenzoquat	0.62	3	9.1	16.2	21.5	18.7	126.9	21.9
Difenzoquat	0.62	5	7.1	17.5	21.7	28.9	171.0	22.6
Difenzoquat	0.90	3	11.9	19.5	20.7	9.4	67.8	20.3
Difenzoquat	0.90	5	5.7	17.7	19.3	27.2	202.7	20.9
Barban	0.25	2	8.5	16.3	21.5	27.8	170.5	27.0
Barban	0.25	3	9.9	18.1	21.7	33.5	159.7	26.2
Barban	0.50	2	13.3	21.0	19.3	9.6	64.7	25.0
Barban	0.50	3	3.4	15.9	18.5	37.7	222.0	26.8
Diclofop	0.94	2	13.3	21.5	20.3	5.7	34.2	25.0
Diclofop	0.94	3	10.8	17.3	18.1	13.0	68.7	18.5
Diclofop	0.94	5	6.2	15.5	21.1	31.2	175.6	20.5
Diclofop	1.86	2	10.5	22.9	17.9	1.7	13.0	19.3
Diclofop	1.86	3	9.6	17.2	18.1	5.4	34.4	19.1
Diclofop	1.86	5	6.8	16.2	21.1	26.1	153.8	18.1
Control			5.4	16.4	20.7	39.1	211.8	25.2
LSD			6.5	NS[2]	3.7	7.1	59.3	4.8

[1]Preplant, incorporated with harrow; perpendicular (emulsifiable concentrate formulation).
[2]NS = not significant at the 5% level.

Herbicide Combination Study

1983

Herbicide treatments had a significant effect on dry weight, population, and height of wild oats and on barley yields (table 5). All of the treatments reduced wild oats numbers and dry weight significantly below that of the control. Combinations of triallate and postemergence herbicides gave the best control of wild oats and resulted in the greatest barley yield. With the exception of diclofop, single herbicides generally provided less control of wild oats than herbicide combinations (table 6, next page). Except for triallate, applied in the fall as an emulsifiable concentrate, all herbicide-treated plots had significantly greater barley yields than did the control. When triallate was applied in the fall, the granular formulation gave better wild oats control than did the emulsifiable concentrate. There was no significant difference between the two formulations in wild oats control when triallate was applied in the spring.

Table 5. Analysis of variance results, 1983 herbicide combination study.[1]

Dependent variable	Blocks (df=4)	Herbicide treatment (df=19)	R^2
Barley			
Yield	**	**	0.47
Test weight	NS	NS	0.12
Wild oats			
Total dry weight	NS	***	0.74
Population	**	***	0.77
Height	**	NS	0.39

[1]NS = not significant at the 5% level.
* = significant at the 5% level.
** = significant at the 1% level.
*** = significant at the .1% level.

1984

The wild oats population in the 1984 study was much lower than in 1983 (0.8 vs. 15.3 plants/ft² in control plots). As a result, wild oat competition was not severe enough to decrease yields in the untreated control plots (table 7, page 13). Herbicide treatments did not injure barley plants to the point where yields were lower than that of the control. In general, wild oats populations and dry weights were decreased more when combinations of preplant and postemergence herbicides were used (table 8, page 14). However, none of the treatments provided complete control of wild oats.

Table 6. The effect of herbicide treatments at various rates and combinations, 1983.

Herbicide treatment	Rate	Barley		Wild Oats		
		Yield	Test weight	Dry weight	Population	Height
	(lb/A)	(bu/A)	(lb/bu)	(g/ft²)	(no/ft²)	(in)
Triallate, G[1], fall	1.5	55.2	47.0	1.3	3.1	31.3
Triallate, G, spring	1.5	56.0	43.5	1.7	4.0	31.0
Triallate, EC[2], fall	0:6	46.5	44.7	3.4	8.2	30.9
Triallate, EC, spring	0.6	53.8	45.2	1.3	3.8	31.3
Barban	0.3	52.9	45.6	0.7	3.8	30.2
Diclofop	1.0	55.7	44.3	0.4	1.9	30.7
Difenzoquat	1.1	51.7	45.8	1.6	5.7	29.8
Triallate, G, fall + barban	1.5+0.3	56.1	45.1	0.2	0.7	31.1
Triallate, G, fall + diclofop	1.5+1.0	55.2	43.9	0.1	0.4	29.4
Triallate, G, fall + difenzoquat	1.5+1.1	59.6	47.8	0.5	1.0	30.6
Triallate, G, spring + barban	1.5+0.3	56.0	45.6	0.1	0.2	29.9
Triallate, G, spring + diclofop	1.5+1.0	53.0	45.8	0.0	0.0	30.1
Triallate, G, spring + difenzoquat	1.5+1.1	63.0	47.6	0.5	1.6	30.4
Triallate, EC, fall + barban	0.6+0.3	60.7	45.1	0.3	1.0	31.0
Triallate, EC, fall + diclofop	0.6+1.0	59.8	47.4	0.1	0.3	30.7
Triallate, EC, fall + difenzoquat	0.6+1.1	59.2	46.2	0.4	1.5	30.6
Triallate, EC, spring + barban	0.6+0.3	54.5	44.9	0.1	0.2	30.0
Triallate, EC, spring + diclofop	0.6+1.0	61.1	45.5	0.1	0.5	30.6
Triallate, EC, spring + difenzoquat	0.6+1.1	57.8	45.3	0.2	0.8	30.3
Control		41.1	46.8	5.2	15.3	31.1
LSD		9.0	NS[3]	1.1	3.0	1.2

[1] G = Granular formulation, preplant, incorporated with rototiller.
[2]EC = Emulsifiable concentrate formulation, preplant, incorporated with rototiller.
[3]NS = not significant at the 5% level.

Table 7. Analysis of variance results, 1984 herbicide combination study.[1]

Dependent variable	Blocks (df=4)	Herbicide treatment (df=19)	R^2
Barley			
Yield	*	NS	0.28
Test weight	NS	NS	0.21
Wild oats			
Total dry weight	NS	NS	0.28
Population	NS	NS	0.30

[1]NS = not significant at the 5% level.
* = significant at the 5% level.

Herbicide-Treatment and Barley-Variety Study

Barley height, yield, and test weights were affected significantly by herbicide treatment and barley variety (table 9, page 15). A lack of herbicide treatment-variety interaction indicates that none of the barley varieties were differentially susceptible to the various wild oat herbicides.

Barley varieties fell into three height categories. The tallest group was comprised of Galt, Otal, Otra, and Weal. Intermediate in height were Lidal, Datal, and Paavo. Eero was much shorter than the other barley varieties (table 10, page 15).

Barley was tallest in the triallate-treated plots, though not significantly taller than that in control plots. Barley in plots treated with diclofop was significantly shorter than barley in control plots (table 11, page 15). Test weights in diclofop-treated plots were also significantly lower than test weights from control plots.

Table 8. The effect of herbicide treatments at various rates and combinations, 1984.

Herbicide treatment	Rate	Barley		Wild Oats	
		Yield	Test weight	Dry weight	Population
	(lb/A)	(bu/A)	(lb/bu)	(g/ft²)	(no/ft²)
Triallate, G[1], fall	1.5	78.5	41.8	1.07	0.9
Triallate, G, spring	1.5	70.2	41.9	1.13	0.9
Triallate, EC[2], fall	0.6	72.8	41.8	0.87	0.6
Triallate, EC, spring	0.6	69.7	41.5	0.41	0.5
Barban	0.3	73.4	41.4	1.21	1.3
Diclofop	1.0	69.8	41.9	0.14	0.6
Difenzoquat	1.1	74.7	40.6	0.72	0.9
Triallate, G, fall+barban	1.5+0.3	72.5	41.6	0.07	0.1
Triallate, G, fall+diclofop	1.5+1.0	71.0	42.2	0.07	0.2
Triallate, G, fall+difenzoquat	1.5+1.1	72.0	41.1	0.04	0.1
Triallate, G, spring+barban	1.5+0.3	73.1	41.2	0.06	0.2
Triallate, G, spring+diclofop	1.5+1.0	67.4	40.8	0.52	0.3
Triallate, G, spring+difenzoquat	1.5+1.1	74.4	41.4	0.02	0.1
Triallate, EC, fall+barban	0.6+0.3	66.2	41.6	0.43	0.5
Triallate, EC, fall+diclofop	0.6+1.0	75.4	41.6	0.04	0.1
Triallate, EC, fall+difenzoquat	0.6+1.1	79.5	41.5	0.65	0.5
Triallate, EC, spring+barban	0.6+0.3	69.9	41.6	0.11	0.2
Triallate, EC, spring+diclofop	0.6+1.0	69.5	41.5	0.04	0.1
Triallate, EC, spring+difenzoquat	0.6+	76.1	41.6	0.00	0.2
Control		76.0	41.1	1.21	0.8
LSD		NS[3]	NS	NS	NS

[1] G = Granular formulation, preplant, incorporated with rototiller.
[2]EC = Emulsifiable concentrate formulation, preplant, incorporated with rototiller.
[3]NS = not significant at the 5% level.

Table 9. Analysis of variance results, 1982 herbicide and barley variety study.[1]

Dependent variable	Herbicide treatment (df=4)	Variety (df=7)	Herbicide X variety (df=28)	R^2
Barley				
Yield	**	***	NS	0.51
Test weight	***	***	NS	0.80
Height	***	***	NS	0.67
Tillers	NS	NS	NS	0.37

[1]NS = not significant at the 5% level.
** = significant at the 1% level.
*** = significant at the .1% level.

Table 10. Differences between barley varieties in height and yield, herbicide-variety study, 1982.[1]

Barley variety	Height	Tillers	Yield	Test weight
	(in)	(no/plant)	(bu/A)	(lb/bu)
Paavo	31.1	2.1	70.8	42.7
Lidal	33.1	2.3	59.5	41.8
Datal	32.2	2.2	60.1	43.8
Eero	26.6	2.7	74.5	43.0
Galt	36.9	2.5	65.2	40.5
Otra	36.5	2.6	52.5	42.5
Otal	36.9	3.2	59.6	42.6
Weal	35.6	2.8	54.1	39.2
LSD	1.4	NS	7.8	2.2

[1]NS = not significant at the 5% level.

Table 11. Effects of herbicide treatments on barley, 1982 herbicide and barley-variety study.

Herbicide treatment	Height	Tillers	Yield	Test weight
	(in)	(no/plant)	(bu/A)	(lb/bu)
Triallate	36.2	3.0	71.0	42.5
Diclofop	28.5	2.5	53.7	39.8
Barban	33.5	2.5	61.1	42.5
Difenzoquat	34.7	2.4	62.9	42.7
Control	35.0	2.4	61.2	42.5
LSD	1.8	NS[1]	NS	2.0

[1]NS = not significant at the 5% level.

Discussion and Conclusions

The results of these studies were highly variable. Herbicides applied singly were not effective in 1981 and 1982 but did provide adequate control in 1983 and 1984. These differences in control can be attributed to differences in the total dry weight of wild oats occurring in each year. In 1981 and 1982, wild oats dry weights were 1.0 oz/ft² and 1.4 oz/ft², respectively. In 1983 and 1984 total wild oat dry weights were much less: 0.2 oz/ft² and 0.04 oz/ft², respectively.

It is apparent that none of the herbicides used will adequately control wild oats when applied singly at infestation levels as severe as those that occurred in the 1981 or 1982 studies. Under these conditions, the competitive effects of wild oats must be minimized at the earliest date possible: the best control in 1982, the year of the most severe infestation, occurred with preplant triallate treatments or when postemergence herbicides were applied at the earliest date recommended by the manufacturer (2-leaf stage of wild oats for barban or diclofop, 3-leaf stage of wild oats for difenzoquat). Other studies have shown that serious competition with wild oats starts before the 2- to 3-leaf stage of wild oats (Chancellor and Peters 1972). Under very competitive conditions, both a triallate treatment and an early postemergence treatment will be required. However, we do not know that even this would have worked in 1982 since none of the herbicide combinations were tried on wild oats populations matching those that occurred then.

Since the results of this study suggest that different control strategies should be undertaken with different infestation levels of wild oats, it would be helpful to growers to have a predictive model relating wild oats infestation level to barley yield loss and to herbicide control measures needed. Dew (1972) reported the relative competitive ability of several crops, including barley, with wild oats. Their studies allow for prediction of yield losses at various densities of wild oats. However, the results of this study indicate that wild oats density may not be the best prediction of yield losses. The density of wild oats in control plots in 1981 was 7 plants/ft² which caused complete crop loss while in 1983 wild oats densities of 15.3 plants/ft² caused only a 35 percent crop loss (yield in control plots compared to best yield). Weather, soil fertility, and time of emergence of wild oats in relation to barley (McBeath et al. 1975) may drastically influence the competitive effect of a certain density of wild oats. Dry weight integrates the effects of such factors and may serve as a better predictor of yield loss than density.

Climatic conditions also influenced the effectiveness of wild oat herbicides. Much less rain fell in May and early June of 1983 than in the other years of the trials (table 12). Under low soil moisture conditions in the spring, emulsifiable concentrate formulations of triallate appeared to work better than granular formulations. On the other hand, the granular

Table 12. Monthly temperature and rainfall means for the growing season at the University of Alaska Agricultural and Forestry Experiment Station farm, 1981-1984.

	May	June	July	August	September
			1981		
Temp. (°F)					
max.	67.4	69.5	66.1	66.6	52.7
min.	38.7	42.3	46.4	40.5	33.7
mean	53.1	56.1	56.1	53.5	43.2
Precip. (in.)	0.40	2.44	4.15	1.30	1.10
			1982		
Temp. (°F)					
max.	58.2	71.1	75.0	67.7	57.7
min.	33.4	44.5	49.0	41.9	36.2
mean	45.8	57.8	62.0	54.3	46.8
Precip. (in.)	0.68	2.26	3.38	1.23	0.61
			1983		
Temp. (°F)					
max.	61.6	73.7	75.2	62.5	50.6
min.	32.1	45.9	52.8	43.0	30.1
mean	46.8	59.8	64.0	52.8	40.4
Precp. (in.)	0.09	1.24	0.87	3.81	0.83
			1984		
Temp. (°F)					
max.	60.7	74.2	70.0	64.1	59.8
min.	36.6	48.6	51.5	43.9	33.1
mean	48.6	61.4	60.8	54.0	46.4
Precip. (in.)	1.06	0.85	1.94	1.30	0.25

formulation of triallate was more effective than the emulsifiable concentrate formulation when applied in the fall.

In general, the postemergence herbicides performed best when applied at the times recommended by the manufacturer. Barban is recommended for application at the 2-leaf stage of wild oats. In this study, applications made after this time were found to be less effective. It is recommended that diclofop be applied before the 4-leaf stage of growth. Wild oat dry weights were increased and barley dry weights were decreased when diclofop was applied at the 5-leaf stage.

In all 4 years, diclofop provided the best wild oats control of any of the herbicides applied singly; however at the highest rates (1.9 lb/A) diclofop decreased barley yields and test weights.

It should be emphasized that none of the herbicides, even when applied in combination (an expensive proposition), provided complete control of wild oats in any of the 4 years. Once wild oats become a problem in a field, it will be a persistent problem since seeds of wild oats can remain viable in cultivated soil for up to 6 years (Banting 1962, Tingey 1961). Thus it would be prudent for growers to take care to prevent infestations of wild oats where they do not already occur.

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