CHEMICAL CONTROL OF WILD OATS ALONE AND WITH BROAD-LEAVED WEEDS IN WHEAT AND BARLEY

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Summary

Candidate chemicals are compared with barban and tri-allate. Benzoylprop-ethyl (2.24 kg/ha) in wheat and chlorfenprop-methyl (4.2 kg/ha) in both wheat and barley have proved satisfactory alternatives to barban for post emergence wild oat (*Avena* spp.) control. The new barban formulation was less selective to wheat than the standard formulation. Mecoprop mixed with chlorfenprop-methyl gave good wild oat and broad-leaf weed control in wheat. Mecoprop mixed with barban reduced wild oat control without reducing yield while the mixture with benzoylprop-ethyl reduced both wild oat control and yield as compared with the chemicals applied a week apart. A reduction of about 95% in the number of panicles at harvest is considered necessary to reduce seed production below the level necessary for population replacement.

INTRODUCTION

Since Allen (1962) reviewed the wild oat problem in New Zealand there has been no marked change in incidence of wild oats though there has been an increase in awareness of and capacity to deal with the weed. *Avena persica* Steud (syn. *A. ludoviciana* Dur.) has been found in the Springs-Ellesmere County of Canterbury. It does not appear to behave differently from the widely spread *A. fatua* L. towards control measures.

Barban and tri-allate are used to treat about 3,000 ha per annum, representing about 10% of the area of crop containing wild oats. This is believed to approximate the area warranting treatment in terms of present treatment cost and crop value. Ability to suppress seeding with consequent reduction of soil seed-load and the ability to control wild oats and broad-leaved weeds in the same operation would justify treating infestations less than the likely yield threshold number. The trials reported here had this objective in view.

EXPERIMENTAL

Trials were conducted on field infestations of wild oats. Where comparisons included pre-plant soil-incorporated (PrePSI) or pre-emergence (PreE) treatments, sites were chosen on the basis of seedling emergence during a preparatory fallow.

Plots 2 m by 20 or 30 m were sprayed with a hand-propelled bicycle-wheel-mounted boom using fan nozzles operated by compressed air. A volume of 100 l/ha was used for barban and 200 l/ha for other treatments, except that 100 l/ha was used for chlorfenprop-methyl in three trials. The high volume was used for all treatments in the mecoprop mixtures trial.

Soil incorporation was usually obtained by harrowing in two directions at right-angles, one pass being that of the drill and seed harrows. A rotary hoe, dutch harrows and discs were each used on one occasion.

Yields were obtained by direct heading whole plots.

RESULTS AND DISCUSSION

Sixteen trials, six in barley and ten in wheat, carried out over a period of four years are summarized. Wild oat numbers were significantly reduced by at least one treatment in all the barley trials and in eight of the wheat trials (two not counted). Similarly, significant yield increases occurred in two barley and seven wheat trials. Only these "wild oat response" and "yield response" trials are considered when stating the responsiveness to individual chemicals.

Details of treatments, growth stages, wild oat counts and yield are given for the last two years' trials in barley in Table 1 (no trials 1971-2), and in wheat in Table 2.

BARBAN

Barban as the 12½% "Carbyne" formulation (12½% w/v barban) at 0.35 kg/ha, the standard field-use rate, was included in all trials and gave in 9 comparisons with untreated 4 significant crop yield increases. Omitting the Irwell and Methven trials (Table 1) which were counted one month after treatment and before the slower acting post-emergence (PostE) chemicals had taken full effect, 6 comparisons out of 12 gave significant reduction of wild oat numbers. Doubling the rate (0.7 kg/ha) did not improve control but resulted in a reduction in crop yield in 3 out of 4 comparisons with the lower rate.

A 25% barban formulation reported to be more active per unit of barban than 12½% barban gave at 0.28 kg/ha similar wild oat control to the standard 0.35 kg/ha of 12½% w/v barban, but in three wheat trials a significantly lower yield (Table 2).

BENZOYLPROP-ETHYL

Wheat has shown good tolerance to benzoylprop-ethyl, being unaffected by 4.48 kg/ha. In four wheat trials, benzoylprop-ethyl has given significant reduction of wild oats and crop yield increases compared with untreated when applied at 2.24 kg/ha in 2001/ha when the majority of wild oats had more than four leaves. Wild oat control at 2.24 kg/ha has been at least as effective as 12½% w/v barban 0.35 kg/ha and chlorfenprop-methyl 4.2 kg/ha, while yield response has been better than for barban and equal to or better than chlorfenprop-methyl.

Barley tolerance appeared to be inadequate (Table 1) and to decrease with age of the barley between the 3- and 6-leaf stage. Barley at the Irwell site, sprayed at the 5-leaf stage, was severely stunted and yield was almost suppressed. However, trials should be repeated with the emulsifiable concentrate formulation used in the later wheat trials.

At Stephens', Irwell, benzoylprop-ethyl (2.24 kg/ha) killed shepherd's purse (*Capsella bursa-pastoris*) and almost eliminated vetch (*Vicia* spp.), while at Chamberlain's, Irwell, cornbind (*Polygonum convolvulus*) was also controlled.

TABLE 1: CHEMICAL TREATMENTS, WILD OAT DATA, BARLEY YIELD
(Crop variety, Research)

Treatment (kg/ha)	Irwell 1969-70 (J. K. Lay)				Methven 1969-70 (C. A. and I. Wilson)				Lincoln 1970-1 (C. S. Simpson)			
	Wild Oat Plants/m ² (√ Trans.)		Barley Yield as % of Not Treated		Wild Oat Plants/m ² (√ Trans.)		Barley Yield as % of Not Treated		Wild Oat Panicles/m ² (√ Trans.)		Barley Yield as % of Not Treated	
PrePSI												
tri-allyl 0.84	8.0 dCD	98 bcdBCD	8.1 cdD	105 aA	—	—	—	—	19.0 ghiFG	110 abcA	—	—
tri-allyl 1.4	6.1 dD	104 bABC	7.7 dD	103 abAB	—	—	—	—	6.9 iG	113 aA	—	—
tri-allyl 2.8	3.7 dD	112 aA	8.5 cdCD	105 aA	—	—	—	—	—	—	—	—
H722 2.24	26.6 bcB	94 cdCD	18.8 bcdBCD	83 cdCD	—	—	—	—	—	—	—	—
H722 4.48	22.2 cBC	85 eE	14.6 bcdBCD	65 eE	—	—	—	—	—	—	—	—
trifluralin 0.42	—	—	—	—	—	—	—	—	55.5 efDE	110 abcA	—	—
trifluralin 0.84	—	—	—	—	—	—	—	—	27.9 ghEF	111 abcA	—	—
chlortoluron 2.24	—	—	—	—	—	—	—	—	95.7 cdBCD	111 abcA	—	—
chlortoluron 2.24	—	—	—	—	—	—	—	—	142.8 abAB	102 bcA	—	—
haloxydine 0.07	28.5 bcB	96 cdBCD	23.6 bcdABCD	83 cdCD	—	—	—	—	—	—	—	—
haloxydine 0.14	39.9 abAB	93 dDE	24.0 bcABCD	72 deDE	—	—	—	—	—	—	—	—
chlortoluron-methyl	—	—	—	—	—	—	—	—	—	—	—	—
3.36	—	—	—	—	—	—	—	—	32.8 fgEF	112 abA	—	—
4.2	33.0 bcB	101 bcBCD	33.3 aA	105 aA	—	—	—	—	—	—	—	—
6.72	—	—	—	—	—	—	—	—	14.0 hiFG	112 abA	—	—
benzoylprop-ethyl	—	—	—	—	—	—	—	—	—	—	—	—
1.12	44.5 abAB	99 bcdBCD	23.6 bcdABCD	90 bcABCD	—	—	—	—	—	—	—	—
2.24	44.0 abAB	99 bcdBCD	32.1 abABC	85 cBCD	—	—	—	—	113.9 bcABC	104 abcA	—	—
barban (25%) 0.14	—	—	—	—	—	—	—	—	69.2 deCD	107 abcA	—	—
barban (25%) 0.28	—	—	—	—	—	—	—	—	59.4 eDE	106 abcA	—	—
barban (12.5%) 0.35	62.1 aA	105 bAB	57.5 aA	103 abAB	—	—	—	—	169.8 aA	100 cA	—	—
Untreated	41.0 abAB	100 bcdBCD	34.1 abAB	100 abABC	—	—	—	—	—	—	—	—
Barley yield:												
Untreated (kg/ha)	1148			3980								
CV%	4.7			9.5					(32.7)			
Stage of growth												
treated	0 to 4 leaf	3½ leaf	1 to 3½ leaf	3 leaf	1 to 3½ leaf	3 leaf	1 to 3 leaf	2½ leaf				

None Wild not counts at Irwell and Methven one month after PostF treatment do not reflect the satisfactory harvest time

TABLE 2: TREATMENTS, WILD OAT COUNTS, WHEAT YIELD

Treatment (kg/ha)		Lincoln 1970-1 B. E. Payne		Lincoln 1971-2 B. E. Payne		Irrwell 1971-2 H. G. Stephens	
		Wild Oat Counted 20/1/71	Wheat Yield as % of Not Treated	Wild Oat Panicles/m ² (√ Trans.)	Wheat Yield as % of Not Treated	Wheat Yield as % of Not Treated	Wheat Yield as % of Not Treated
tri-alleate 1.4	PrePSI	14.6 cdCD	120 bcBCD	49.6 bcBC	124 bcAB	102 abcAB	
tri-alleate 2.8	"	7.7 dCD	117 cdCDE	33.5 cdCD	120 bcB	90 dC	
tri-alleate (gran.) 2.2	PostE	28.1 bcBC	107 efgFG	—	—	—	
barban (12.5%) 0.35	"	24.8 bcBC	111 deDEF	40.7 cdBC	116 cBCD	97 cB	
barban (12.5%) 0.7	"	—	—	37.0 cdC	105 dCDE	80 eD	
barban (25%) 0.14	"	48.5 aA	108 efEFG	59.3 bB	116 cBCD	98 bcB	
barban (25%) 0.28	"	38.3 abAB	96 hH	47.9 bcBC	104 dDE	91 dC	
chlorfenprop-methyl 4.2	"	15.4 cdCD	129 aAB	62.4 bB	118 bcBC	101 abcAB	
chlorfenprop-methyl 8.4	"	13.8 cdCD	130 aA	29.5 dCD	128 abAB	103 abAB	
benzoylprop-ethyl 2.24	"	13.8 cdCD	126 abABC	16.3 CD	135 aA	105 aA	
benzoylprop-ethyl 4.48	"	2.8 dD	132 aA	3.4 fE	136 aA	102 abAB	
Untreated	"	48.5 aA	100 ghGH	97.3 aA	100 dE	100 bcAB	
Wheat variety and yield untreated (kg/ha)			Aotea 3400	Kopara 4330		Aotea 4070	
CV%		42.9	4.8	(72.1)	6.3	3.6	
Growth stage at treatment (a)		1 to 4 leaf	3½ leaf	51% 3 leaf	2½ to 3 leaf	3 leaf	
Growth stage at treatment (b)		2 to 5 leaf	4½ to 5 leaf	24% 3 leaf	4½ to 5 leaf	4½ to 5 leaf	

(a) = barban and chlorfenprop-methyl applied.

(b) = benzoylprop-ethyl applied.

TABLE 3: COMBINATIONS OF WILD OAT CONTROL CHEMICALS WITH MECOPROP
TREATMENTS, WILD OAT DATA AND WHEAT YIELD
(J. Mason Chamberlain)

Treatments		Wild Oats			Wheat	
(kg/ha)	Dates Applied	Plants/m ² *	Panicles/m ² *	Seeds/panicle†	Seeds/m ² ‡	Yield as % Not Treated
barban (25%) 0.2	26/8/71	26.2 fgDE	59.8 deDE	9.6 cC	481 cC	110 deCDE
barban (25%) 0.2/ mecoprop 2.24	26/8/71	47.0 cdeBCD	129.7 bcBCD	10.3 cC	991 bcC	107 efDEF
barban (25%) 0.2/ mecoprop 2.24	26/8/71 8/9/71	31.7 efgCDE	72.5 cdeDE	7.2 cC	429 cC	111 cdeBCD
chlorfenprop-methyl 3.5/ chlorfenprop-methyl 3.5/ mecoprop 2.24	26/8/71	18.5 fgE	26.2 eE	9.3 cC	250 cC	122 abA
chlorfenprop-methyl 3.5/ mecoprop 2.24	26/8/71	13.8 gE	21.5 eE	8.4 cC	200 cC	124 aA
chlorfenprop-methyl 3.5/ mecoprop 2.24	26/8/71 8/9/71	19.0 fgE	26.2 eE	7.7 cC	151 cC	121 abAB
benzoylprop-ethyl 2.24/ benzoylprop-ethyl 2.24/ mecoprop 2.24	16/9/71	34.0 defCDE	80.5 cdeDE	12.7 cBC	885 bcC	118 abcABC
benzoylprop-ethyl 2.24/ mecoprop 2.24	16/9/71	54.3 bcABC	186.2 abAB	18.8 bAB	1906 bcBC	107 efDEF
benzoylprop-ethyl 2.24/ mecoprop 2.24	16/9/71 8/9/71	33.7 defCDE	93.5 cdCDE	11.0 cC	725 bcC	116 bcdABCD
mecoprop 2.25	26/8/71	72.5 aA	229.0 aA	22.2 abA	6055 aA	97 gF
mecoprop 2.25	8/9/71	68.8 abAB	211.2 aAB	22.3 abA	4554 aAB	98 gF
Untreated		52.0 bcdABC	170.5 abABC	25.0 aA	2630 bBC	100 fgEF
CV %		29.8	36.1	26.1	82.2	4.4

Wheat yield untreated (kg/ha) = 3170 variety Kopara.
Stage of growth: 26/8/71 wild oats; 1- to 3-leaf; wheat, 3-leaf.
16/9/71 wild oats; 60% 3-leaf; wheat 5-leaf.

Wheat yield untreated (kg/ha) = 3170 variety Kopara.
Stage of growth: 26/8/71 wild oats; 1- to 3-leaf; wheat, 3-leaf.
16/9/71 wild oats; 60% 3-leaf; wheat 5-leaf.

*Based on 5 samples per plot.

†Based on one sample per plot.

CHLORFENPROP-METHYL

Chlorfenprop-methyl (4.2 kg/ha) applied to wheat and barley when the majority of wild oats were 1- to 3-leaf reduced wild oats compared with untreated in the 9 trials in which it was used, with significant yield increases on 6 occasions. Better wild oat control than 12½% w/v barban 0.35 kg/ha was obtained 7 out of 10 times and better yield response twice. Doubling the rate improved wild oat control but not crop yield.

Although post spraying yellowing of the crop has occurred, high rates (barley 6.72 kg/ha, wheat 8.4 kg/ha) have not affected yield.

HALOXYDINE AND H722

Haloxydine used PostE in both wheat and barley and H722 used PrePSI in barley proved unsuitable because of poor crop tolerance.

CHLORTOLURON AND TRIFLURALIN

With one trial only, in barley (Table 1) conclusions are not possible with respect to chlortoluron or trifluralin. Trifluralin PrePSI immediately before drilling and chlortoluron applied to moist soil immediately prior to crop emergence (Lincoln, Table 1) significantly reduced wild oat numbers. Further work is warranted in view of their wider weed spectra.

TRI-ALLATE

In the 9 "wild oat response" comparisons in wheat and barley of rates (1.12 to 1.4 kg/ha) approximating field-use recommendations with untreated, tri-allate highly significantly reduced wild oat counts and in 4 of the 7 "yield response" comparisons significantly increased yield. Doubling the rate (2.8 kg/ha) caused delay in crop emergence, in part because of uneven depth of incorporation, and did not improve wild oat control. In barley, the high rate tended to yield more than the standard rate, significantly so at Irwell (Table 1), while in wheat the high rate yield was similar to or less than the standard rate (significantly so at Irwell, Table 2). The good results with spring barley together with the more favourable conditions for incorporation at this time commend the chemical for spring-sown crops.

WILD OAT CONTROL CHEMICALS WITH MECOPROP

The three wild oat control chemicals used alone significantly reduced numbers of wild oat plants, number of panicles per plant, and seeds per panicle, as did treatment with mecoprop and chlorfenprop-methyl whether applied separately or in combination.

Mixing mecoprop with benzoylprop-ethyl drastically reduced the degree of control and though the plots could be distinguished from untreated at harvest only the seeds per panicle were significantly less than untreated.

The mecoprop/barban mixture was also much less effective than barban alone but easier to distinguish from untreated by the definitely smaller panicles.

The unexpectedly low population of broad-leaf weeds in this third year wheat crop was well controlled by mecoprop and does not appear to have affected yield. Barban alone with no effect on broad-leaf weeds yielded the same as the split application of barban and mecoprop which had no broad-leaf weeds and similar wild oats while the two benzoylprop-

ethyl plus mecoprop treatments had no broad-leaf weeds but differed in yield and wild oat numbers. However, removal of the broad-leaf weeds appeared to benefit the wild oats in terms of plant number and seed production.

SUPPRESSION OF SEEDING

No treatment killed all wild oats or completely suppressed seeding. Reduction of plant number by the most successful treatment in each trial ranged from 73 to 96% of untreated. Plants remaining after treatment, with PostE chemicals in particular, had fewer panicles and fewer grains per panicle. At Chamberlain's (Table 3) the best treatment reduced panicle number 87% and seed returned to the soil by 92%. This still represented more seed than necessary to replace the original population. With similar reduction of seeds per panicle, about 95% reduction of panicles would be needed to reduce seeding below replacement level, though at such high levels of control further marked reduction in panicle size occurs. In barley at Lincoln, panicles in treatment samples with no panicles above the crop averaged 3.3 grains each. A control level of the order of 95% has only been obtained with "normal" rates on one occasion (chlorfenprop-methyl, wheat) and on four occasions at double normal rate (once tri-allate, barley, once chlorfenprop-methyl, wheat, twice benzoylprop-ethyl, wheat) though the presence of the new chemicals in this category is of interest. Thus further study of wild oat seeding at high levels of control are needed before the use of wheat or barley plus chemical can be recommended in Canterbury as wild oat cleaning crops as described by Selman (1970) for tri-allate treated spring barley. However, when a heavy strike occurs in the cereal phase of the crop rotation, the cost of a high rate to prevent seed replenishment could be covered by the likely yield response.

Benzoylprop-ethyl in wheat and chlorfenprop-methyl in both wheat and barley appear as worthwhile alternatives for post-emergence wild oat control. Rates of application somewhat lower than those taken as normal in the trials may be adequate for yield ensurance and optimum cash return.

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