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A QUICK LOW COST SURVEY OF WILD OATS IN BARLEY IN NORTH EAST SCOTLAND 1974/75

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Summary A survey of the presence of wild oats in roadside barley fields was carried out in north east Scotland in 1974 and 1975. The extent and density of infestation in 1436 fields was recorded. Fields were classified using a "wild oat index" derived from the proportion of the field infested multiplied by the density of infestation within the affected area.

A large number of fields (66%) were found to contain wild oats (*Avena fatua* only). Considerable variation was found to exist between districts within the region ranging from 80% of infested fields in the predominantly arable farming district of Lower Banff to 33% in the upland pastoral Cairngorm district. Overall 40% of infestations were in the very light category.

INTRODUCTION

Wild oat is an extremely common weed in cereals in the north east of Scotland and is generally believed to be rapidly increasing in frequency and density of infestation. This survey was designed to reveal the present level of infestation in the area as quickly and cheaply as possible and to provide a base line for assessment of changes over future years. The area was sub-divided into districts according to geographical and known agricultural characteristics in an attempt to reveal any relationship of wild oat infestation to farming systems.

The north east of Scotland has not been previously surveyed for the presence of wild oats but was included in the seed drill survey reported by Elliott J.G. and Attwood P.J. (1970) when a higher frequency of wild oat contamination (33%) in cereal seed was recorded than for any other part of the United Kingdom.

METHOD AND MATERIALS

A pilot survey of a later harvested upland area (Cairngorm) in September 1974 revealed that it was relatively easy to detect wild oat panicles in barley fields just prior to harvest by careful scanning using binoculars. The main part of the survey was conducted in August 1975. Only fields in which a confident identification could be made were recorded as infested. Initially it was necessary to occasionally check identification by close examination of individual plants but later no great difficulty was experienced in differentiating wild oats from cultivated oats *Avena sativa*, tall oat grass *Arrhenatherum elatius*, and creeping soft grass *Holcus mollis*, all of which may superficially resemble wild oats when viewed from a distance. Of the three British species of wild oats only *Avena fatua* was encountered in the survey. *Avena ludoviciana* has never been recorded in the area and the bristle oat *Avena strigosa* is nowadays very rarely seen.

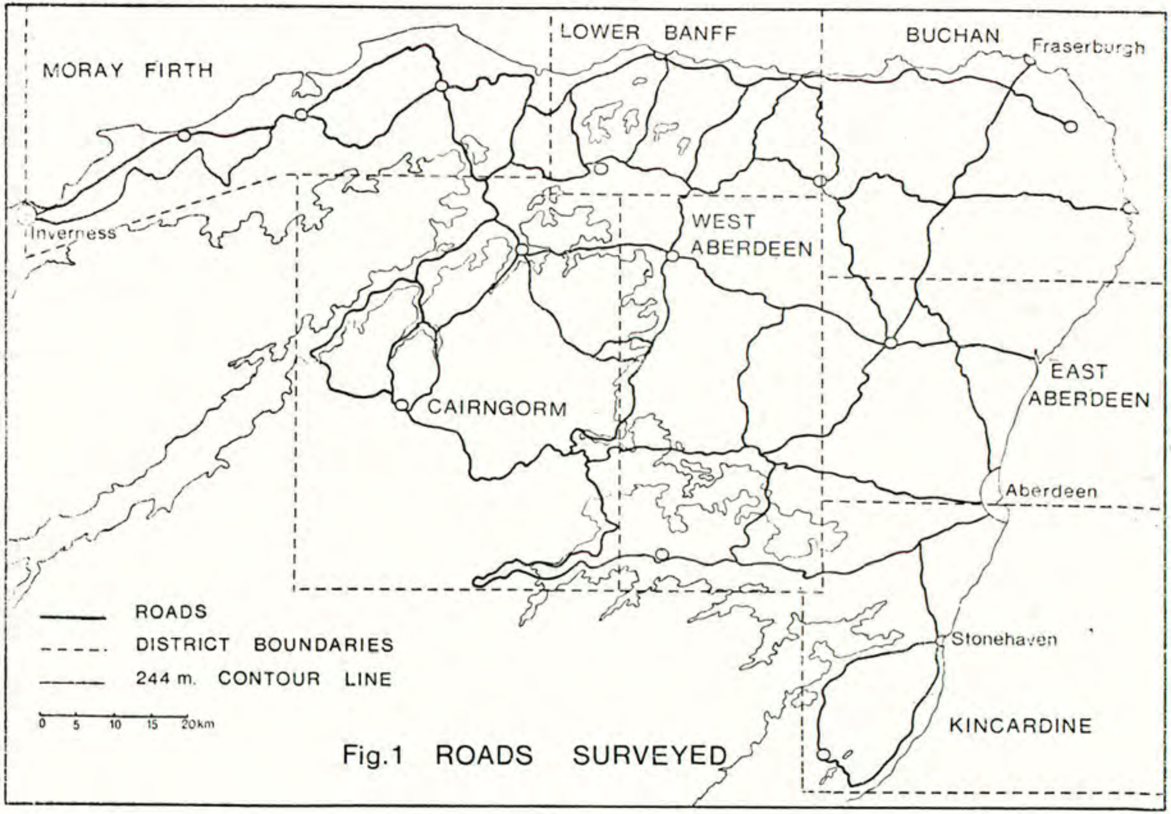
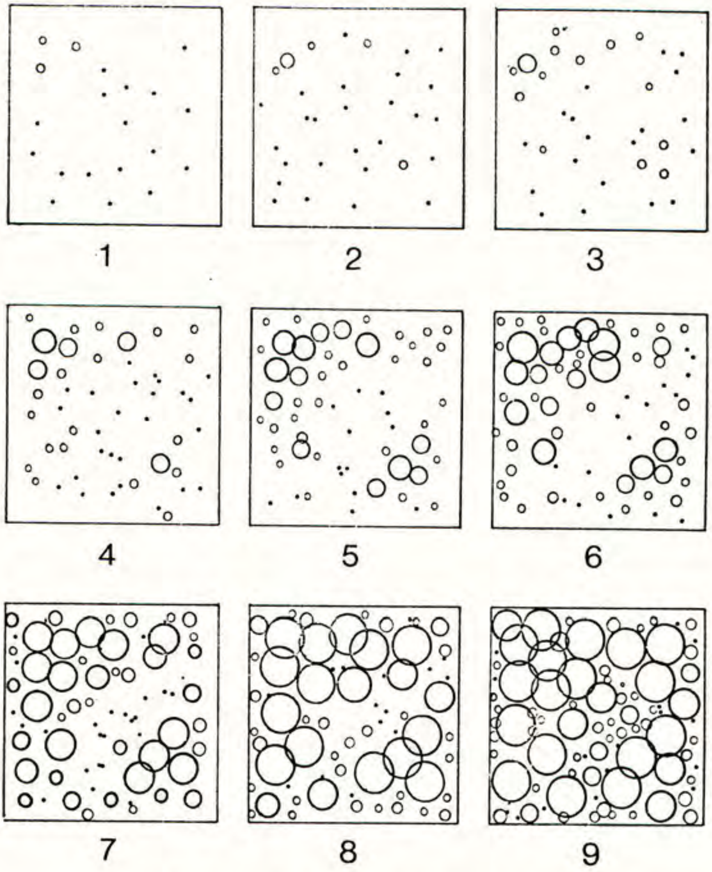


Fig.1 ROADS SURVEYED

PROPORTION OF FIELD INFESTED



DENSITY OF INFESTATION

VL very low (1)
L low (2)
M medium (3)
H high (4)
VH very high (5)

Fig.2 KEY FOR CLASSIFICATION OF FIELDS

It was considered that the purpose of the survey would best be met by examination of a large number of fields. In order to do this as quickly and cheaply as possible it was decided to examine all barley fields adjacent to a series of public roads giving a good unbiased coverage of the area, Figure 1. The north east of Scotland is probably unusually suitable for this method of surveying as it is well supplied with good quiet roads, and is almost free from hedges. In this survey public roads were regarded as a series of fixed repeatable transect lines which it will be possible to resurvey in the future to detect changes in the level of wild oat infestation. Individual fields can be relocated if necessary but because of crop rotation there is no certainty that they will be in cereal cropping.

Wild oat infested fields were classified on a 1-9 scale for proportion of field infested and a 1-5 scale for density of infestation within affected parts of the field, Figure 2. Only three people took part in the survey and agreement on classification was ensured by independent scoring of a series of widely differing fields at the commencement of the survey.

The allocation of fields to the five categories of infestation (Table 1) was by means of a wild oat index calculated by multiplying the proportion of the field infested by the density within the infested area. On this basis fields with an index of not more than 2 were classified as very light, 3-6 light, 7-15 medium and 16-45 as heavy infestations. These are arbitrary levels and no information is available to relate them to actual numbers of panicles per unit area or to the light, intermediate or heavy categories used in the WRO/ADAS survey reported by Phillipson A. (1973).

It must be remembered that this survey is a post spraying assessment of wild oats. It is likely that fields classed as heavily infested had not been sprayed but it is probable that some of those in the lower categories had received partially effective treatment.

Problems were encountered in intensive cereal growing districts were field boundaries have been obliterated and as these also tend to be more heavily infested with wild oats the survey results probably give a lower value than would be obtained using an acreage basis. Where large size or uneven terrain prevented complete examination of a field it was classified on the basis of that part visible from a roadside vantage point which again would probably result in a lower estimate of the number of fields infested than if a more thorough examination had taken place.

A total of 1436 barley fields alongside 1055 km of road was examined in 28 man days during 1974 and 1975. Under favourable conditions over 100 fields were examined by a single person in one day. The estimated total cost of the survey was £720.

RESULTS

In Table 1 the results of the survey are given by districts. It will be seen that a high overall frequency of infestation, 66%, was detected although a large proportion of fields, 40%, were in the very light category. There were considerable differences between districts within the region ranging from 80% of fields infested in Lower Banff to 33% in the Cairngorm district.

A χ^2 test shows a high probability of real differences between districts in percentages of infested fields $\chi^2 = 91.7$ ($p = 0.01$) and in the various levels of infestation $\chi^2 = 65.3$ ($p = 0.01$).

Table 1

Results of 1974/75 wild oat survey

	Moray Firth	Lower Banff	Buchan	East Aberdeen	West Aberdeen	Kincardine	Cairngorm (1974)	Total
Approx area km^2	1062	777	1062	881	1450	777	2279	8288
Length of road km	159	172	121	101	171	93	238	1055
Fields examined	221	363	207	208	199	178	60	1436
				Percentage of fields				
Wild oats not detected	28	20	36	32	44	49	67	34
Very light infestation	39	40	49	39	42	38	27	40
Light infestation	20	20	8	12	5	9	3	13
Medium infestation	9	14	3	10	8	4	3	9
Heavy infestation	4	6	4	7	1	0	0	4
Total infested fields	72	80	64	68	56	51	33	66

Close examination of Table 1 shows that the number of fields examined in Lower Banff is high in relation to the size of the district and the length of road traversed, tending to bias the overall results towards the high side as this is the most heavily infested district. However, as these figures are also the result of a larger number of barley fields being encountered per km of road traversed they are a reflection of the greater intensity of barley growing in that area. Calculation of the mean of district percentages of infested fields gives a figure of 61% which shows that the overall mean of 66% has not been unduly influenced by the larger number of fields recorded in the most heavily infested district.

DISCUSSION

Comparison of these results with the limited data available for other regions of Britain is difficult owing to differences in surveying technique. It appears that the overall frequency of infestation is comparable to that given by Phillipson A. (1973) for certain parts of England and much higher than the 26% infested acreage which he reports for eastern Scotland or the 16% of infested farms (0.8% acreage) recorded by Waterson H.A. and Davies G.J. (1973) in the west of Scotland.

There are no obvious reasons why the north east should be more heavily infested with wild oats than the remainder of Scotland. In the past oats (Avena sativa) were the main cereal crop in the region and it is possible that wild oats were widely present as an unnoticed impurity in crops and home saved seed. Hand roguing is comparatively rarely practised except in potential seed crops and there is a tendency towards greater toleration of weeds in what is primarily a stock rearing region than might be found in more intensive arable farming areas. Spraying is now widely practised on medium or heavily infested fields and may reduce the general level of infestation but is unlikely to have any effect on the frequency of light or very light infestations where treatment would probably be uneconomic.

In the Moray Firth and Lower Banff districts where the weed has been known by the authors to be troublesome for many years (at least 30) high densities of infestation are frequently encountered. Here fairly intensive cereal growing is practised and this is probably an important factor in encouraging the weed. There is also a part of East Aberdeen where long standing infestations are present associated with frequent cereal growing. West Aberdeen shows a surprisingly high frequency of infestation considering its predominantly pastoral character and even the upland Cairngorm district with very limited cereal acreage is now lightly infested. Kincardine shows a distinctly lower level of infestation and in this respect it is similar to Angus and Perth to the south. Here cereal growing is extensive but root crops are also important and the general standard of arable farming is possibly higher than further north.

Throughout the area very light infestations are by far the most numerous. On the evidence available it is impossible to say whether these are recent infestations which will progressively increase to higher levels or are old infestations which have for biological and agricultural reasons failed to multiply. A repeat of this survey in 5-10 years should give valuable information on the rate of spread and increase in density of infestation with wild oats in a mixed farming area.

Acknowledgements

The advice and encouragement of A.D. McKelvie is gratefully acknowledged.

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WILD-OAT CONTROL AND YIELD RESPONSE IN WHEAT TREATED WITH FLAMPROP-METHYL

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Summary Field trials were carried out in Europe over 4 years to compare the performance of flamprop-methyl and benzoylprop-ethyl (SUFFIX*) against Avena spp. Flamprop-methyl at 0.4 - 0.6 kg a.i./ha gave a mean 93-96.5% reduction in total spikelets compared with a mean 89% from benzoylprop-ethyl at recommended dose rates. A smaller series of field trials against Alopecurus myosuroides showed flamprop-methyl to be very active. For optimum performance against both weeds flamprop-methyl should be applied to actively growing crops during the period from late tillering until just before formation of the second node.

Yield gains from the treatment of wild-oat infested crops were very similar for both compounds. Mean increases in grain production for flamprop-methyl varied from 6% in low infestations to 71% in heavy infestations.

Résumé Des essais de plein champ ont été realisés en Europe pendant 4 ans pour comparer l'action de flamprop-methyl et de benzoylprop-ethyl (SUFFIX*) sur Avena spp. La reduction moyenne du nombre d' epillets a été de 93-96.5% avec flamprop-methyl á 0.4 - 0.6 kg a.i./ha et de 89% avec benzoylprop-ethyl aux doses recommandeés. Un plus petit nombre d'essais sur Alopecurus myosuroides a désmontré la bonne efficacité de flamprop-methyl. Pour obtenir le meilleur resultat dans la lutte contre ces deux mauvaises herbes flamprop-methyl doit être applique á des cultures en pleine croissence dans la période allant de la fin du tallage a la formation du deuxieme noeud.

Les gains de rendement obtenuslors du traitement de cultures infesteés de folle-avoine furent du même ordre avec les deux produits. Le pourcentage moyen d'augmentation de la production avec flamprop-methyl a ête de 6% en cas d'infestation legére et de 71% pour une culture trés infesteé.

INTRODUCTION

Flamprop-methyl was introduced by Haddock et al (1974) when the mode of action, chemical and physical properties, glasshouse and initial field results were described.

Field trials in 1973 and 1974 showed that good control of Avena spp. resulted when flamprop-methyl was applied at a dose within the range 0.4 - 0.6 kg a.i./ha to

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actively growing crops at crop stage F/G - I/J (after Keller and Baggiolini, 1954). In relation to a field dose in the region of 0.5 kg a.i./ha the compound showed a clear twofold margin of selectivity on the crop. Field data also indicated good activity against blackgrass (Alopecurus myosuroides) in wheat.

Further field trials with flamprop-methyl have been conducted in 1975 and 1976 to determine fully the performance of the compound compared with benzoylprop-ethyl as a standard. This paper reviews the results of work from 1973 to 1976.

METHODS AND MATERIALS

Field trials details

Sixty four replicated trials were carried out on commercial crops, mostly in the UK and also in Spain, France and Germany. Plot size was 20 - 45 m^2 for hand sprayed plots and 60 - 90 m^2 for Land Rover sprayed plots. The spray volume was between 250 - 500 l/ha, delivered at a pressure of 2 - 4 bars. Flamprop-methyl and benzoylprop-ethyl were applied as a 15% and 20% e.c. respectively.

The dose rates of flamprop-methyl varied slightly from year to year. In 1973 doses of 0.4 and 0.6 kg a.i./ha were chosen for exploratory purposes. The dose range was narrowed further in 1974 and 1975 to 0.525 and 0.6 kg a.i./ha. In 1976 the principal dose was 0.525 kg a.i./ha (3.5 litres formulated product/ha).

All applications were made during the period from late tillering to the formation of the second node of the crop.

Assessments

Wild-oat counts. In all trials, counts of panicles were made close to harvest in 0.25 m^2 quadrats located in the central two thirds of each plot. In most of the trials a more detailed assessment of wild-oats was made by classifying the panicles, as suggested by Holroyd (1972) into one of three size categories:-

i) small panicles with less than 11 spikelets
ii) medium panicles with 11 - 30 spikelets, and
iii) large panicles with more than 30 spikelets.

The values for total spikelet numbers per treatment were calculated from these data.

Blackgrass counts. Counts of flowering heads above and below crop height were made in quadrats as for wild-oats.

Yield. An area ranging from 12.5 m^2 - 40 m^2 per plot was harvested depending on the size of the treated plots and the type of harvester available.

RESULTS

Control of wild-oat - Avena spp.

For each year the results are summarised in three basic categories, which denote the density of wild-oats in the treated crop. The three categories are:-

low density:	< 50 panicles/m^2
medium density:	51 - 100 panicles/m^2
high density:	>100 panicles/m^2

Tables 1 and 2 show the level of wild-oat control given by flamprop-methyl and benzoylprop-ethyl in terms of % reduction of total panicles and spikelets.

Table 1

Control of wild-oat - Mean % reduction in total panicles

Year	Density of wild-oats	No. of trials	Treatment		
			Benzoylprop-ethyl	Flamprop-methyl	
1973	Dose kg a.i./ha:		1.0	0.4	0.6
	Low	5	74	78	83
	Medium	5	73	75	78
	High	3	84	88	94
	Mean		75.9	79.2^{ns}	83.6*
	LSD		-	4.1	5.8
1974	Dose kg a.i./ha:		1.0-1.2	0.5-0.525	0.6
	Low	5	76	75	84
	Medium	11	76	87	92
	High	8	77	86	86
	Mean		76.3	84.2*	88.3*
	LSD		-	4.7	5.4
1975	Dose kg a.i./ha:		1.0-1.3	0.4-0.525	0.6
	Low	6	74	83	92
	Medium	7	72	79	87
	High	2	74	83	89
	Mean		73.1	81.1*	89.3*
	LSD		-	7.4	6.9
1976	Dose kg a.i./ha:		1.12	0.525	
	Low	4	63	74	
	Medium	5	72	90	
	High	3	84	96	
	Mean		72.0	86.2*	
	LSD		-	6.4	
All 4 years	Overall mean	64	74.7	82.8*	87.4*
	LSD		-	2.9	3.2

NB LSD values are applicable only to the annual mean and overall mean differences between flamprop-methyl and benzoylprop-ethyl.

ns Difference not significant at P= 0.05

* Difference significant at P< 0.05

Table 2

Control of wild-oat - Mean % reduction in total spikelets

Year	Density of wild-oats	No. of trials	Treatment Benzoylprop-ethyl	Flamprop-methyl	
1973	Dose kg a.i./ha:		1.0	0.4	0.6
	Low	5	89	90	95
	Medium	5	85	90	94
	High	2	93	94	98
	Mean		88.0	90.7 ns	95.1*
	LSD		-	4.1	4.9
1974	Dose kg a.i./ha:		1.0-1.12	0.5-0.525	0.6
	Low	5	94	93	97
	Medium	6	94	95	99
	High	3	90	96	96
	Mean		93.6	94.5 ns	97.6*
	LSD		-	3.6	2.6
1975	Dose kg a.i./ha:		1.0-1.3	0.4-0.525	0.6
	Low	3	90	93	97
	Medium	6	88	94	96
	High	2	96	98	98
	Mean		90.0	94.5 ns	96.6*
	LSD		-	4.7	5.5
1976	Dose kg a.i./ha:		1.12	0.525	
	Low	4	78	84	
	Medium	3	82	96	
	High	3	91	99	
	Mean		83.1	92.1*	
	LSD		-	5.3	
All 4 years	Overall mean LSD	47	89.1 -	93.0* 2.1	96.5* 2.2

NB LSD values are applicable only to the annual mean and overall mean differences between flamprop-methyl and benzoylprop-ethyl

ns Difference not significant at P = 0.05

* Difference significant at P<0.05

Control of blackgrass - Alopecurus myosuroides

The results of trials carried out in France are shown in Table 3. There were much fewer applications of benzoylprop-ethyl than flamprop-methyl and a full comparison of the two compounds is not therefore possible.

Table 3

Activity of flamprop-methyl against blackgrass (Alopecurus myosuroides)

Compound	Dose kg a.i./ha	No. of applications	% Reduction heads above crop	% Reduction total heads
flamprop-methyl	0.45	22	89	68
	0.60	20	92	68
benzoylprop-ethyl	1.0	3	77	53

No. of flowering heads per m^2 in control plots ranged from 6 - 384.

Yield response to wild-oat control

Fig. 1

Comparison of yield gain following treatment with flamprop-methyl and benzoylprop-ethyl

Means of 4 years trials

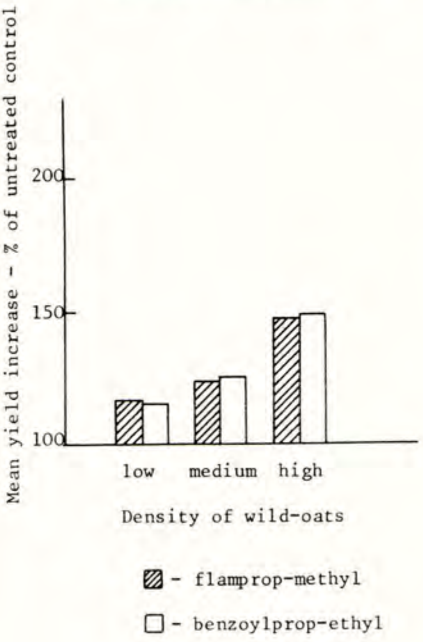
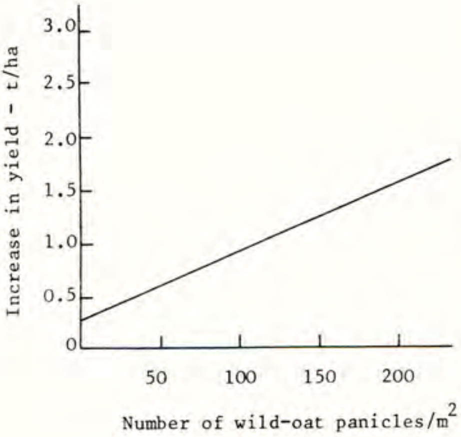


Fig. 2

Relationship between density of wild-oats and yield gain following treatment with flamprop-methyl



Equation for regression =
0.246 + 0.0069 x wild-oat density
($\pm$0.140) ($\pm$0.0014)

Table 4

Mean yields expressed as % of untreated control

Year	Density of wild-oats	No. of trials	Treatment		
			Benzoylprop-ethyl	Flamprop-methyl	
1973	Dose kg a.i./ha:		1.0	0.4	0.6
	Low	5	120	128	127
	Medium	5	157	160	154
	High	3	165	169	171
	Mean		144.6	149.8^{ns}	147.5^{ns}
	LSD		-	6.8	7.7
1974	Dose kg a.i./ha:		1.0-1.12	0.5-0.525	0.6
	Low	5	106	106	106
	Medium	11	115	116	119
	High	8	137	142	139
	Mean		120.5	122.6^{ns}	123.0^{ns}
	LSD		-	3.1	3.2
1975	Dose kg a.i./ha:		1.0-1.3	0.5-0.525	0.6
	Low	6	106	107	114
	Medium	7	122	125	126
	High	2	133	120	142
	Mean		117.1	118.1^{ns}	123.2^{*}
	LSD		-	4.4	4.5
1976	Dose kg a.i./ha:		1.12	0.525	
	Low	4	121	121	
	Medium	5	118	119	
	High	3	173	165	
	Mean		131.5	131.2^{ns}	
	LSD		-	5.4	
All 4 years	Overall mean	64	126.6	128.7^{ns}	129.2*
	LSD		-	2.2	2.6

NB LSD values are applicable only to the annual mean and overall mean differences between flamprop-methyl and benzoylprop-ethyl

ns Difference not significant at $P = 0.05$

* Difference significant at $P<0.05$

The mean annual yields given by flamprop-methyl and benzoylprop-ethyl in the three levels of weed infestation are given in Table 4. Yield response varied with the years though the gains were very similar for both compounds within each year and within each level of weed infestation. Fig. 1 shows the overall mean % increase in yield response given by both compounds at the different levels of weed infestation over the four years. Fig. 2 shows the estimated relationship between actual yield increase and density of wild-oats. The analysis shows the following yield gains that can be expected following control of the different densities of wild-oat:-

20 wild-oat panicles/m^2 - 0.3 t/ha
50 wild-oat panicles/m^2 - 0.6 t/ha
100 wild-oat panicles/m^2 - 0.9 t/ha
200 wild-oat panicles/m^2 - 1.6 t/ha

DISCUSSION

Control of wild-oats

The estimation of wild-oat control on the basis of spikelet reduction gives a much more detailed assessment of weed control than panicle counts alone. It gives classification of the remaining panicles according to size, and therefore their competitive effect on the crop. It also gives an estimate of the capacity of the different treatments to reduce the potential number of seeds returned to the soil.

The data from this series of field trials show that flamprop-methyl and benzoylprop-ethyl both give a consistently large reduction of wild-oat spikelets at all levels of weed infestation. Over the four years, flamprop-methyl at half the dose of benzoylprop-ethyl gave a significantly greater reduction in the number of spikelets.

This investigation and those by Haddock et al (1974) and Breslin (1974) show that in crops with medium to heavy densities of wild-oats the potential return of wild-oat seed to the soil can be up to 60,000/m^2 (assuming two seeds per spikelet). The improvement in spikelet control achieved with flamprop-methyl is therefore very important since the number of seeds returned to the soil is further reduced by as much as 4,000/m^2.

Yield response to wild-oat control

Stovell and Bowler (1972) and Kirkland and Ashford (1976) have shown that substantial yield gains are obtained following the treatment of wild-oat infested crops with benzoylprop-ethyl or flamprop-methyl at crop growth stages between mid tillering and early shooting. The data reported here from trials carried out in crops with a range in densities of wild-oats demonstrates that both compounds give very similar increases in grain production. This is commensurate with the fact that both compounds equally reduce the gross level of weed competition. The substantial increase in grain production given by the treatment of crops with medium and heavy wild-oat infestations will give a very worthwhile return to offset the treatment cost. Treating even low infestations of wild-oats should prove beneficial to crop production in following years by significantly reducing the burden of wild-oat seed in the soil.

Control of blackgrass (Alopecurus myosuroides)

Although the data available for comparison is limited it appears that flamprop-methyl is more active than benzoylprop-ethyl against blackgrass. The overall 68% reduction in the number of flowering heads coupled with the severe stunting of the remaining heads following treatment with flamprop-methyl represents a very useful level of weed control. In further work, assessments will be based on the estimate of seed reduction, calculated from the number and length of flowering heads, as suggested by Baldwin and Livingstone (1972) and Hubbard and Livingstone (1974).

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THE EFFECT OF TIMING OF THE APPLICATION OF FLAMPROP METHYL ON ITS ACTION ON GRAMINACEOUS WEEDS IN WINTER AND SPRING WHEAT

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Summary Flamprop methyl was compared in a series of twelve field trials in Great Britain in 1976 with benzoylprop-ethyl and difenzoquat and shown to give a good control of *Avena* spp in wheat at all timings and of *Alopecurus* at later timings with marked yield responses within the period of crop growth from late tillering to just before the formation of the second node. In terms of *Avena* seed returned it proved better than the commercial standards in the majority of situations at all timings, the poorer performance being in the early timing. Blackgrass plants were stunted and seed head production was reduced. The control of heads was good at late timings (beginning of shooting) and superior to the performance at any timing of other compounds tested. The efficiency of flamprop methyl for *Avena* and *Alopecurus* control at all timings was further confirmed by a series of forty-three farmer applied trials.

INTRODUCTION

The chemical and physical properties of flamprop methyl have been reported by (Haddock et al 1974) where it was demonstrated that the compound gave good control of *Avena* spp in wheat at rates of 0.45 - 0.60 kg/ha in extensive field trials in Europe.

Field trials in 1975 and in 1976 investigated the effects of timing of flamprop methyl for the control of *Avena* spp and *Alopecurus myosuroides* in Great Britain.

METHOD AND MATERIALS

Flamprop methyl formulated as a 15% E.C. was applied to 12 sites ranging from Perthshire to South Berkshire. The trials were designed as a randomised block lay-out with four replicates, the number of timings varying from 2 - 4. The treatments which included benzoylprop-ethyl and difenzoquat as commercial standards were applied using a land rover mounted sprayer operating at a pressure of 2.8 bars and using a volume of 280 litres per hectare on 7 sites and 440 litres per hectare on 5 sites, nos. 208/9/10/11/12.

The plots measured 70 square metres, yield data was obtained using a modified Claas Comet combine harvester and yields were corrected to 14% moisture.

The assessment of *Avena* and *Alopecurus* control was made by panicle or head counts using 10, 0.5m x 0.5m quadrats per plot. Where the population of *Avena* spp was uniformly high the number of quadrats was reduced to eight or six. An assessment was also made of the spikelets per panicle and seeds returned to the soil, spikelets were counted and means used to give the number of potential spikelets per panicle above and below crop height for each treatment. The seed return was calculated by assuming 2 seeds/spikelet and relating the spikelet/panicle counts to

Table 1

Site Ref.No. County	Variety	Drilled	Crop Vigour	Earlier Overall Chemical Applied	W.O./B.G. Panicles or heads $/m^2$	SPRAY DATES 1976				CROP GROWTH STAGE				
						T1	T2	T3	T4	T1	T2	T3	T4	
H235 Notts	Maris Huntsman	15.11.75	Moderate	cyanazine mecoprop	66	12.4.	29.4.	27.5.		F/G	H	K		TIMING TRIALS
H233 N'hants	Mega	20.10.75	Moderate	NIL	33	9.4.	11.5.	27.5.		F/G	I	J/K		
H208 Oxon	Mega	6.10.75	Thick	dimethoate cyanazine/MCPA	67	21.4.	28.4.	4.5.		G/H	H/I	I/J		
H209 Hants	Sappo	10.3.76	Moderate	cyanazine/ MCPA	16	14.5.	21.5.	3.6.		G	H/I	I/J		
H214 Berks	Maris Huntsman	15.10.75	Thick	cyanazine/ MCPA	184	24.3.	8.4.	22.4.	30.4.	E	F/G	G/H	I	EARLY TIMING
H213 Oxon	Maris Freeman	21.10.75	Moderate	NIL	B.G. 439	26.2.	6.4.	27.4.	4.5.	D/E	F/G	G	G/H	
H234 Cambs	Bouquet	3.11.75	Moderate	NIL	95	9.4.	7.5.			G	I/J			REGISTRATION
H261 Perth	Maris Huntsman	25.10.75	Thick	mecoprop	35	6.5.	14.5.	18.5.		H	J	J/K		TRIALS
H260 Perth	Maris Huntsman	20.10.75	Thick	mecoprop	26	10.5	22.5.	4.6.		G/H	I	J/K		
H210 Berks	Atou	15.10.75	Thick	methabenz thiazuron	221	1.4.	19.4.			G	I			
H211 Berks	Maris Huntsman	8.10.75	Thick	cyanazine/ MCPA	77	8.4.	29.4			G	I			
H212 Berks	Sappo	19.2.76	Thick	Liquid fertilizer	4	14.5.	2.6.			G	J			

the number of panicles per quadrat above and below the crop to give a figure for seed returned.

Table 1 indicates the location of each site, the variety, drilling date, crop vigour, previous treatment, spray dates, crop growth stages (Keller - Baggiolini 1954) and the population of Avena or Alopecurus spp expressed as a number of panicles or heads per m^2. Crop effects were scored by visual observations on a 1 - 9 scale.

RESULTS

The crop effects have been omitted for clarity since nothing was recorded above 3 and all effects were transient except crop shortening which was not associated with yield response except at H260. The results are set out in the following tables. Table 2 shows the control of Avena fatua and Alopecurus myosuroides in an early timing trial. Table 3 shows yield responses for these trials. Table 4 shows the control of Avena by application of herbicides at three timings, while the yield responses are set out in Table 5. Table 6 deals with Avena control in the registration series and the yield responses are given in Table 7. Table 8 sets out the percentage wild oat seeds returned to the soil in the registration and timing trials from each of the herbicides. The spread of timing of the forty-three farmer applied trials and the degree of Avena control obtained is demonstrated in figure 1.

DISCUSSION

The figures for seed returned to the soil are based on a count of florets giving the potential seed present regardless of maturity and in the case of flamprop methyl any panicles remaining were small, green and below crop level averaging 10 - 12 seeds per panicle so that seed from these plots would probably not have any dormancy (Chancellor et al 1975) and possibly a reduced viability.

Flamprop methyl was shown to give a good control of Avena spp at all timings, and was better than or equal to the commercial standards over all timings at 14 out of 20 situations (Table 8). At 5 of the remaining situations where performance tended to fall off treatment was at the early timing C.G.S. F/G. Trial design makes a direct comparison of treatments possible within each of the two series, registration and timing. In the registration series benzoylprop-ethyl was also more effective in reducing seed returned, particularly at later timings of application.

In the timing series H208, 209, 235 and 233 the most effective treatments in reducing wild oat seeds returned to the soil were flamprop methyl at 0.525 kg ai/ha and difenzoquat at 1.0 kg ai/ha. In all cases in this series the return of seeds from benzoylprop-ethyl treated plants decreased with later applications. In general the decrease was greater between timings 1 to 2 than 2 to 3. This increased efficacy in the later timings was not shown by difenzoquat which was less effective in trials 209, 235 and 233 at the later timings.

The early timing series was designed to investigate blackgrass but except at one site the infestation was too variable to allow meaningful counts to be made, however at all sites the effects on blackgrass which had been noticed in previous years were apparent, the plants became stunted and seed head production was reduced. At H213 the performance of flamprop methyl improved with successive applications until at C.G.S. G/H control was superior to the performance at any timing of the other compounds or mixtures tested. C.G.S. D was obviously too late for any contribution from the barban component following such a mild winter. By reducing seed returned to the soil the late control of blackgrass heads could be particularly effective in preventing the development of serious infestations where a few plants have become established.

Table 2

The Effect of Early Timing of Flamprop methyl (WL29761) on the Control of Avena fatua and Alopecurus myosuroides

% Control Avena fatua Panicles Alopecurus Heads

Site:		H214 (Berks) Avena				H213 (Berks) Alopecurus			
	kg ai/ha	E/F	F/G	G/H	I/J	D	F/G	G	G/H C.G.S.
Flamprop methyl	0.525	93	73	94	66	27	34	63	75
" "	0.563	95	62	91	66	41	45	67	80
Barban + Flamprop methyl	0.26/0.26	95	85	-	-	48	61	-	-
Benzoylpropethyl	1.00	-	-	87	69	-	-	32	34
Difenzoquat	1.00	85	85	74	71	23	11	21	6
Control (Panicles or head/m^2)				(184)		(407)	(509)	(513)	(327)

Table 3

% Yield Responses from the Control of Avena fatua and Alopecurus myosuroides at Early Timings

Site:		H214 (Berks)				H213 (Berks)			
	kg ai/ha	E/F	F/G	G/H	I/J	D	F/G	G	G/H C.G.S.
Flamprop methyl	0.525	153	156	151	129	130	120	113	120
" "	0.563	154	145	150	140	137	122	124	115
Barban + Flamprop methyl	0.26/0.26	145	152	-	-	130	121	-	-
Benzoylpropethyl	1.00	-	-	152	128	-	-	112	113
Difenzoquat	1.00	143	163	137	138	115	105	105	107
Control (t/ha)			(2.88)				(2.77)		
LSD between treatments			22				18		
" " timings $(P > 0.05)$			30				24		

Table 4

% Control of Avena fatua Panicles at 3 Timings

	Site:	H235 (Notts)			H208 (Oxon)			H209 (Hants)			
	kg ai/ha	F/G	I	J/K	G/H	H/I	I/J	G	H/I	I/J	C.G.S.
Flamprop methyl	0.525	-	95	39	-	90	97	-	100		
" "	0.787	53	-	-	96	-	-	97	-	-	
Benzoylpropethyl	1.12	5	67	30	71	66	75	71	97	99	
Difenzoquat	1.00	82	93	71	72	84	92	100	94	95	
Control (panicles/m²)			(66)			(67)			(16)		

Table 5

% Yield Responses from the Control of Avena fatua at 3 Timings

	Site:	H233 (N'hants)			H235 (Notts)			H208 (Oxon)			H209 (Hants)		
	kg ai/ha	F/G	I	J/K	F/G	H	K	G/H	H/I	I/J	G	H/I	I/J
Flamprop methyl	0.525	-	99	99	-	120	106	-	128	120	-	96	116
" "	0.787	112	-	-	124	-	-	132	-	-	128	-	-
Benzoylpropethyl	1.12	104	100	97	113	120	109	119	133	128	117	98	116
Difenzoquat	1.00	109	91	90	125	121	100	122	128	116	112	107	111
Control (t/ha)			(3.10)			(2.96)			(3.01)			(2.42)	
LSD at one timing		8			6	7	8		-			18	
" at different timing (P>0.05)		13			-	11	-		21			23	

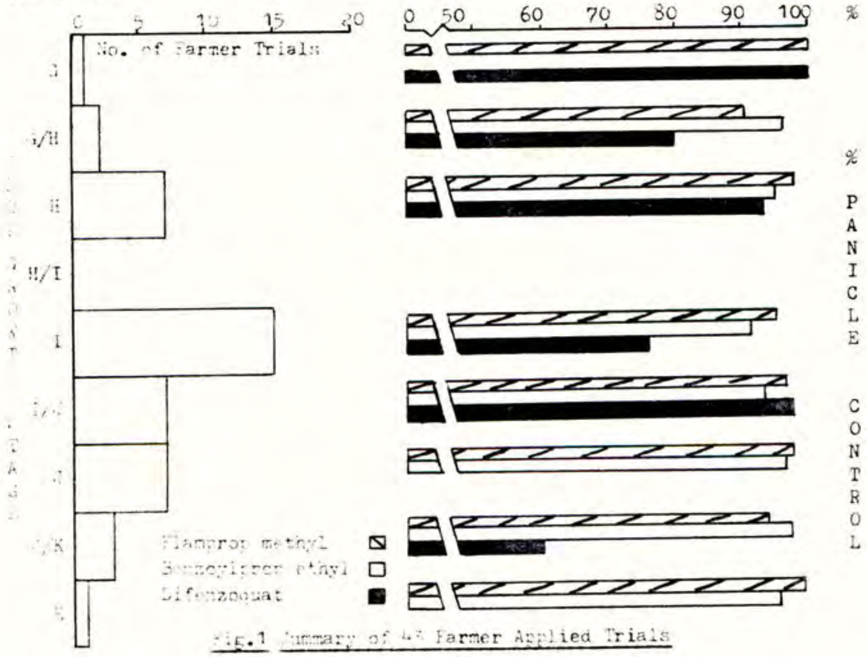

Fig.1 Summary of 43 Farmer Applied Trials

Table 6

% Control of Avena fatua Panicles in Registration Trials

		H234 (N'hants)		H261 (Scot.)			H260 (Scot.)			H210 (Berks)		H211 (Berks)		
	kg ai/ha	G	I/J	H	J	J/K	G/H	I	J/K	G	I	G	I	C.G.S.
Flamprop methyl	0.45	82	95	96	49	-	91	91	-	95	95	71	90	
	0.525	84	93	91	61	34	100	97	100	89	100	77	97	
	0.60	76	92	91	57	-	86	100	-	90	100	66	93	
	1.05	96	97	96	90	37	97	100	100	99	100	75	97	
Benzoylpropethyl	1.12	25	84	-	96	-	-	100	-	77	98	27	77	
	2.24	55	91	-	97	-	-	-	-	96	99.4	86	89	
Difenzoquat		97	47	-	97		91	-	-	95	89	59	93	
Control (Panicles/m^2)		(95)			(35)			(26)		(276)	(166)	(48)	(106)	

Table 7

% Yield Responses from the Control of Avena fatua in Registration Trials

		H234 (N'hants)		H261 (Scot.)			H260 (Scot.)			**H210** (Berks)		H211 (Berks)		H212 (Berks)		(In absence of wild oat)
		G	I/J	H	J	J/K	G/H	I	J/K	G	I	G	I	G	I	C.G.S.
Flamprop methyl	0.45	120	111	103	107	-	100	102	-	191	206	128	148	94	113	
" "	0.525	118	119	101	100	101	103	99	90	187	184	131	121	87	103	
" "	0.60	124	112	108	101	-	103	101	-	190	215	130	133	103	112	
" "	1.05	124	111	103	97	95	110	100	87	193	205	153	149	84	93	
Benzoylpropethyl	1.12	106	110	-	103	-	-	103	-	177	201	130	140	97	109	
"	2.24	120	115	-	103	-	-	102	-	196	206	140	137	93	104	
Difenzoquat	1.0	112	109	-	103	-	109	-	-	198	205	125	137	101	102	
Control (t/ha)		(2.66)			(4.6)			(5.43)		(2.30		(3.34	(2.76)	(4.03)	(3.35)	
LSD at same timing		10			-		-			-		19	20	16	19	
" at different timing		13			9.6		9.6			23		-	-	-	-	

Table 8

Reduction of Avena fatua seed as % of Control

REGISTRATION	Site:	H210 (Berks)		H211 (Berks)		H234 (Cambs)		H260 (Scot.)		H261 (Scot.)		
	kg ai/ha	G	I	G	I	G	I/J	G/H	I	H	J	C.G.S.
Flamprop methyl	0.45	97	99.1	90	98	96	99.4	99	99.2	99.8	94	
	0.525	94	100	92	99.4	93	99	100	99.7	99.3	95	
	0.66	94	100	84	98	93	98	98	100	99.2	93	
	1.05	99	100	95	99.5	99	99	99.7	100	99.9	99.5	
Benzoylpropethyl	1.12	78	99.6	46	94	59	94	-	100	-	99.9	
Difenzoquat	1.00	92	93	79	95	99.3	66	99	-	-	99.9	
Control (Seeds/m^2)		(31448)	(22076)	(9168)	(20456)	(11047)	(8108)	(366)		(3807)		

Table 8 (cont.)

Reduction of Avena fatua seed as % of Control

TIMING	Site:	H208 (Oxon)			H209 (Hants)			H235 (Notts)			H233 (N'hants)			
	kg ai/ha	G/H	H/J	I/J	F/G	H/I	I/J	F/G	H	K	F/G	I	J/K	C.G.S.
Flamprop methyl	C.45	-	-	-	-	-	-	-	-	-	-	-	-	
	0.525	99.6	99.9	100	99.2	100	99.7	81	96	80	80	93	64	
	0.66	-	-	-	-	-	-	-	-	-	-	-	-	
	1.05	-	-	-	-	-	-	-	-	-	-	-	-	
Benzoylpropethyl	1.12	76.20	86	99.4	86	98	99.6	61	82	73	4	82	54	
Difenzoquat	1.00	82	93	90	100	91	98	94	96	86	98	84	62	
Control (Seeds/m^2)		(9412)	(10908)	(6272)	(598)	(603)	(1341)	(6406)	(4538)	(5261)	(2343)	(2324)	(1692)	

In the farmer applied series each application was checked and recorded by a trained observer though no advice as to location of site or method of application was given beyond that contained in an outline leaflet. Half the sites were infested with blackgrass and these results reflected those in the replicated trial giving severe stunting of the plants.

Yield figures show no clear difference between timings except at H212 and H26 At H212 the crop was laid and presented difficulties at harvest, here straw shortening improved the standing of the latter applications. At H260 application was delayed until crop stage J/K and a very marked straw shortening occurred as we as a reduction in yield which was just significant. This was not seen at H261 where rain followed immediately after spraying the C.G.S. J/K treatment. It is interesting to compare H260 with the yields in H233 at the same timing and H235 at later timing where the effect is not so marked and flamprop methyl does not produc the greatest yield reduction (Table 5). As a result of these indications from thi year's work, any recommendation for use will terminate at growth stage I to allow a possible recurrence of the growth conditions experienced in 1976 when crops were under considerable stress, not only from drought but also from a series of night frosts in early May.

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THE CONTROL OF AVENA FATUA IN WINTER WHEAT BY THE USE OF POST EMERGENCE HERBICIDES APPLIED AT DIFFERENT TIMINGS

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Summary Trials over a period of four years compared the control of wild oats and crop yield responses obtained by using four herbicides applied at different timings between early April and early June.

Benzoylprop-ethyl and flampropmethyl and difenzoquat generally gave a high level of wild oat control at all times of application, but there was some indication that difenzoquat became less reliable after about crop growth stage 6 (Feekes Large). HOE 23408 was only effective when used before GS6 of the crop.

Considerable yield increases were obtained using all materials up to about crop GS8 (towards the end of May) with the yield response generally greatest where there was a high percentage control of wild oats. Very late applications, beyond crop GS9 tended to result in lower yield responses.

INTRODUCTION

The introduction of post emergence herbicides which are effective for the control of wild oats at a relatively late stage in the life of the crop made it necessary to discover with some precision when wild oat competition occurred in the wheat crop in order to establish the latest stage that Avena spp could be removed without the yield of wheat grain being seriously affected.

METHODS AND MATERIALS

The materials used were benzoylprop-ethyl, difenzoquat, HOE 22870, flamprop-isopropyl & flampropmethyl. Only the first of these was used in all years, the tables indicate where and when the other materials were used.

The trials were all in farm crops of winter wheat chosen wherever possible for heavy and uniform populations of wild oats. Avena fatua predominated though a few Avena ludoviciana were present at some sites. Three randomised blocks were laid down at each site with multiple controls, usually 3 per block, to try and overcome some of the difficulties of uneven weed distribution. Plot size was 25 m^2.

The effects of the herbicides on the wild oats were assessed by cutting out and weighing the panicles from quadrats in the plots before shedding began except in 1976 when drought resulted in premature ripening and shedding so that counts of panicle numbers were made instead. Quadrat sizes were adjusted according to weed population to give samples of adequate but manageable size.

Herbicides were applied with a modified van der Weij sprayer in 225 l/ha with fan jets at 2.21 bar.

TABLE 1
TRIAL DETAILS

Site Details

YEAR	SITE	SOIL TEXTURE	VARIETY	TIMES OF APPLICATION GROWTH STAGES (FEEKES LARGE) OF CROP, AND *AVENA FATUA* IN BRACKETS 1	 2	 3	 4	 5
1973	1	CL	Bouquet	-	-	GS6(7) 25/4	GS7(8) 7/5	GS9(10) 1/6
	2	CL	M. Huntsman	-	-	GS6 (6) 11/4	GS7 (6) 25/4	GS10 (8) 1/6
1974	1	CL	M. Ranger	GS4 (3-5 lf) (1-5 lf) 2/4	GS5 (3-4) 16/4	GS6(5) 30/4	GS7(6) 13/5	GS8(7) 29/5
	2	CL	M. Ranger					
1975	1	CL	Atou	GS4 (2) 25/4	GS5 (4) 2/5	GS6(5) 14/5	GS7(6) 21/5	GS8(7) 30/5
	2	L	Bouquet	GS4 (3) 24/4	GS5 (4) 9/5	GS6(5) 16/5	GS7(6) 22/5	GS8(7) 30/5
	3	L	M. Huntsman	GS4 (4) 22/4	GS5 (5) 2/5	GS6(7) 14/5	GS7(7) 21/5	GS8/9(8) 4/6
	4	SL	Flinor	GS4 (3) 16/4	GS5 (4) 1/5	GS7(4) 15/5	GS8(5) 23/5	GS9(6) 4/6
1976	1	CL	Bouquet	GS4 (3) 9/4	GS5 (4) 28/4	GS6(5) 6/5	GS8(6) 17/5	GS9(7) 21/5
	2	CL	M. Huntsman	GS4 (2) 9/4	GS5 (3) 28/4	GS6(4) 7/5	GS8(5) 14/5	GS9(6) 21/5
	3	CL	M. Freeman	GS4 (2) 1/4	GS5 (3) 13/4	GS6(5) 22/4	GS7(6) 30/4	GS8(7) 7/5
	4	Pt.L	Bouquet	GS4 (4) 12/4	GS5 (4) 22/4	GS6(4) 7/5	GS7(5) 14/5	GS9(5) 21/5

Application Rates:-

	Rate a.i. (Kg/ha)	Rate product (l/ha)
Benzoylprop-ethyl	1.12	5.6
Flampropmethyl	0.525	1.17
HOE 23408	1.0	2.8
Difenzoquat	1.0	4.0
Difenzoquat (1973)	1.24	3.13

Infestation of *Avena* spp on control plots expressed as weight of panicles per square metre in 1973, 1974, and 1975, and as numbers of panicles per square metre in 1976 when drought resulted in early seed shedding.

	1973		1974		1975				1976			
Site	1	2	1	2	1	2	3	4	1	2	3	4
	187.9	63.6	53.8	58.5	58.2	88.0	167.5	26.9	822	34	39	34

RESULTS

TABLE 2

BENZOYLPROP-ETHYL

SITE	% control of *Avena* spp. (GS = growth stage of crop)					Yield of grain (tonnes/hectare)						
	GS3-4	GS5	GS6	GS7-8	GS9-10	GS3-4	GS5	GS6	GS7-8	GS9-10	Untreated Control	SE
1973 1	-	-	77	99	97	-	-	3.90	4.96	3.04	3.08	± 0.71
2	-	-	95	98	62	-	-	6.29	6.08	4.97	4.88	± 0.66
1974 1	83	99	100	99	86	-	-	-	-	-	-	
2	93	90	96	95	98	6.0	6.05	6.65	6.32	6.00	5.45	± 0.76
1975 1	72	77	93	94	89	4.48	4.70	4.64	4.68	3.74	4.09	± 0.48
2	90	76	76	91	87	5.14	5.03	4.82	4.62	4.37	4.48	± 0.61
3	94	87	90	81	94	5.26	5.31	4.48	4.42	4.36	3.73	± 0.84
4	90	87	94	46	97	5.50	6.10	5.95	5.52	5.59	5.35	± 0.64
1976 1	28	53	47	34	51	-	-	-	-	-	-	
2	50	55	47	9	21	5.65	5.70	5.72	5.73	5.24	5.67	± 0.36
3	74	-	93	81	90	-	-	-	-	-	-	± -
4	34	34	75	67	41	3.28	3.33	3.86	3.24	3.35	3.05	± 0.46
Means	70.8	70.9	81.9	74.5	76.1	5.04	5.17	5.15	5.01	4.52	4.42	

TABLE 3

FLAMPROPMETHYL

SITE	% control of *Avena* spp. (GS = growth stage of crop)					Yield of grain (tonnes/hectare)						
	GS3-4	GS5	GS6	GS7-8	GS9-10	GS3-4	GS5	GS6	GS7-8	GS9-10	Untreated Control	SE
1975 1	98	82	81	92	94	5.16	4.58	4.36	4.54	4.57	4.09	± 0.48
2	96	91	75	89	85	5.53	5.25	4.77	5.13	4.19	4.48	± 0.61
3	-	91	89	94	94	-	5.59	5.10	4.65	3.59	3.73	± 0.84
4	-	91	83	85	96	-	5.64	5.02	5.93	4.81	5.35	± 0.64
1976 1	49	49	64	63	10	-	-	-	-	-	-	-
2	75	70	100	92	79	6.01	5.58	5.49	5.10	5.49	5.67	± 0.36
3	97	83	99	96	96	-	-	-	-	-	-	-
4	42	73	98	53	93	3.40	3.16	3.01	3.35	3.20	3.05	0.46
Means	76.2	78.8	86.1	83.0	80.9	5.03	4.97	4.63	4.78	4.31	4.42	

TABLE 4

HOE 23408

SITE		% control of *Avena* spp. (GS = growth stage of crop)					Yield of grain (tonnes/hectare)						
		GS3-4	GS5	GS6	GS7-8	GS9-10	GS3-4	GS5	GS6	GS7-8	GS9-10	Untreated Control	SE
1974	1	94	100	83	57	50	-	-	-	-	-	-	-
	2	98	99	86	56	49	6.54	6.05	6.65	6.16	5.78	5.45	± 0.
1975	1	90	94	62	66	83	4.95	4.29	4.87	4.19	4.17	4.09	± 0.
	2	74	83	75	59	57	4.93	4.69	4.77	4.36	5.06	4.48	± 0.
	3	89	96	73	83	83	5.12	4.93	5.11	4.86	3.85	3.73	± 0.
	4	81	67	66	71	31	5.75	6.12	5.71	5.14	4.77	5.35	± 0.
1976	1	69	11	-	-	10	-	-	-	-	-	-	-
	2	83	42	37	55	12	5.81	5.75	5.82	5.40	5.41	5.67	±
	3	81	81	33	30	5	-	-	-	-	-	-	-
	4	37	70	34	45	28	3.18	2.86	3.23	3.36	3.06	3.05	± 0.
Means		79.6	74.3	54.9	52.2	40.8	5.18	4.96	5.17	4.78	4.59	4.42	

TABLE 5

DIFENZOQUAT

SITE		% control of *Avena* spp. (GS = growth stage of crop)					Yield of grain (tonnes/hectare)						
		GS3-4	GS5	GS6	GS7-8	GS9-10	GS3-4	GS5	GS6	GS7-8	GS9-10	Untreated Control	SE
1973	1	-	-	96	99	91	-	-	4.23	4.28	2.79	3.08	± 0.7
	2	-	-	98	92	60	-	-	6.52	6.28	4.80	4.88	± 0.6
1974	1	100	100	97	0*	38	-	-	-	-	-	-	-
	2	97	99	93	28*	96	6.25	5.70	5.89	5.67	5.34	5.45	± 0.7
1975	1	76	62	56	90	98	4.76	4.01	3.78	3.94	4.05	4.09	± 0.4
	2	88	91	74	89	98	4.93	4.98	4.81	4.38	4.29	4.48	± 0.6
	3	88	80	90	97	97	4.85	5.24	4.32	4.73	3.86	3.73	± 0.8
	4	77	73	97	80	84	5.82	6.40	5.70	4.89	6.03	5.35	± 0.6
1976	1	65	48	30	11	3	-	-	-	-	-	-	-
	2	93	49	86	66	42	5.74	5.80	5.70	4.93	5.38	5.67	± 0.3
	3	100	84	76	75	-	-	-	-	-	-	-	-
	4	87	89	96	74	44	2.81	3.25	3.86	2.77	3.25	3.05	± 0.4
Means		87.1	77.5	82.4	77.3	68.3	5.02	5.05	4.98	4.65	4.42		

* Rain showers after spraying: excluded from means

DISCUSSION

There are two main reasons for controlling wild oats in a crop -

(1) To reduce competition to the crop, which is considered to be serious when wild oats exceed 10 per square metre.

(2) To reduce seed production of the wild oats both in the saleable produce and to reduce the burden of weed on the farm.

The trials were mainly carried out in the presence of dense populations where the first consideration would apply, but the degree of control was generally assessed by weighing the wild oat panicles to give comparisons of seed return by the various treatments, which is relevant to the second consideration.

The yield response was obviously greatest where dense populations of wild oats had been removed by the herbicide treatments, and highest where the control approached 100%.

A point must come in the growth of the crop where even complete control of wild oats will result in no increase in yields because competition from the weed will already have caused irretrievable loss. Stovell and Bowler argue that wild oat competition occurs relatively late in the life of the crop, mainly for light and the trial results reported in this paper tend to bear out this theory. In trials in the Eastern Region in 1972 (Proctor and Livingston 1972) there had also been a strong indication that even though the control of wild oats using benzoylprop-ethyl had improved from 85% at GS 3 to 94% at GS8, yield responses to WO removal had been marginally greater at the earliest time of application. But in the trials reported here, only in 1973 did treatments remove the wild oats as late as crop GS10, and by that time the crop appeared unable to respond to the removal of competition. In all the other trials yield response appeared to depend much more on the degree of wild oat control obtained rather than the earliness of treatment as such. Mean effect over the four years for the different times of application shows a trend towards lower yields from later applications; though this often reflected lower percentage control figures as well as longer periods of wild oat competition.

The effect of competition from other grass and broad leaved weeds was a complication in some trials and a degree of herbicide toxicity to the crop may have also occurred. Only one trial (site 5 in 1975) was virtually free of wild oat competition and there it appeared that only benzoylprop-ethyl appeared to have no depressing effect in crop yield at any time of application. This material had a marked effect on Alopecurus myosuroides in 1975 with up to 50% reduction in total head length was recorded at site 1.

There were no very clear indications of the optimum time for applying these herbicides in order to achieve the maximum percentage control of wild oats, except in the case of HOE 23408 which generally became much less effective after crop GS5 to 6. The other materials showed considerable variation in optimum timings in different trials though it would appear that factors other than the growth stage of the crop and weed were also important; for example difenzoquat was made much less effective by rain showers after the fourth application in 1974. In 1976 the drought resulted in some crops with very poor vigour and in the absence of good crop competition some herbicide treatments were rather ineffective.

Benzoylprop-ethyl generally gave the best results between crop Growth Stages 4 & 7. Compared with benzoylprop-ethyl, WL 29761 (flampropmethyl) gave marginally better and more consistent levels of control.

The conclusion is that current recommendations for the use of these herbicides are correct but that in the presence of heavy wild oat infestations maximum yield responses are likely to be obtained by applications towards the early part of the period advised, provided that conditions are otherwise suitable for spraying. It would be unwise in practice to delay applications of any herbicide beyond crop GS8 because soon after then competition from heavy infestations of Avena species may cause considerable yield loss.

ACKNOWLEDGEMENTS

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THE CONTROL OF AVENA FATUA IN SPRING BARLEY USING POST EMERGENCE HERBICIDES

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Summary Fifteen replicated trials in the two years 1975 and 1976 compared the control of Avena fatua and responses in crop yield obtained by applying herbicides at five different times of application post emergence in spring barley.

Difenzoquat, flamprop-isopropyl, barban, and HOE 23408 were used in both years, and of these difenzoquat generally gave the highest and most consistent levels of control. Both difenzoquat and flamprop-isopropyl gave satisfactory control over a fairly long period of time but the optimum time of application was earlier for difenzoquat than for flamprop-isopropyl. Timing was more critical with barban and HOE 23408 both being most effective with earlier times of application.

In 1976 chlorfenpropmethyl + additive and WL 43425 were included at some sites and timings. The former gave inferior control to barban applied at the same time while WL 43425, (later timings only) gave very promising results.

Yield responses were obtained from all herbicides and tended to be related to Avena fatua population and degree of control.

INTRODUCTION

Trials were carried out to provide information regarding the relative effectiveness of herbicides for Avena fatua control and the optimum timing for their application. A secondary objective was to further assess how far early removal of wild oat competition was more important than a high percentage control of the weed per se.

METHOD AND MATERIALS

All the experiments were on commercial crops where naturally occurring populations of Avena fatua were expected. Relevant site details, treatment application dates, stages of crop and weed growth, and the herbicides used are listed in Table 1. A randomised block design with 3 replications was used. Plot size 3m x 9m. All treatments applied using a modified van de Weij sprayer with Allman '00' jets. Application rates were 1976 225 l/ha at 2.21 bar, 1975 281 l/ha at 3.31 bar with barban (B25) at 168 l/ha and + 2.76 bar in both years, Chlorfenprop-methyl + additive (1976 only), at 281 l/ha at 3.31 bar.

Wild oat control was assessed in July by removing Avena fatua panicles from a num of quadrats in each plot. the numbers and dry weights being recorded except for s sites in 1976 when drought conditions resulted in premature shedding of seed. Cr yields were taken by a sample harvesting technique.

TREATMENTS AND RESULTS
HERBICIDES APPLIED

TABLE 1

	1975		1976	
Spray Timings	Herbicides	Rate ai kg/ha	Herbicides	Rate ai kg/ha
(i)	Difenzoquat Barban "B25" HOE 23408	1.0 0.35 1.26	Difenzoquat	1.0
(ii)	Difenzoquat Barban B25 HOE 23408	1.0 0.35 1.26	Difenzoquat Barban B25 HOE 23408 Chlorfenprop-methyl + additive	1.0 0.35 1.26 3.4
(iii)	Difenzoquat HOE 23408 Flamprop-isopropyl	1.0 1.26 1.0	Difenzoquat HOE 23408 Flamprop-isopropyl WL 43425 Chlorfenprop-methyl + additive	1.0 1.26 1.0 1.0 3.4
(iv)	Difenzoquat HOE 23408 Flamprop-isopropyl	1.0 1.26 1.0	Difenzoquat Flamprop-isopropyl WL 43425 HOE 23408	1.0 1.0 1.0 1.26
(v)	Difenzoquat HOE 23408 Flamprop-isopropyl	1.0 1.26 1.0	Difenzoquat Flamprop-isopropyl WL 43425	1.0 1.0 1.0

In 1976 not all herbicides were applied at some sites at the timing listed, see table for the site variations.

TABLE 2 1975

Site Details

Site	1	2	3	4	5	6	7	8
Soil Texture	CL	CL	SL	CL	ZyCL	ZyL/ZL	ZL	CL
Cultivar	G. Promise	Wing	Wing	Berac	Tern	Maris Mink	Hassan	Hassan
Date drilled	6.5.75	23.4.75	26.4.75	29.4.75	28.4.75	23.4.75	14.4.75	28.4.75

Treatment Details

Crop Growth Stages (Feekes Large) without brackets
<u>Avena fatua</u> within brackets

Timing	Herbicide	1	2	3	4	5	6	7	8
(i)	Difz	6.6.75	23.5.75	4.6.75	28.5.75	29.5.75	22.5.75	22.5.75	19.5.75
	B25	3-4L	1½-2L	3-4L	2-3L	2-3L	1½-2½L	2-4L	1½-4L
	23408	(1½-2½L)	(1-1½L)	(1½-3L)	(1½-2½L)	(1½-2½L)	(1-2L)	(1-3L)	(1-3L)
(ii)	Difz	12.6.75	6.6.75	10.6.75	9.6.75	9.6.75	9.6.75	9.6.75	6.6.75
	B25	GS3	GS2	GS2-3	GS2-3	GS2-3	GS2-3	GS3-5	GS3
	23408	(1½-4L)	(1½-3L)	(3-4L)	(1½-3½L)	(1½-3½L)	(1½-3½L)	(4L-GS3)	(1½-3L)
(iii)	Difz	24.6.75	13.6.75	20.6.75	17.6.75	19.6.75	19.6.75	12.6.75	16.6.75
	23408	GS5	GS3-4	GS4-5	GS4-5	GS4	GS4	GS4-5	GS3-4
	Flam	(GS3-5)	(1½L-GS3)	(GS3-4)	(3L-GS4)	(5L-GS4)	(2L-GS5)	(GS3-5)	(GS2-3)
(iv)	Difz	27.6.75	20.6.75	24.6.75	25.6.75	26.6.75	26.6.75	19.6.75	24.6.75
	23408	GS6-7	GS5	GS6-8	GS6-8	GS5-6	GS5-6	GS4-7	GS6-8
	Flam	(GS4-5)	(GS3-5)	(GS3-6)	(GS3-6)	(GS2-5)	(GS2-6)	(GS4-7)	(GS3-7)
(v)	Difz	2.7.75	27.6.75	1.7.75	1.7.75	2.7.75	2.7.75	-	27.6.75
	23408	GS7-8	GS6-7	GS7-9	GS8-10	GS7-8	GS7-8	-	GS6-8
	Flam	(GS5-8)	(GS5-7)	(GS5-8)	(GS5-10)	(GS4-7)	(GS4-9)	-	(GS4-8)

TABLE 3 1975

% Control of *Avena fatua* as Dry Weight of Panicles

Treatments		Site 1	2	3	4	5	6	7	8
(i)	Difz	96	88	97	89	88	72	97	97
	B25	62	73	78	77	91	72	88	73
	23408	100	77	92	91	94	66	83	98
(ii)	Difz	80	89	96	99	100	89	75	96
	B25	66	79	1	+15	57	54	32	46
	23408	45	75	78	81	58	42	71	79
(iii)	Difz	98	46	98	95	96	92	86	85
	23408	+34	67	5	64	80	52	28	39
	Flam	100	56	93	85	95	53	61	73
(iv)	Difz	75	100	95	0	88	92	81	85
	23408	40	47	44	16	+20	6	27	13
	Flam	89	84	90	90	93	86	87	81
(v)	Difz	54	90	81	53	69	72	-	75
	23408	28	58	19	62	+2	+12	-	52
	Flam	98	75	97	53	93	91	-	87
Wt of *Avena fatua* panicles on control plots g/m^2		3.15	63.02	17.90	10.62	5.43	19.93	115.95	43.98

TABLE 4 1975

Grain Yield in t/ha @ 85% DM

		Site 1	2	3	4	5	6	7	8	Mean All Sites
Untreated		3.15	1.98	2.81	3.51	3.63	2.56	-	2.40	2.86
(i)	Difz	3.46	3.55	3.04	3.87	3.90	3.14	-	2.94	3.27
	B25	2.96	2.80	3.11	3.47	3.72	3.20	-	3.12	3.20
	23408	3.17	2.23	2.42	2.85	3.81	2.75	-	2.86	2.87
(ii)	Difz	3.23	2.42	3.25	3.69	4.24	3.23	-	2.75	3.26
	B25	3.31	2.52	3.31	3.50	3.47	2.85	-	2.72	3.10
	23408	3.33	2.71	2.88	3.47	3.69	2.59	-	2.38	3.01
(iii)	Difz	3.26	2.21	3.35	3.70	3.33	2.69	-	2.62	3.02
	23408	3.02	2.14	2.98	3.64	3.37	2.64	-	3.10	2.98
	Flam	2.74	2.44	3.25	4.47	3.56	2.46	-	2.72	3.09
(iv)	Difz	3.51	2.69	2.64	3.92	3.47	2.84	-	2.81	3.13
	23408	2.81	2.06	2.73	3.21	3.66	2.86	-	2.63	2.85
	Flam	3.19	2.32	2.80	3.68	3.81	2.56	-	2.90	3.04
(v)	Difz	3.18	2.42	3.03	3.38	4.06	2.66	-	2.33	3.01
	23408	3.07	1.89	3.04	3.72	3.41	2.64	-	2.49	2.89
	Flam	3.17	2.52	3.10	4.04	3.89	2.70	-	2.36	3.11
SE between treatment		± 0.11	±0.13	±0.16	±0.19	±0.08	±0.23	-	±0.18	±0.06
SE between control and treatments		± 0.18	±0.22	±0.27	±0.32	±0.14	±0.23	-	±0.31	±0.93

TABLE 5 1976

Site Details

Site	1	2	3	5	6	7	8
Soil Texture	Calc Zyl	ZL	ZyCl	ZyCL	SCL	ZyCL	ZyCL
Cultivar	M. Mink	Hassan	Wing	M. Mink	Hassan	Tern	M. Mink
Date Drilled	25.2.76	24.2.76	8.3.76	3.3.76	29.2.76	26.2.76	27.2.76

Treatment Details

Crop Growth Stage (Feekes Large) without brackets
Avena Fatua within brackets

Timing	Herbicide	1	2	3	5	6	7	8
(i)	Difz	22.4.76	17.4.76	16.4.76	–	8.4.76	12.4.76	13.4.76
	B25	2½-3L	2-2½L	2L	–	1½L	2-2½L	1½-2½L
	23408	(1-3L)	(1-2½L)	(1-2½L)	–	(1-2½L)	(1-2½L)	(1-2½L)
(ii)	Difz	10.5.76	7.5.76	29.4.76	28.4.76	22.4.76	29.4.76	29.4.76
	B25	GS3	GS2-3	GS203	GS2	3L-GS3	GS2-3	GS2
	23408	(2½-4L)	(2L-GS2)	(1L-GS3)	(1½L-GS2)	(1-4L)	(1L-GS2)	(2L-GS2)
	(a) Chlor+							
(iii)	Difz	14.5.76	13.5.76	10.5.76	7.5.76	29.4.76	7.5.76	7.5.76
	(b) 23408	GS3-4	GS3-4	GS3-4	GS3-4	GS3-4	GS4	GS3-4
	Flam	(3L-GS3)	(4L-GS4)	(4L-GS3)	(2L-GS3)	(2L-GS3)	(GS2-4)	(3L-GS3)
	(c) 43425							
	(d) Chlor+							
(iv)	Difz	21.5.76	21.5.76	18.5.76	13.5.76	7.5.76	14.5.76	13.5.76
	Flam	GS4	GS4-5	GS4-5	GS4	GS4-5	GS5-6	GS4-5
	(e) 43425	(4L-GS3)	(GS3-5)	(GS2-4)	(4L-GS4)	(GS2-5)	(GS3-5)	(GS2-5)
	(f) 23408							
(v)	Difz	3.6.76	28.5.76	26.5.76	21.5.76	14.5.76	21.5.76	21.5.76
	Flam	GS7	GS5-7	GS5-6	GS5	GS5-6	GS6	GS5-6
	(g) 43425	(Up to GS6)	(GS3-6)	(GS3-6)	(GS3-5)	(GS2-6)	(GS5-6)	(GS2-5)

a) Not applied at site 6
b) Not applied at site 3
c) Not applied at sites 1, 3, 5, 7 & 8
d) Applied at Site 5
e) Not applied at sites 2 & 6
f) Applied at sites 3 & 5
g) Applied at sites 5 & 6

TABLE 6 1976

% Control of <u>Avena Fatua</u> on head Numbers (Dry wt of Panicles on sites 5 & 7)

SITES

Treatments		1	2	3	5	6	7	8
(i)	Difz	90	80	47	-	90	96	68
	B25	92	88	64	-	87	87	88
	23408	97	65	28	-	61	61	92
(ii)	Difz	88	81	83	99	99	99	85
	B25	62	56	89	91	88	99	93
	23408	55	75	41	84	87	90	81
	Chlor+	60	4	67	80	-	72	66
(iii)	Difz	84	94	91	100	100	100	100
	23408	46	18	-	91	80	89	72
	Flam	43	11	77	90	87	100	78
	43425	-	82	-	-	98	-	-
	Chlor+	-	-	-	71	-	-	-
(iv)	Difz	85	77	83	99	95	98	77
	Flam	26	43	82	78	92	99	59
	43425	68	-	88	100	-	100	97
	23408	-	-	71	64	-	-	-
(v)	Difz	64	71	4	90	55	80	51
	Flam	+13	39	72	96	79	96	64
	43425	-	-	-	99	91	-	-
No. <u>Avena</u> on control plots/m^2		36	31	66	36	248	31	52
Wt. panicles g/m^2		-	-	-	24.5	-	16.6	-

TABLE 7 1976

Yield of Spring Barley @ 85% DM t/ha

			SITES			
Treatments		5	6	7	8	Mean
	Control	4.14	2.06	3.87	2.72	3.20
(i)	Difz	-	3.60	4.37	3.01	3.66
	B25	-	3.71	4.14	3.03	3.63
	23408	-	3.11	4.19	3.18	3.49
(ii)	Difz	4.50	3.55	4.48	3.31	3.96
	B25	4.19	3.17	4.19	3.33	3.72
	23408	4.57	2.94	4.41	2.97	3.72
	Chlor+	4.41	-	4.22	3.04	3.89
(iii)	Difz	4.10	3.43	4.39	3.41	3.83
	23408	4.44	2.94	4.29	3.26	3.73
	Flam	4.53	3.31	4.55	3.27	3.92
	43425	-	3.25	-	-	(3.25)
	Chlor +	4.63	-	-	-	(4.63)
(iv)	Difz	4.15	2.95	4.30	2.83	3.56
	Flam	4.80	2.91	4.36	2.89	3.74
	43425	4.74	-	4.23	3.26	4.08
	23408	4.41	-	-	-	(4.41)
(v)	Difz	4.29	2.82	4.33	2.97	3.60
	Flam	4.29	2.91	3.90	2.93	3.51
	43425	4.56	3.00	-	-	(3.78)
SE comparison between treatments and control		±0.252	±0.228	±0.17	±0.175	±0.105
SE comparison between treatments		±0.178	±0.162	±0.12	±0.124	±0.074

DISCUSSION

In both years growing conditions were abnormal; in 1975 because of the wet spring drilling was delayed and drought followed, and in 1976 crops were drilled early but were under drought stress most of the season. The resultant speedier development of crops meant that herbicide applications tended to be telescoped into relatively short periods. They also had to be carried out much later in 1975 than in 1976. The barley crop in both seasons was notably less vigorous and competative than usual, and final grain yields were generally low.

Most herbicide applications resulted in substantial yield increases and these were generally related to the degree of wild oat control. There were some indications that wild oat competition was having an effect on crop development by the time of the last applications, but the lower yield responses could not be directly attributed to delayed spraying because levels of control were often lower by then in any case.

Except in the odd instance where rain followed soon after spraying, the control following the use of difenzoquat averaged over 80% provided that it had been applied between crop growth stages 2 and 6. At several sites wild oat control was virtually complete during this period, and even the first and last applications in the trials gave acceptable results at most sites.

Flamprop-isopropyl gave the best results when used after crop growth stage 4, and continued to give satisfactory results as late as GS8 or even 9 in some trials. At crop GS4 it gave marginally lower wild oat control levels than difenzoquat, but by the last application was generally a little better.

WL 43425 was only used in 1976 and appeared to give slightly higher levels of control than flamprop-isopropyl.

HOE 23408 showed some phytotoxicity in 1975, and yield responses were not significant even where it gave good levels of control, but this effect was not seen the following year, when yields were not detectably inferior to other treatments. The optimum time of application appeared to be early, before crop GS3, and where early applications were not successful this may have been associated with delayed wild oat germination.

Barban gave good levels of control and high yield responses when applied before crop GS3, Chlorfenprop-methyl gave similar but slightly inferior results in terms of wild oat control but about the same yield response.

It was clear that it is essential that the last 3 materials must be applied to wild oats before tillering if they are to be successful.

The conclusion from this and the previous trial series (Baldwin and Finch 1974) must be that post emergence wild oat herbicides should be applied with the aim of obtaining the maximum degree of wild oat control, there being little danger of crops suffering from excessive competition and therefore loss of yield within the periods for application advised by the manufacturers of these materials.

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TIME OF APPLICATION OF HERBICIDES FOR AVENA FATUA CONTROL IN SPRING WHEAT AND BARLEY

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Summary Eleven replicated experiments in spring wheat and eight in spring barley were carried out with three different Avena fatua herbicides in 1974-1976. Three different times of applications were compared. Treatments were made at following growth-stages of the cereal: (I) the middle to end of tillering, (II) beginning of elongation to 1-node stage and (III) 2-node stage.

Both in spring wheat and barley the optimum application time for benzoylprop-ethyl (1.35 kg/ha) was the second and for difenzoquat (1 kg/ha) the first.

Flamprop-methyl (0.65 kg/ha) in spring wheat gave excellent control both at the first and the second time of application.

The average effect of flamprop-isopropyl (0.60 kg/ha) was less satisfactory. The isomer (WL 43425) used in 1976 proved better, however.

For all these herbicides the third application proved too late. The higest increases in yields were obtained at the first application, except for benzoylprop-ethyl in spring barley.

In Finland the optimum time for application of these Avena fatua herbicides is short, an average of 7-10 days, sometimes even less.

Résumé Onze essais de rendement avec le blé du printemps et huit avec l'orge du printemps ont été faites à l'aide de trois différents herbicides contre Avena fatua en 1974-1976. Trois différentes époques de pulvérisation ont été comparées. Les traitements ont été donnés aux stades de croissance suivants des céréales: (I) du milieu à la fin du tallage, (II) du début de la montaison jusqu'au stade de 1 noeud et (III) de deux noeuds.

Tant pour le blé que pour l'orge du printemps l'époque optimum de pulvérisation du benzoylprop ethyl (1.35 kg/ha)était le deuxième stade et du difenzoquat (1 kg/ha)le premier stade.

Le flamprop methyl (0.65 kg/ha) dans le blé du printemps a donné un contrôle excellent à la première et la deuxième époque de pulvérisation.

L'effet moyen du flamprop isopropyl (0.60 kg/ha) a été moins satisfaisant. L'isomer (WL 43425) appliquée en 1976 s'est toutefois

avérée meilleure.

Pour tous les herbicides la troisième époque s'est avérée trop tardive. Les augmentations de rendement maximales ont été obtenues à la première pulvérisation à l'exception du benzoylprop ethyl dans l'orge du printemps.

En Finlande l'époque de pulvérisation optimale de ces herbicides Avena fatua est courte, en moyenne 7-10 jours, quelquefois même moins.

INTRODUCTION

Preliminary experiments in 1973 in Finland with benzoylprop-ethyl against Avena fatua indicated that the time of the application was of great importance and that optimum effect was obtained only during a short period (Pessala 1974).

In Finland, spring cereals are sown in May and harvested in August to September. In northern conditions the cereal stands develop rapidly after emergence, especially at tillering to 1-node stage (Pessala 1976), compared with the development in Central Europe (Kolbe 1974).

These experiments were conducted to establish the optimum time of application for benzoylprop-ethyl, difenzoquat, flamprop-methyl and flamprop-isopropyl against Avena fatua and the selectivity of the crop to these herbicides.

The development of both crops and wild oats was closely followed.

METHODS AND MATERIALS

A total of 11 timing experiments in spring wheat and 8 in spring barley were carried out with three herbicides on commercial crops in an even infestation of Avena fatua in 1974-1976. A randomized block design with four replicates was used. The plot size was 20 m^2. All treatments were applied with an Azo propane sprayer with hollow cone nozzles. Two guardrat samples of 0.25 or 0.50 m^2, depending on the level of infestation, were taken from each plot. The panicles of Avena fatua were counted and the plants of both Avena fatua and cereals were dried and weighed. The yield was harvested from 17.10 m^2.

In spring wheat as well as in spring barley benzoylprop-ethyl 1.35 kg/ha a.i. and difenzoquat 1.00 kg/ha a.i. were used. The third herbicide was alternatively flamprop-methyl 0.65 kg/ha a.i. in spring wheat and flamprop-isopropyl 0.60 kg/ha a.i. in spring barley. Dates of sowing and spraying and growth-stages at the various applications are given in Table 1.

The weather

The weather conditions in the year 1974 was cold and rainy. The growing season started as normal. The temperatures in May were a little below the average. In June the temperatures were normal, but July and August again were colder. From July until the end of the growing season it rained more than usually, which made the harvesting difficult.

In 1975 the beginning of the growing season was warmer than normal. Hence the growth and development of plants were very rapid. At the end of May there was a week with severe night frosts. The rest of the season was favorable with temperatures above normal. The growing season was drier than usual, which depressed the spring cereal yields.

In 1976 the growing season started at normal time, about a week later than the year before. In the middle of May there was a very warm spell, but at the end of the month the weather turned cold. The precipitation has been satisfactory all through the summer. The cold and rainy weather has delayed the ripening of crops.

Table 1

Number of experiments, dates of sowing and applications, and growthstages for crop and Avena fatua 1974-1976

No of experiments		Dates of sowing	Dates of application		
			I	II	III
Spring wheat					
1974	4	May 2-15	June 13-14	June 18-20	June 25-27
1975	4	" 2- 9	" 3-11	" 10-18	" 17-24
1976	3	" 11-12	" 10-17	" 17-23	" 4-28
Spring barley					
1974	3	May 4-17	June 14-15	June 19-20	June 26-27
1975	3	" 6-20	" 3-23	" 10-30	" 17-July 3
1976	2	" 14-20	" 17-18	" 23	" 28- " 1
Growth-stages*					
Spring cereals			F-G	H-I	(I)-J
Avena fatua			B-G	D-I	G -J

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* Keller-Baggiolini scale

Yields from experiments in 1976 were not obtained when this paper was written.

RESULTS

After the treatment with difenzoquat the plants showed scorching of leaves. This was very marked in 1976. Difenzoquat had no effect on crop height in spring barley, but reductions in straw length were observed in the spring wheat experiments at some sites. Also benzoylprop-ethyl and flamprop-methyl shortened the straw in some wheat experiments.

The time of application had a significant influence on the effect. In spring wheat the first time of application was optimum for difenzoquat and the second for benzoylprop-ethyl and flamprop-methyl (Fig. 1). In barley experiments the optimum application time for benzoylprop-ethyl and difenzoquat was the same as in wheat (Fig. 2). The effect of flamprop-isopropyl was poor in 1974, but in 1975 and 1976 somewhat better, the second time of application was optimum. In the last application,

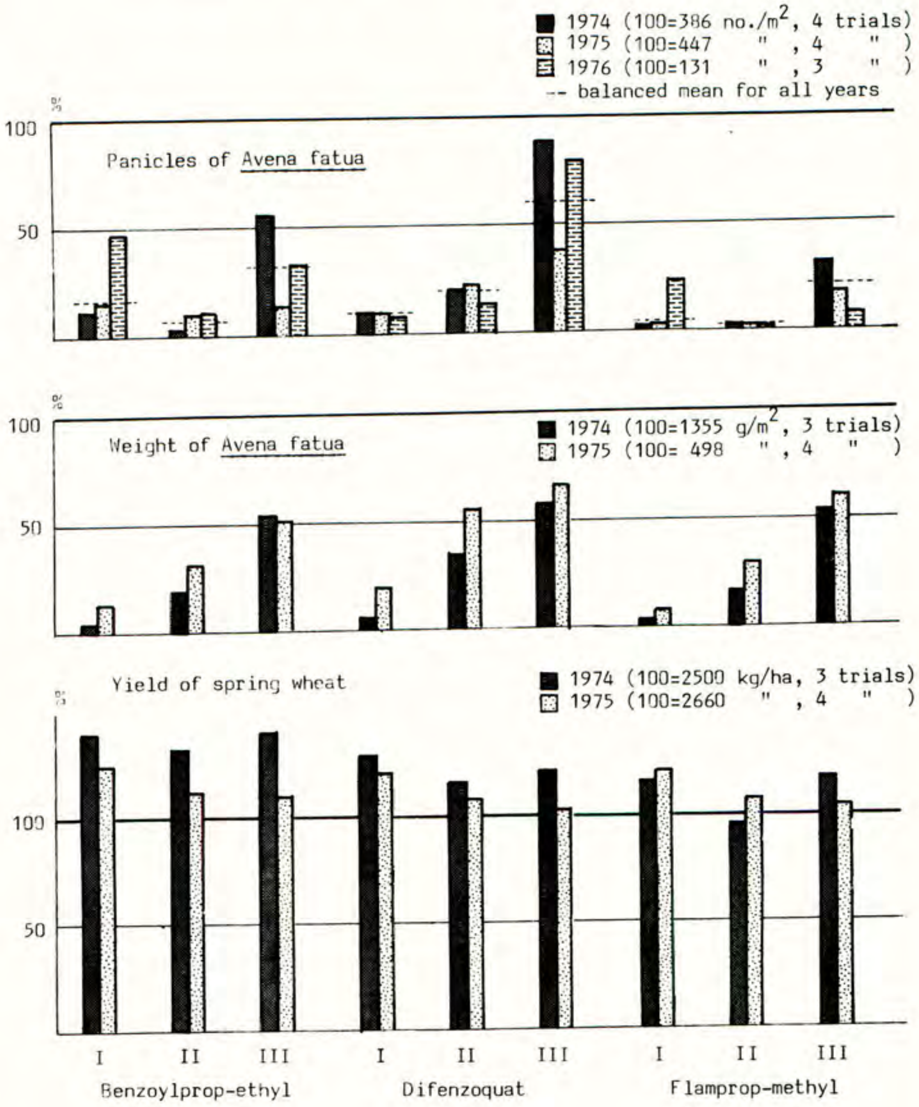
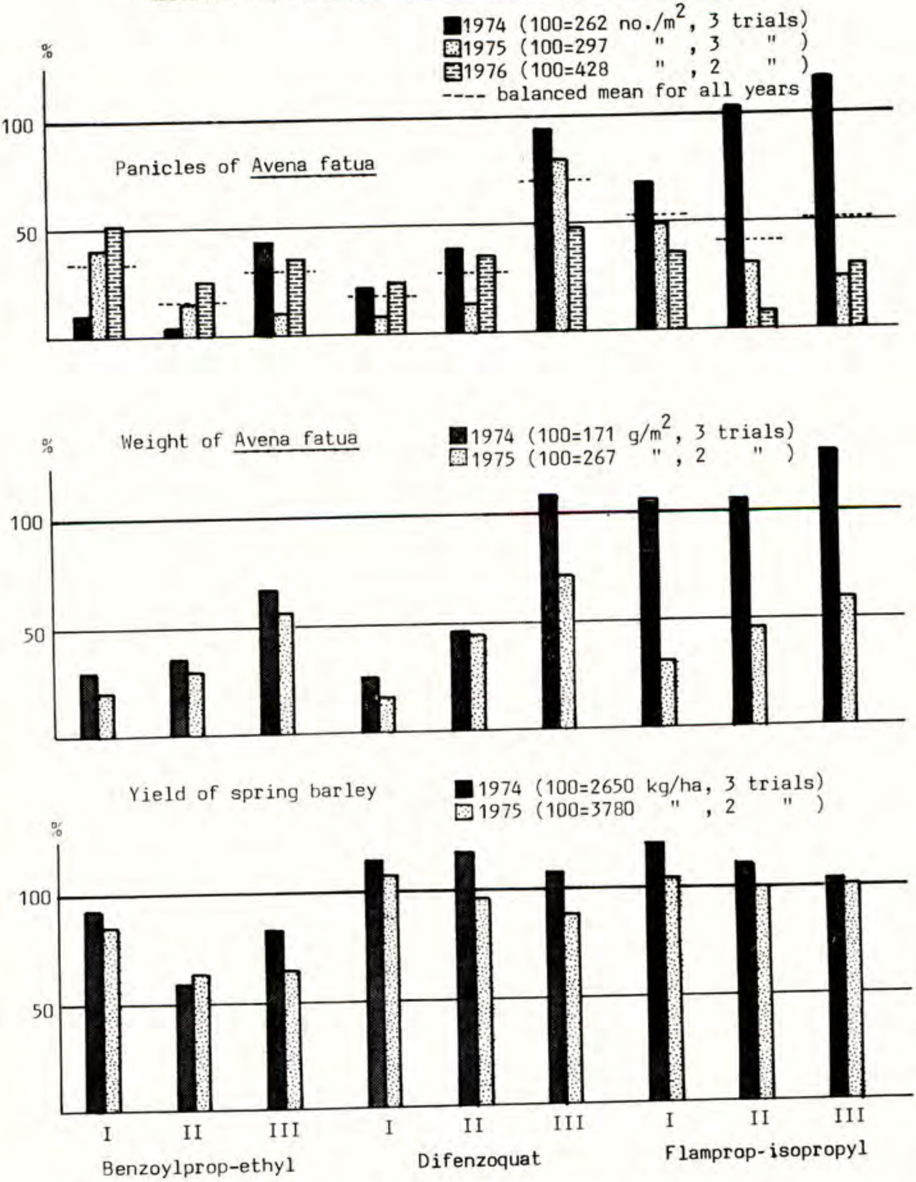


Fig 1

Avena fatua experiments in spring wheat 1974-1976. Number of panicles and weight of Avena fatua and yield of wheat as per cent of the number, weight and yield in the untreated plots

Fig 2

Avena fatua experiments in spring barley 1974-1976. Number of panicles and weight of Avena fatua and yield of barley as per cent of the number, weight and yield in the untreated plots



at the 2-node stage, the effect decreased rapidly.

The weight of Avena fatua increased significantly (wheat F = 5.62 ^{xx}, barley F = 8.78 ^{xx}) with later application time (Fig. 1 and 2). The highest yield was obtained at the first treatment for all herbicides in the wheat experiments. The yields were significantly higher (F = 7.72^{x}) than in untreated plots. Barley is not tolerant to benzoylprop-ethyl (Fig. 2). Yield increases were obtained in barley with bothdifenzoquat and flamprop-isopropyl.

DISCUSSION

The development of stands of cereals and Avena fatua and the distribution of plants in different stages of development were earlier studied in Avena fatua infested fields of spring wheat and barley in Finland. The emergence of the cereals was quicker and more even than that of Avena fatua. In early June the Avena fatua stand was clearly lagging behind in development. After mid June the development of Avena fatua was rapid and it caught up with the cereals. All stands went into ear at about the same time (Pessala 1976).

In Finland, the optimum application time for difenzoquat is about a week earlier than that for benzoylprop-methyl and flamprop-methyl. Difenzoquat and flamprop-methyl depressed the wheat when applied at the beginning of elongation to first node stage. Results from individual experiments show this clearly.

The average effect of flamprop-isopropyl on Avena fatua was less satisfactory. Nevertheless, the flamprop-isopropyl isomer (WL 43425) used in 1976 gave the best result against Avena fatua in the barley experiments. Over 90 % control was obtained at the second application time. Despite the poor effect against Avena fatua in 1974 and 1975 the barley yields were higher than expected. For example, at the first treatment flamprop-isopropyl gave as high a yield as difenzoquat, although there was a significant difference in the weight of Avena fatua plants between these two. The result from single experiments during these years indicate also that flamprop-isopropyl is more dependent on good crop competition that the other herbicides in these experiments. The importance of crop competition for the effect of flamprop-isopropyl has also been pointed out by other workers, e.g. Warley et al (1974)

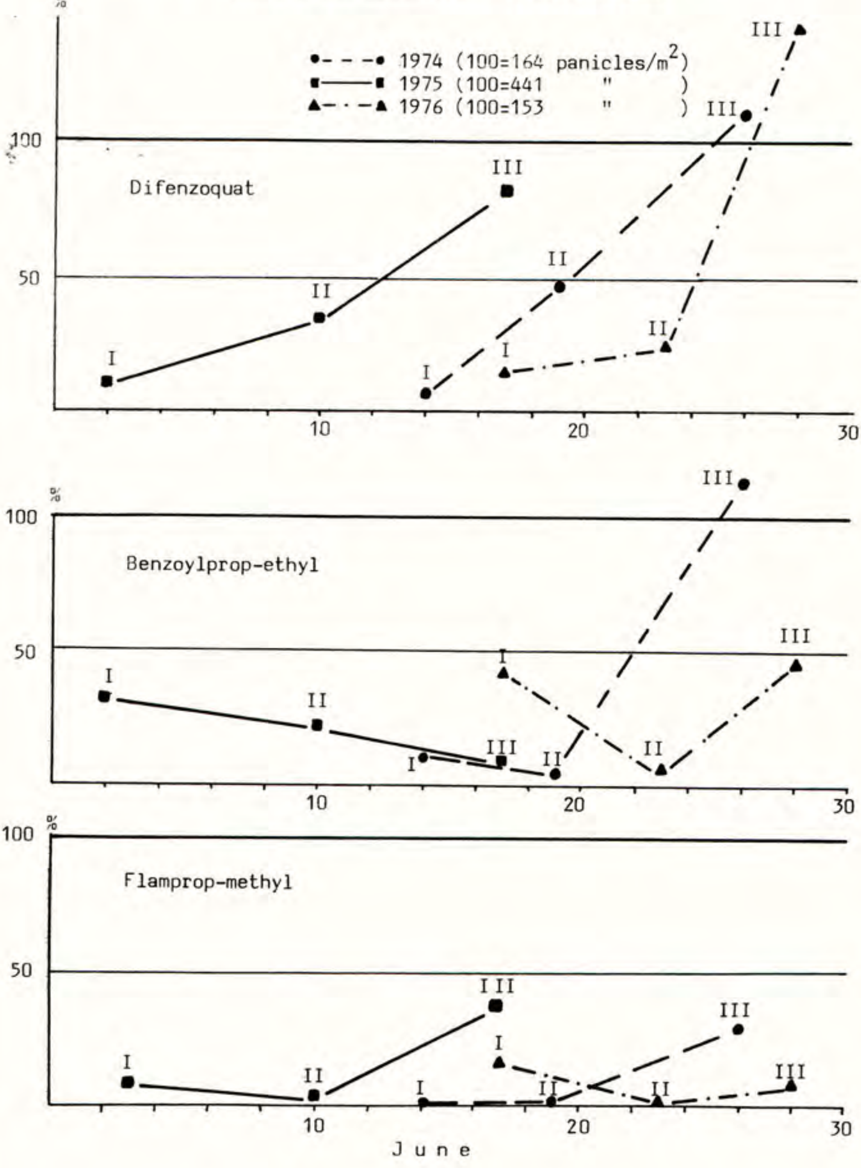
In June 1976 the weather was cold untill June 21st, this with night and day temperatures under 10 and 20 °C respectively. This cold period before and after the first application might explain the lessened effect of flamprop-methyl in 1976 compared with its effects in 1974 and 1975.

The short time in which the optimum effect is obtained with foliar herbicides against Avena fatua in Finland is evident e.g. from the results of experiments at a single site in Loviisa on the south coast of Finland (Fig 3). The spring wheat experiments were located in the same field all three years. The interval between first (growth-stage F-G) and second (H-I) application was in 1974 5 days, in 1975 8 days and in 1976 6 days. Kolbe (1974) in Germany observed that the time from the beginning of growth-stage F in spring wheat to end of stage I was much longer, in average 18 days.

The effects of various herbicides on Avena fatua in Loviisa (Fig. 5) were the same as described earlier in this report. The unusually good effect of the last treatment with benzoylprop-ethyl in the 1975 experiment is obviously due to the fact that the year was warm and dry. The panicles which usually are formed after applications at this growth-stage did not emerge from the leafsheat, but dried up.

Fig 3

The interval between application times I, II, and III, in days, in spring wheat at Loviisa 1974-1976. The number of panicles as per cent of the number in untreated plots.



The correct time of treatment for these Avena fatua herbicides in Finland falls within a fairly short period. Also in Sweden, in conditions comparable to Finnish, the application time is limited according to Gummesson (1976). It means that even a few days' delay can either considerably improve or weaken the effect. The interval of 5 days that should elapse between spraying for broadleaved weed control and the difenzoquat treatment, or 10 days for the benzoylprop-ethyl treatment according to the manufacturers, has proved difficult for the farmer. In years with rapid growth there is hardly time for both treatments. If the spraying against broadleaved weeds is delayed, the Avena fatua treatment is also carried out too late, which may reduce the effect considerably. Bad weather conditions can also cause severe difficulties in proper timing of the treatment as pointed out also by Tottman and Phillipson (1974).

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Proceedings 1976 British Crop Protection Conference - Weeds

THE EFFECT OF LIGHT, TEMPERATURE AND HUMIDITY ON THE CONTROL OF AVENA FATUA WITH DIFENZOQUAT

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Summary The effects of light intensity, temperature and humidity on the control of pot-grown wild oats (*Avena fatua* (L)) with difenzoquat were studied in controlled environment cabinets where one factor was varied while the others were held constant. During the period for up to eight hours following spraying, herbicide efficacy was enhanced by relatively high levels of temperature (20°C compared with 12°C) and humidity (90% RH compared with 60%), while light intensity had no effect. There were serious deleterious effects on performance from the intense washoff treatments, being greatest at the lower dose, under adverse environmental conditions (low temperatures and humidity) and when least time elapsed between spraying and washoff. Over the longer term, for up to three weeks after spraying, control was increased when the plants were kept under high temperature conditions (27°C compared with 18°C and 10°C). The effect of light was less clear cut, but tended to be better at low intensity (10 and 40 Wm^{-2} compared with 120 Wm^{-2}). Washing off one hour after spraying had no effect at 27°C but reduced herbicide performance substantially in all other environments.

INTRODUCTION

Difenzoquat is a water soluble herbicide applied post-emergence to control wild ats in wheat and barley (Shafer 1974). Little information is available on the nfluence of weather on the performance of this herbicide and the purpose of this eport is to present data on the effects on its activity after spraying of light, emperature, humidity and simulated heavy rain.

There are two types of experiment described here. In the first, "short-term" ype, the effects on herbicide performance of these environmental factors for a eriod of up to eight hours are investigated. The objective of these experiments s to indicate which environmental conditions are the most favourable for herbicide erformance and to indicate the consequences of application under less desirable onditions. In the second, "long-term" type, the effects of light intensity and emperature were studied for several weeks following spraying. These experiments ive an indication of the influence of seasonal climatic conditions on the activity f difenzoquat. It was considered that the main effects on performance of humidity ould be during the period of herbicide uptake, and so only temperature and light actors were studied over the long term period. Controlled environment cabinets ere used in both types of experiment to allow one of the environmental factors o be varied while the others were held constant.

METHOD AND MATERIALS

Plants. The seeds used in all the experiments were obtained in the field during 1972. To improve the uniformity of this genetically mixed population only large (20-25 mg), brown husked seeds were used. These were sown on moist filter paper and germinated at 15°C. When the radicles were 2-5 mm in length, the young seedlings were planted at a depth of 2.5 cm in a soil mix consisting of 1 part peat, 1 part sand and 4 parts of a Begbroke sandy loam. The plants were raised in a glasshouse where the temperature was 16° ± 8°C and the humidity was 60% ± 20%. From the two leaves unfolded stage (stage 12, Zadoks, 1974) the plants were watered weekly with a proprietary liquid feed.

Chemicals. Difenzoquat, technical material 96% pure containing 69% active ingredient was dissolved in distilled water to give the required doses. For all treatments the herbicide solution contained the surfactant Agral 90 at a concentration of 0.5% w/v. Control treatments were sprayed with an aqueous solution of 0.5% surfactant.

Application. The herbicide was applied at a volume rate of 200 l/ha using a laboratory pot sprayer fitted with a Spraying Systems 8001 Tee-jet nozzle operating at 2.1 bars.

Washoff Method. The intense washing method as described by Caseley *et al* (1975) was used. All visible traces of tartrazine dye, formulated and applied in the same way as the herbicide, were removed from the foliage by this method. It is assumed that most of the herbicide on the plant is removed as this treatment applied soon after spraying almost completely removes the biological effects of herbicide. For the short-term experiments, washoff treatments were applied within 5 min and at 1. 4 and 8 h after spraying. In the long-term experiments, the plants were washed 1 h after herbicide application.

Procedure for Short-Term Experiments. Plants at early tillering (main stem and from two to four tillers, stages 21-24; Zadoks, 1974) were selected for uniformity approximately two days before herbicide application. One day before spraying all the plants were moved into a 'holding cabinet' adjusted so that the conditions were mid-way between the two contrasting ones to be used in the experiment. After this conditioning period the plants were taken out, sprayed, and returned to their designated cabinets where one factor was varied while the others were held constant. After washing the plants were kept in the 'holding cabinet' until all the washing treatments were completed. This, together with staggered spraying times enabled the return of all the plants to the glasshouse at approximately the same time. The plants were arranged in a randomised block design in both glasshouse and controlled environment cabinet and were harvested three weeks after spraying. Conditions for these experiments are given in Table 1.

Procedure for Long-Term Experiments. Plants were raised in the glasshouse as described above and selected for uniformity one day prior to spraying. After treatment with the herbicide the plants were put in their respective environments, details of which are given in Figure 1, certain treatments were then washed and the plants returned to their cabinets where they remained for three weeks until harvest.

Table 1

Conditions in cabinets for short-term experiments

	Light (Wm^{-2})	Temp. (^oC)	VPD*(mb)	RH (%)
Holding cabinet	50	12.0	2.8	80
Low light	10	12.2	3.0	78
High light	140	11.7	2.8	80
Holding cabinet	150	16.0	4.5	75
Low temperature	150	12.2	4.4	69
High temperature	150	21.6	5.0	81
Holding cabinet	150	15.0	3.8	76
Low humidity	150	13.9	6.0	61
High humidity	150	15.3	1.5	94

The holding cabinets had a 12 hour daylength. * VPD = vapour pressure deficit.

Short-term experiments. Results of these experiments are given in Table 2. Temperature had no significant effect on the performance of difenzoquat following washoff within five minutes of spraying, and when no washoff treatment was applied. Following washoff at 1, 4 and 8 hours, the efficacy of difenzoquat at 0.5 kg/ha was significantly greater at high compared to low temperature but this effect was greatly reduced at the 1 kg/ha dose.

In general, light intensity during the 8 hours following application of the herbicide had no effect on the performance of difenzoquat.

Humidity had no effect on difenzoquat activity on plants receiving washoff treatments within five minutes of herbicide application and for those which had no washoff. In general, better control was achieved under conditions of high compared with low humidity. Following washoff at one hour after spraying, humidity had no significant effect at the 0.5 kg/ha dose but efficacy of the 1 kg/ha dose was increased at high humidity. In contrast, following the four and eight hour washoffs, high humidity significantly increased the performance of difenzoquat at the lower doses, but at the 1.0 kg/ha dose the improvement was not significant.

Long-term experiments. Results of these experiments are given in Figure 1. Better control was achieved at 27°C than at 18°C or 10°C with both the 0.5 kg/ha and 1.0 kg/ha doses. There were no significant differences at 27°C between those treatments washed and those not washed. However, at the lower temperatures there was much less control with those plants washed off 1 hour after spraying. In general, with the two lower temperature levels, the higher dose gave better control than the lower dose, the only exception being at 10°C with washing one hour after spraying.

There were no differences in foliage weight between treatments at the two lower light intensities (40 Wm^{-2} and 10 Wm^{-2}) irrespective of dose level, when the plants

Table 2

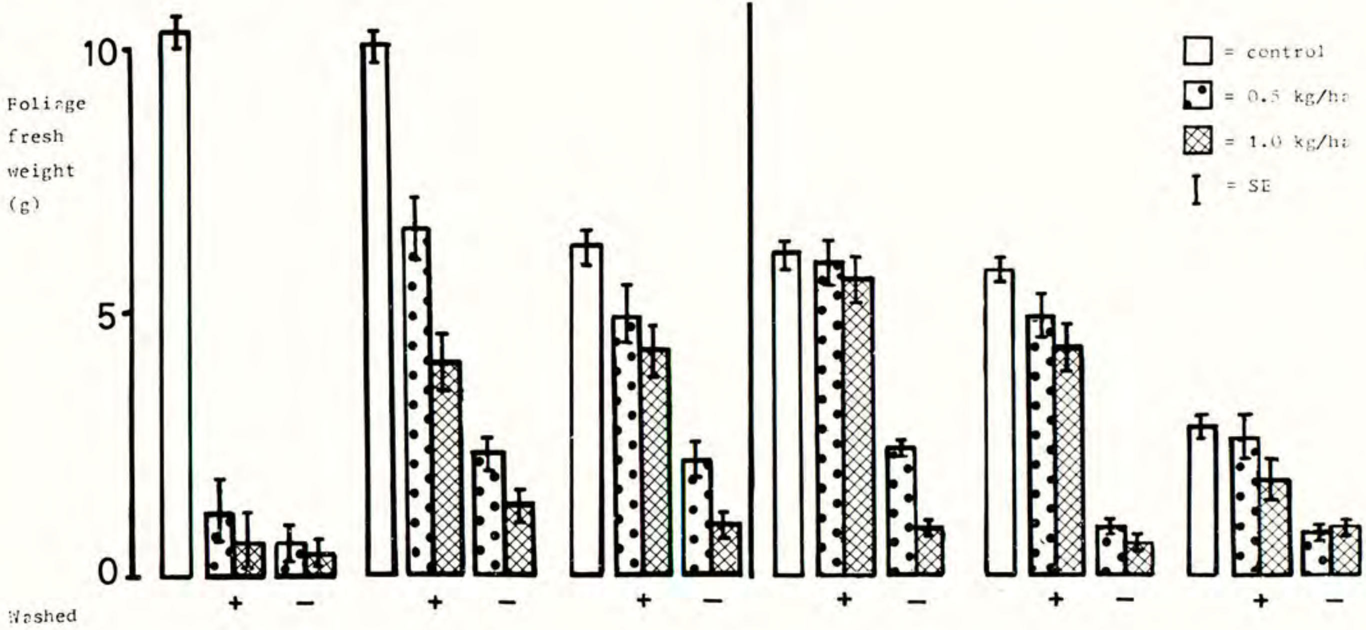
Short-term effects of light, temperature and humidity ± washoff on foliage weight of wild oats treated with difenzoquat

Washoff time (h)		0 - 0.10		1		4		8		not washed	
Difenzoquat (kg/ha)		0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
Environment	Control			Fresh wt (g)							
Low light	8.3	6.8	6.4	6.8	7.1	5.9	5.5	2.3	1.4	2.2	1.5
High light	7.9	8.3	8.1	6.6	6.3	5.9	3.3	2.0	2.1	2.0	1.9
LSD	1.5	2.1		1.9		1.0		0.7		0.4	
Low temperature	9.8	7.3	4.7	6.7	2.6	4.6	2.0	5.3	2.5	1.5	1.1
High temperature	11.0	8.1	4.1	4.2	3.7	2.4	1.8	2.3	1.5	1.5	1.1
LSD	2.4	2.5		1.1		1.3		1.0		0.5	
Low humidity	14.7	13.7	9.7	11.9	9.7	7.8	5.3	6.9	3.4	2.6	1.3
High humidity	14.0	15.2	10.1	10.5	5.0	4.5	3.8	4.2	2.6	2.3	1.4
LSD	4.4	2.0		1.8		1.5		1.4		0.7	

LSD ($P = 0.05$) are used for comparing means of five replicates.

Figure I Long term effects of temperature and light ± washoff on foliage weight of wild oats treated with difenzoquat

Temp. (°C)	27	18	10	12	12	12
Light (Wm^{-2})	140	140	140	120	40	10
VPD (mb)	5.4	5.2	5.0	2.8	2.8	2.8
RH (%)	83	75	59	80	80	80



received no washoff treatment. This is in contrast to the higher light level where, at the lower dose, the plants were significantly larger than those treated with the higher dose. Following washoff at one hour, those plants treated with the lower dose at 120 Wm $^{-2}$ and 10 Wm^{-2} were not different from the controls. Those at the intermediate light level, however, were significantly smaller than the controls. With the washed treatments increasing the dose had very little effect on overall performance at all light levels.

DISCUSSION

In the short-term experiments subjecting the plants to a washoff treatment within five minutes of spraying, as might be expected, did not allow sufficient time for the contrasting environments to have an effect. However, following washoff at one, four and eight hours there was a marked effect of temperature on the performance of the herbicide at 0.5 kg/ha, the reduction in foliage weight of the wild oats being greater at 22°C compared to 12°C. At the higher dose level of 1.0 kg/ha there are no differences in herbicide performance between the two temperature levels, a result which suggests that increasing the dose of herbicide can compensate for conditions that are less favourable for herbicide activity. Differences between low and high humidity were not apparent until the four and eight hour washoff treatments at the lower dose. Again, increasing the dose level tended to overcome the adverse environmental effects, although with washoff at one hour the effect at 90% rh was significantly better than at 60%. This low level of performance after one hour at low humidity may be attributed in part to the larger plant size at the time of spraying compared with the light and temperature experiments. There seems to be no clear cut effect of light intensity on herbicide performance. Although there are several examples in the literature where herbicide efficiency is increased by relatively high light intensity levels, there are many instances where light intensity has no effect (Kirkwood, 1972). In all experiments there were no differences between any of the treatments that were not washed off. It seems in this case that there was sufficient herbicide absorbed over the three week period in the glasshouse to overcome any environmental effects during the initial eight hour period (after spraying) in the controlled environment cabinets.

In the long-term experiments difenzoquat was much more effective at 27°C than at the lower temperatures (18°C and 10°C). Washoff treatments did not differ from unwashed at 27°C but at 18°C and 10°C performance was greatly reduced, indicating that at these lower temperatures slower uptake was allowing the washoff treatments to have an influence on herbicide performance. Apart from the 27°C treatment, increasing the dose tended to increase the degree of control especially when the plants received no washoff. Thus as with the short-term experiments increasing the dose can help to overcome the effects of low temperature.

The light experiment was conducted at 12°C which is not conducive to difenzoquat activity and this is reflected in the poor performance following washoff when at 120 Wm^{-2} the herbicide treatments did not differ from the controls. Light has a considerable influence on the growth of the plant and taking this into account the performance of difenzoquat was about the same for all light levels when washing occurred one hour after spraying. Without washoff, herbicide activity is significantly better at 10 Wm^{-2} and 40 Wm^{-2} than at 120 Wm^{-2}. The intermediate light level corresponds to the mean daily level during the early part of the year (January to April) or in a competitive situation within a crop (light measurements at WRO, unpublished data).

The results presented here are obtained from experiments performed in glasshouses and controlled environment cabinets and consequently cannot be directly applied to field situations, but they have some practical implications. It seems that the rate of penetration of difenzoquat decreases as the temperature falls and so, for good control of lower temperatures, a longer period is necessary between spraying and the incidence of heavy rain. Increasing the dose from 0.5 to 1.0 kg/ha under these conditions may also improve performance. Humidity also plays an important role in determining difenzoquat efficacy and it is likely that in Britain lower temperatures would be compensated to some extent by higher humidities.

Acknowledgements

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TRIALS IN THE U.K. WITH PHENOXY-PHENOXYPROPIONIC ACID DERIVATIVES FOR GRASS WEED CONTROL IN WINTER CEREALS

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Summary Ninety-eight trials with two derivatives of phenoxy-phenoxypropionic acid as new selective herbicides for post-emergence control of grass weeds in cereals are described. Hoe 22870, 2-[4-(4'-chlorophenoxy)-phenoxy]-isobutylpropionate, has given over 95% control of *Alopecurus myosuroides* up to the shooting stage with 0.54 kg/ha a.i. Crop tolerance was outstanding, there being no effect at over twice-normal rates of application on all varieties of wheat, barley and oats tested. Hoe 23408, 2-[4-(2',4'-dichlorophenoxy)-phenoxy]-methyl-propionate, was effective at 1.1 kg/ha a.i. against *Avena* spp. up to early tillering, and gave some control of *A. myosuroides* at this stage. Good selectivity was obtained in all treated varieties of winter and spring wheat and barley. There was no effect on broad-leaf weeds with either product, but mixtures with ioxynil or bromoxynil are possible; with mecoprop an interval of seven days is required.

Résumé Quatre-vingt-dix-huit essais avec deux dérivés de l'acide phenoxy-phenoxypropionique comme nouveaux herbicides sélectifs pour le contrôle en post-émergence des graminées en céréales sont décrits. Hoe 22870, 2-[4-(4'-chlorophenoxy)-phenoxy]-isobutylpropionate, a contrôlé à plus de 95% *Alopecurus myosuroides* jusqu'au stade de la montaison avec 0.54 kg/ha m.a. La compatibilité avec les cultures était excellente, il n'y a pas eu d'effet avec des doses plus que doubles des quantités d'application normales sur toutes les variétés testées de blé, d'orge et d'avoine. Hoe 23408, 2-[4-(2',4'-dichlorophenoxy)-phenoxy]-methyl-propionate, était efficace à 1.1 kg/ha de m.a. contre *Avena* spp. jusqu'au debut du tallage et a donné un certain contrôle de *A. myosuroides* à ce stade. Une bonne sélectivité a été obtenue dans toutes les variétés traitées du blé et de l'orge d'hiver et de printemps. Ni l'un ni l'autre produit n'a eu d'effet sur les dicotylédons, mais des mélanges avec ioxynil ou bromoxynil sont possibles; avec mecoprop, un intervalle de sept jours est demandé.

INTRODUCTION

Hoe 22870 and Hoe 23408 are new herbicides for selective control of grass weeds post-emergence in small-grain cereals and broad-leaf crops. They are derivatives of a new group of compounds, the phenoxy-phenoxypropionic acids, discovered by Hoechst Aktiengesellschaft. Both materials have a similar mode of action in that they strongly inhibit root growth and meristematic activity of the shoot (Köcher and Lötzsch,1975). After foliar application there is translocation in both an acropetal and basipetal direction. Applied to the roots, however, the chemical is strongly accumulated there, with only little translocation to the shoot. Richardson and Parker (1976) and Richardson et al (1976) showed both materials had pre- as well as post-emergence activity, although with the exception of Poa spp. and Veronica persica, which was the only susceptible broad-leaf weed, post-emergent treatment was the more effective.

Hoe 22870 is the code number for 2-[4-(4'-chlorophenoxy)-phenoxy]-isobutylpropionate. The chemistry, toxicology and initial trials work has previously been described by Schwerdtle and Schumacher (1975) and Schwerdtle et al (1975). Of the common grass weeds in U.K. cereals, Hoe 22870 will control Alopecurus myosuroides, Poa trivialis and Lolium spp. but Avena spp., P. annua, Apera spp. and all perennial grasses are resistant. It has shown good selectivity in winter and spring varieties of wheat, barley and oats, although maize is sensitive. Onion and all broad-leaf crops so far tested are tolerant.

Hoe 23408 is closely related to Hoe 22870, having the chemical name 2-[4-(2',4-dichlorophenoxy)-phenoxy]-methyl-propionate. The early work on this compound was reported by Langelüddeke et al (1975) and Schumacher and Schwerdtle (1975). Hoe 23408 differs from Hoe 22870 in controlling Avena spp., but is less active against A. myosuroides. The spectrum of activity on other weeds and crops is the same as for Hoe 22870 with the exception of cultivated oat which is sensitive. Hoe 23408 can therefore be used for Avena control in winter or spring wheat and barley, onion and a range of broad-leaf crops.

The object of work described in this paper was to investigate the efficacy and crop safety of these two materials under field conditions in the U.K.

METHOD AND MATERIALS

A total of ninety-eight trials was carried out during 1974 - 76. Of these, eighty-six were replicated plot trials to investigate rate and time of application, and the influence of adding materials for broad-leaf weed control. All of these trials were in commercial cereal crops located throughout Eastern England. The sites covered a range of varieties; soil types were usually clay or sandy-clay loams.

Plot size was 2 by 5 metres and all treatments, which included standard materials and untreated controls, were arranged in a randomised block design with three replicates. All applications were made with a Van der Weij 'AZO' Sprayer at a pressure of 2.5 bar using fan jets delivering 300 l/ha. Hoe 22870 and 23408 were formulated as 36% e.c.'s. Standard materials used in the trials were as follows: isoproturon ('Arelon') 75% w.p.; chlortoluron, 80% w.p.; 30% octanoate ester and 20% K-salt formulations of ioxynil and bromoxynil; K-salt of mecoprop, 64% a.e.; difenzoquat 62% s.p. and benzolyprop-ethyl, 20% e.c. The Feekes-Large scale was used to denote crop growth stages (G.S.).

A. myosuroides and Avena spp. were assessed by counting the seed heads and panicles, respectively, in a number of 0.5 m^2 quadrats at random in each plot. Crop vigour was assessed at intervals by scores on a 1 - 9 scale. Yield data was obtained using a small combine harvester with the plots cut across the rows to minimise variability; yields were adjusted to 85% d.m.

In the remaining twelve trials the chemicals were applied at normal and double rates across a range of weed-free cereals to compare the tolerance of different varieties under identical soil and weather conditions. These strips were generally unreplicated. Visual assessments were made during the season.

RESULTS

Hoe 22870

Application rate

The mean result obtained in each series of trials is given in Tables 1 and 2. Stages of *A. myosuroides* at application ranged from 1 - 3 leaf in winter 1975 to mid - late tillering in those trials sprayed in late spring. In early spring 1974 and early spring 1975 plants were at the 1 - 4 tillers stage.

Early effects on *A. myosuroides* were visible 10 - 14 days after application. These were seen as a change in leaf colour to dark green and cessation of further leaf growth. Later the leaves were often coloured green-blue or purple before turning necrotic. Root development was drastically reduced.

Table 1

Percentage control of *A. myosuroides* seed heads

Compound	kg/ha a.i.	End Feb.- Early March 1974	1975	End March- Mid April 1975	Late Nov.- Mid Dec. 1975	Mid March- April 1976
Hoe 22870	0.36	88	-	-	-	95
"	0.54	96	98	97	97	98
"	0.72	99	-	-	99	100
"	1.08	-	99	98	-	-
Isoproturon	2.1	93	93	88	90	59
Chlortoluron	2.7	78	-	-	52	-
Range of *A. myosuroides* seed heads/m^2 on controls (mean)		33-600 (190)	100-570 (210)		120-430 (250)	180-380 (290)
Number of trials		8	9		6	6

Table 2

Relative crop yields (control = 100)

Compound	kg/ha a.i.	End Feb.- Early March 1974	1975	End March- Mid April 1975	Late Nov.- Mid Dec. 1975	Mid March- April 1976
Hoe 22870	0.36	120	-	-	-	111
"	0.54	129	134	132	121	113
"	0.72	132	-	-	125	116
"	1.08	-	139	123	-	-
Isoproturon	2.1	137	139	127	139	105
Chlortoluron	2.7	127	-	-	121	-
Range of yields, t/ha, on controls (mean)		2.8-5.5 (3.6)	1.3-6.2 (3.7)		2.5-4.2 (3.4)	1.7-5.4 (3.5)
Number of trials		5	4		4	5

None of the winter wheats or winter barleys treated in these trials showed any signs of damage. Avena spp. and broad-leaf weeds were also unaffected by application of Hoe 22870.

Timing trials

Following the encouraging results obtained with Hoe 22870 over a range of growth stages of A. myosuroides, a series of timing trials was carried out in 1976 to investigate this aspect further. Applications were made in late March - early April, mid April and late April - early May, and the results are summarised in Table 3. Hoe 22870 had no visible effect on the crop at any dose rate or timing in these trials.

Table 3

Percentage control of A. myosuroides seed heads and relative crop yields following application of Hoe 22870 at different times

Stage of crop (G.S.) and A. myosuroides	Compound	kg/ha a.i.	% Control	Relative yield (control = 100)
G.S. 3 - 4 Early - mid tillering	Hoe 22870	0.54	94	113
	"	0.72	98	115
	Isoproturon	2.1	61	104
G.S. 4 - 5 Mid - late tillering	Hoe 22870	0.54	97	116
	"	0.72	99	110
	Isoproturon	2.1	59	105
G.S. 5 - 6 Late tillering - shooting	Hoe 22870	0.54	95	107
	"	0.72	95	109
	Isoproturon	2.1	67	101
Range of A. myosuroides seed heads/m^2 and crop yields, t/ha, on controls (means)			220-2260 (710)	1.6-5.0 (3.3)
Number of trials			7	3

Mixtures with broad-leaf herbicides

Early work with Hoe 22870 had suggested antagonism when this material was mixed with dinoseb or hormone weedkillers. Trials were therefore carried out in 1976 with Hoe 22870 applied as a tank mix with mecoprop or ester formulations of ioxynil or bromoxynil, and with mecoprop applied 7 days after the grass herbicide. Treatment was made when A. myosuroides was at the late-tillering stage, and weed control and crop yield data are given in Table 4. The main broad-leaf weeds were Galium aparine, Polygonum convolvulus, Atriplex patula and Myosotis arvensis. In addition, ioxynil and bromoxynil salts were compared with the esters at two sites. Hoe 22870 alone at 0.54 kg/ha a.i. and as a tank mix with the salt and ester formulations of ioxynil gave 99% control of A. myosuroides and with both formulations of bromoxynil 98% control.

Varietal tolerance of cereals

Hoe 22870 has been applied at G.S. 3 - 4 in six trials during 1975 - 76 to a total of thirty-six varieties of winter wheat, eleven winter barleys, six spring wheats, forty-six spring barleys and seven spring oat varieties at rates up to 1.4 kg/ha a.i. without adverse effect. Although there was slight initial chlorosis at 1.4 kg/ha a.i. on spring oats, this effect was quickly outgrown.

Table 4

Effect of applying broad-leaf herbicides with Hoe 22870

Compound	kg/ha a.i.	% control A. myosuroides	Broad-leaf weed score (1 - 9)	Relative yield (control = 100)
Hoe 22870	0.54	97	9	105
" + ioxynil	0.54 + 0.25	97	7.3	103
" + bromoxynil	0.54 + 0.25	96	6.2	112
" + mecoprop	0.54 + 2.7[1]	75	3.7	105
" + mecoprop	0.54 + 2.7[2]	93	4.3	105
Range of *A. myosuroides* seed heads/m^2 and crop yield, t/ha, on controls (means)		170-2800 (760)	9	2.3-5.1 (3.6)
Number of trials		7	3	3

1, tank mix; 2, mecoprop applied 7 days later

Hoe 23408

Application rate

The results of trials carried out to investigate control of *Avena* spp. in winter cereals are summarised in Table 5. In early March 1974, Hoe 23408 was included in trials where a mixed population of *A. myosuroides* and *Avena* spp. occurred, and the latter were in the 2 - 4 leaf stage at application (crop G.S. 2). In later series the crop was at G.S. 4 (mid April - early May, 1975) or 4 - 5 (mid April - early May, 1976) at which time the growth stage of *Avena* spp. was early tillering and early - mid tillering respectively.

Table 5

Percentage control of *Avena* spp. panicles and relative crop yield

Compound	kg/ha a.i.	% control 1974	1975	1976	relative yield (control = 100) 1974	1975	1976
Hoe 23408	0.90	93	96	75	123	113	110
"	1.1	-	98	80	-	113	112
"	1.3	96	98	-	126	111	-
"	1.8	97	98	-	126	112	-
Difenzoquat	1.0	-	94	88	-	111	113
Benzoylprop-ethyl	1.1	-	91	-	-	109	-
Range of *Avena* spp. panicles/m^2 and yields, t/ha, on controls (means)		6-43 (29)	20-280 (100)	10-270 (80)	2.1-5.7 (4.5)	1.9-6.4 (4.6)	2.9-4.4 (3.4)
Number of trials		3	6	8	3	5	6

There was no visible effect on *Avena* spp. until 7 - 10 days after application when the plants developed chlorotic mottling on the leaves. Later there was a change of leaf colour, the leaves often showing a reddish or yellow tinge. Also, root growth had been considerably suppressed since the plants could easily be severed at the soil surface.

Timing trials

In 1976 trials were made with Hoe 23408 applied at different times at the same site. The results are summarised in Table 6. At 2.2 kg/ha a.i. Hoe 23408 caused some initial chlorosis on the crop when applied at G.S. 3 or 4, although these effects were usually outgrown.

Table 6

Percentage control of *Avena* spp. panicles and relative cereal yields following application with Hoe 23408 at different times

Date Crop Stage (G.S.)	*Avena* spp. stage	Compound	kg/ha a.i.	% control	Relative yield (control = 100)
Mid April 3 - 4	1 - 5 leaf	Hoe 23408	1.1	95	113
		"	2.2	97	110
		difenzoquat	1.0	90	113
Late April-Early May 4 - 5	4 lf - tillering	Hoe 23408	1.1	77	109
		"	2.2	88	107
		difenzoquat	1.0	84	118
Early-mid May 5 - 6	4 lf - shooting	Hoe 23408	1.1	57	108
		"	2.2	58	103
		difenzoquat	1.0	86	107
Range of *Avena* spp. panicles/m^2 and yield, t/ha, on controls (means)				11-390 (110)	2.9-5.4 (3.8)
Number of trials				6	3

Mixtures with broad-leaf herbicides

Trials similar to those carried out with Hoe 22870 were made with Hoe 23408 in 1976 to investigate the effect of adding broad-leaf herbicides on control of *Avena* spp. (Table 7). None of the treatments, which were applied at G.S. 4 - 5 of the crop and tillering of *Avena* spp., affected crop vigour in any of the trials.

Table 7

Effect of applying broad-leaf herbicides with Hoe 23408

Compound	kg/ha a.i.	% control *Avena* spp.	Relative crop yield (control = 100)
Hoe 23408	1.1	82	109
" + ioxynil ester	1.1 + 0.25	86	108
" + bromoxynil ester	1.1 + 0.25	80	108
" + mecoprop	1.1 + 2.7^1	46	104
" + mecoprop	1.1 + 2.7^2	77	110
Range of *Avena* spp. panicles/m^2 crop yields, t/ha, on controls (means)		33-290 (100)	3.1-5.3 (4.0)
Number of trials		6	4

1, tank mix; 2, mecoprop applied 7 days later

In two of the trials salt and ester formulations of ioxynil and bromoxynil as tank mixes with Hoe 23408 were compared. Hoe 23408 alone at 1.1 kg/ha a.i. gave 81% control of Avena spp., with esters of ioxynil and bromoxynil 84 and 76%, respectively, and 83% control with both formulated as salts.

Varietal tolerance of cereals

Applications were made to a range of cereal varieties in six trials during 1975 - 76 at approximately G.S. 4 with Hoe 23408 at rates up to 2.2 kg/ha a.i. In all, thirty-seven varieties of winter wheat and nine winter barleys were treated together with ten spring wheats and thirty-six spring barleys. At the highest rate applied, slight leaf chlorosis was evident on winter wheats 7 - 10 days after application and although this was soon outgrown most varieties showed a slight height reduction throughout the season. On winter and spring barleys at 2.2 kg/ha a.i. small brownish areas occurred on the leaves, but the plants quickly grew away from this initial effect. Spring wheats were unaffected at all dosage rates tested.

Control of A. myosuroides

In six trials sprayed in early March 1974, Hoe 23408 at 1.3 kg/ha a.i. gave, on average, 92% control of A. myosuroides which was treated at the early-tillering stage. In the same trials, Hoe 22870 at 0.54 kg/ha a.i. gave 96% control.

DISCUSSION

Control of A. myosuroides with Hoe 22870 was similar to that obtained in Germany by Schwerdtle and Schumacher (1975) and Schwerdtle et al (1975), a rate of 0.54 kg/ha a.i. consistently giving over 95% reduction in numbers of seed heads. It was equally effective applied in winter, before all plants had emerged, as in late spring when A. myosuroides had reached the shooting stage (Tables 1 and 3). Although the material is mainly foliar acting, the winter application clearly showed an additional residual effect, which Richardson et al (1976) also demonstrated in glasshouse tests. The high activity of Hoe 22870 enabling A. myosuroides to be controlled at a relatively late stage of development was an outstanding feature of this compound. Being mainly foliar acting it also gave good control under dry soil conditions when urea-based materials are less effective e.g. isoproturon applied in the late spring of 1976 (Table 1). Although Hoe 22870 gave better control of A. myosuroides than did isoproturon, the latter often produced the higher yield response (Table 2). This appeared to be due to control of Avena spp. and broad-leaved weeds which occurred in some trials by isoproturon.

There is a high degree of tolerance to Hoe 22870 in both winter and spring varieties of wheat, barley and oat, enabling A. myosuroides to be controlled post-emergence in oats and spring cereals where existing materials generally cannot be used. Glasshouse trials (Richardson and Parker, 1976) have also shown broad-leaf crops to be tolerant to Hoe 22870 and possibilities exist for its use in crops drilled in autumn or early spring where A. myosuroides may occur. Examples are field beans, oil-seed rape and sugar beet, and Schwerdtle and Schumacher (1975) have reported results from German trials in sugar beet.

Although Hoe 23408 was effective against A. myosuroides at the early-tillering stage, higher rates were needed than for Hoe 22870 and only the latter controlled plants in a more advanced stage of growth. Unlike Hoe 22870, however, Hoe 23408 controlled Avena spp. Applied at G.S. 2 of the crop in 1974 over 90% reduction in panicle numbers was obtained with all rates examined (Table 5). High yield responses in these trials were probably due to additional control of A. myosuroides. Applied somewhat later in 1975 (G.S. 4) excellent control of Avena spp. was obtained with 0.9 kg/ha a.i. In 1976, when applications were made slightly later than in

1975, control with both Hoe 23408 and difenzoquat was less good. From the timing trials carried out in 1976 (Table 6) it was found that applications made at G.S. 3 - 4 were the most effective and confirms that Hoe 23408 in Table 5 was applied slightly too late to obtain optimum results. Possibly translocation of the chemical may have been reduced by the relatively dry conditions in 1976. Preliminary trials in spring cereals have given encouraging results, and over 90% control of *Avena* spp. was obtained in spring wheat and barley in Germany by Schumacher and Schwerdtle (1975) with 0.9 kg/ha a.i.

There was no evidence of varietal susceptibility to Hoe 23408 of winter and spring wheats and barleys but unlike Hoe 22870 it cannot be used in cultivated oat. A range of broad-leaf crops are also tolerant (Richardson and Parker, 1976) and results in peas and broad beans are reported at this Conference (King and Handley, 1976). Schumacher and Schwerdtle (1975) earlier reported results of *Avena* control in sugar beet with Hoe 23408.

Although neither Hoe 22870 nor Hoe 23408 will control broad-leaved weeds, tank mixes with salt or ester formulations of ioxynil and bromoxynil are possible. However, with mecoprop there was antagonism which was reflected in reduced control of *A. myosuroides* with Hoe 22870 (Table 4) and *Avena* spp. with Hoe 23408 (Table 7). Control of broad-leaved weeds, however, was unaffected when mecoprop was applied as a tank mix with Hoe 22870 (Table 4). An interval of 7 days would seem to be required between the grass herbicide and mecoprop to eliminate this antagonistic effect. Work on further mixtures is continuing.

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CHEMICAL CONTROL OF ALOPECURUS MYOSUROIDES IN WINTER CEREALS

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Summary Four herbicides were compared at seventeen winter wheat sites and two winter barley sites in harvest years 1975 and 1976. Timings of applications of chlortoluron and iso-proturon were compared in both years. Early post emergence applications of both chemicals to winter wheat gave better *A. myosuroides* control and better yields than pre emergence applications. Half rate applications of these chemicals gave poor weed control on winter wheat sites particularly where there were substantial infestations but a worthwhile yield response. Hoe 22870 and iso-proturon proved to be effective in controlling well tillered *A. myosuroides* quite late in the season.

In direct drilling situations pre emergence treatments were less effective than on cultivated sites but early post emergence treatments were equally effective.

INTRODUCTION

This series of trials is part of a programme of work undertaken by ADAS Eastern Region Agronomy Department to compare the effectiveness of a range of herbicides on weeds in a range of crop plants over many different soils, seasons and weed infestation situations. The information and experience gained is used directly in advice to the Agricultural community.

The 1975 series was confined to winter wheat but the increasing acreage of winter barley on *A. myosuroides* infested land prompted three experiments on winter barley in 1976. The current interest in direct drilling has raised the question of whether soil acting herbicides would be effective in these conditions. The series includes 5 experiments where direct drilling was practised.

Extremes of weather and soil conditions during the autumns of recent years have created difficulties over the use of herbicides at that time in winter cereals. A range of timings of both chlortoluron and iso-proturon were included to evaluate the flexibility of these herbicides.

METHOD AND MATERIALS

Eight trials were completed in 1975 and ten in 1976. All the trials were superimposed on commercial crops where naturally occurring infestations of *A. myosuroides* were expected.

The herbicides used are listed in Table 1. Site details, treatment application dates, stage of growth of the winter wheat and *A. myosuroides* are given in Tables 2 and 3.

Plot size was 10 m x 2.7 m and all treatments were applied using a modified van der Weij sprayer with size '00' fan jets at a pressure of 2.2 bar. Application rate was 225 l/ha. A randomised block with three replications was used.

Treatment effects were assessed by removing all the A. myosuroides plants in a number of quadrats in late May/June. The total length of seed heads was then measured to give both some indication of seed return and weed competition. Crop yields were measured by a sample harvest technique in the remainder of the plot.

The assessment of length of seed head gives a measure of seed return. In relation to degree of infestation more than 30 m/m^2 is considered heavy, 10–30 m/m^2 moderate and less than 10 m/m^2 as light infestation. In most circumstances with reasonable crop competition 10 m/m^2 relates to a spring plant population of about 50 m^2, a level at which an economic response to herbicide application is likely. These figures are average and will vary with degree and vigour of tillering which in turn is affected by crop density and vigour.

Table 1

Treatments

1975 Common name	Applied	Rate ai kg/ha	1976 Common name	Applied	Rate ai kg/ha
1 Chlortoluron	Pre em	3.6	1 Chlortoluron	Pre em	3.6
2 Iso-proturon	Pre em	2.5	2 Iso-proturon	Pre em	2.5
3 Chlortoluron	Pre em	1.8	3 Chlortoluron	Pre em	1.8
4 Iso-proturon	Pre em	1.3	4 Iso-proturon	Pre em	1.3
5 Chlortoluron	Early post em	3.1	5 Chlortoluron	Early post em	3.1
6 Iso-proturon	Early post em	2.1	6 Isoproturon	Early post em	2.1
7 Chlortoluron	Post em	3.1	7 Chlortoluron	Post em	3.1
8 Iso-proturon	Post em	2.1	8 Iso-proturon	Post em	2.1
9 Chlortoluron	Spring	2.7	9 Chlortoluron	Spring	2.7
10 Iso-proturon	Spring	2.1	10 Iso-proturon	Spring	2.1
11 Hoe 22870	Spring	0.5	11 Iso-proturon	Spring	2.1
12 Hoe 22870	Late spring	0.5	12 Metoxuron	Spring	4.0
13 Iso-proturon	Spring	2.1	13 Iso-proturon	Late spring	1.9
14 Metoxuron	Spring	3.6	14 Hoe 22870	Late spring	0.5
15 Iso-proturon	Late spring	2.1	15 Hoe 22870	v. late spring	0.5
16 Iso-proturon	Spring	1.9	16 Iso-proturon	v. late spring	2.1

Table 2 - Site details 1975

Site:-	1	2	3	4	5	6	7	8
Soil texture:-	ZyCL	CL	ZyCL	CL	CL	CL	ZyCL	ZyCL
Variety:-	Bouquet	Bouquet	Atou	Atou	Bouquet	Bouquet	Joss Cambier	Bouquet
Date drilled:-	21/10	21/10	25/10	6/11	24/9	15/10	26/10	14/10
Seedbed at first spray:-	Cloddy sticky	Very cloddy	Sticky	Good moist	Good moist	Direct drill sticky	Direct drill dry	Direct drill sticky
Treatment dates	(Growth Stages of Crop and A. Myosuroides given in ZADOKS Scale)							
1 2 3 4 (pre em)	21/10	28/10	4/11	7/11	3/12	18/10	31/10	16/10
5 6	26/11	27/11	26/11	6/12	3/12	29/11	4/12	26/11
GS Crop	11	11	11	11	11	11-12	11-12	11-12
GS A. myosuroides	11	11	11	11	11	11	11	11
7 8	30/11	31/12	30/12	17/1	6/2	2/1	3/1	30/12
GS Crop	12	13	13	13	13-15	13-14	13	13
GS A. myosuroides	12	11-12	12-13	22	11-17	12	13	13
9 10 11 13 14 16	3/4	18/4	3/4	18/4	23/4	18/4	29/4	3/4
GS Crop	27	27	28	28	28	29	28	27
GS A. myosuroides	17	21	21	27	21	25-26	21	21
12 15	30/4	12/5	30/4	14/5	15/5	15/5	14/5	30/4
GS Crop	30	31	30	31	31	31	29	30
GS A. myosuroides	27	30	29	26	26	41	52	26
Dry wt A. fatua panicles (gm/m^2) on untreated control	79.3	77.0	173.1	20.0	-	45.5	16.2	45.8

Table 3 - Site details 1976

Site:-	1	2	3	4	5	6	7	8	9	10
Soil texture:-	CL	CL	SCL	CL	ZyL	ZyL	Org ZyL	ZyCL	SCL	ZyL
Variety:-	Bouquet	Bouquet	Maris Freeman	Bouquet	Flinor	Bouquet	Flinor	Bouquet	Maris Otter	Maris Otter
Date drilled:-	3/10	3/10	13/10	18/10	15/10	5/11	28/10	21/11	22/10	22/10
Seedbed at first spray:-	Direct drilled	Good	Very cloddy	Cloddy	Direct drilled	Very cloddy hard	Direct drilled	Cloddy	Very good	Good
Treatment dates	Growth stages of crop and *A. myosuroides* given in ZADOKS scale									
1 2 3 4 (pre em)	6/10	6/10	13/10	21/10	20/10	7/11	3/11	21/11	23/10	23/10
5 6	28/10	31/10	15/12	15/12	6/11	10/12	10/12	29/12	18/11	6/11
GS Crop	12	12	11–13	11	11–12	11	11	11	11	11
GS *A. myosuroides*	12	12	11–13	11–12	11	none	11	11		
7 8	12/12	12/12	16/1	16/1	10/2	10/2	10/2	10/2	29/12	16/1
GS Crop	13	13	13	13	21	13–14	13–14	12–13	13–14	14
GS *A. myosuroides*	13	13	13	13	21	13	11–13	11–13		
9 10 11 12	11/3	11/3	15/3	14/3	12/4	2/4	2/4	2/4	23/3	23/3
GS Crop	26	26	21	15–16	29	29	26	21	29	29
GS *A. myosuroides*	26	21	21	21	21	26	21	21		
13 14	22/4	22/4	22/4	28/4	29/4	28/4	28/4	28/4	12/4	12/4
GS Crop	31	31	31	31	30	30	30	29	30	31
GS *A. myosuroides*	27	27	22	27	39	27	22	22		
15 16	29/4	29/4	6/5	7/5	7/5	10/5	13/5	13/5	6/5	6/5
GS Crop	31–32	31–32	32	31	31	31–32	37	31–32	30–31	31–32
GS *A. myosuroides*	30	30	41	41	41	49	31	27		
A. fatua per m^2 on untreated control	-	-	52	8	-	-	62	-	-	-

Sites 1 – 8 Winter Wheat   Sites 9 10 Winter Barley

Table 4 - Grain yield as percentage of control yield 1975

Treatment	Site								
	1	2	3	4	5	6	7	8	**Mean**
Control t/ha	3.63	4.20	2.99	4.76	5.50	4.42	2.35	4.13	%
1. Chlortoluron	91	123	146	105	-	130	148	140	126
2. Iso-proturon	107	121	161	106	-	114	146	135	127
3. Chlortoluron	84	111	117	99	131	120	148	132	118
4. Iso-proturon	91	115	97	109	113	107	139	129	113
5. Chlortoluron	123	127	145	100	119	146	186	137	135
6. Iso-proturon	122	117	135	110	111	128	188	132	130
7. Chlortoluron	108	144	158	111	128	144	171	146	139
8. Iso-proturon	115	142	151	105	118	145	183	128	136
9. Chlortoluron	106	125	102	108	108	123	134	107	114
10. Iso-proturon	101	111	122	114	102	138	153	100	118
11. Hoe 22870	127	94	129	98	110	118	160	99	117
12. Hoe 22870	115	85	106	95	115	101	154	106	110
13. Iso-proturon	94	110	99	102	104	127	144	83	110
14. Metoxuron	103	117	89	108	117	124	134	99	111
15. Iso-proturon	136	95	126	104	98	115	117	128	115
16. Iso-proturon	107	116	125	107	102	115	141	108	115
SE Comparison between treatments and control:-	19.5	7.5	15.8	3.5	8.0	11.7	11.6	9.3	
SE comparison between treatments:-	13.8	5.3	11.2	2.4	5.6	8.3	8.2	6.6	

Table 5 - Grain yield as percentage of control yield 1976

Treatment	Site											
	1	2	3	4	5	6	7	8	**Mean**	9	10	**Mean**
Control t/ha	1.18	3.44	2.02	2.72	3.86	3.55	2.54	2.24	%	3.12	4.28	%
1. Chlortoluron	230	106	138	119	112	116	101	134	132	132	112	122
2. Iso-proturon	222	111	123	117	105	100	113	113	126	134	117	126
3. Chlortoluron	149	108	103	114	110	106	106	105	113	133	111	122
4. Iso-proturon	144	98	158	138	110	101	106	104	120	111	121	116
5. Chlortoluron	246	107	152	125	111	121	110	123	137	156	113	135
6. Iso-proturon	217	111	151	146	107	115	133	126	138	138	122	130
7. Chlortoluron	217	112	158	125	108	97	122	132	134	123	97	110
8. Iso-proturon	264	109	162	131	108	105	151	129	145	147	114	131
9. Chlortoluron	149	102	103	106	110	106	117	135	116	111	116	114
10. Iso-proturon	211	103	94	112	110	109	106	108	119	111	116	114
11. Iso-proturon	225	112	115	103	108	96	107	118	123	117	103	110
12. Metoxuron	153	102	139	111	110	102	108	103	116	107	115	111
13. Iso-proturon	123	97	115	103	99	106	104	125	109	104	92	98
14. Hoe 22870	184	103	129	95	95	90	109	104	114	101	108	105
15. Hoe 22870	146	111	128	98	101	104	97	92	110	115	104	110
16. Iso-proturon	122	100	135	95	96	98	111	138	112	106	90	98
SE comparison between treatments and control:-	19.8	8.7	14.1	8.4	4.7	8.8	24.5	11.7		7.0	6.8	
SE comparison between treatments:-	14.0	6.1	10.0	5.9	3.3	6.2	17.4	8.3		5.0	4.8	

Table 6 - Alopecurus myosuroides,percentage control 1976

Treatment		Site											
		1	2	3	4	5	6	7	8	Mean wheat	9	10	Mean barley
Control m/m^2		217.49	121.94	55.58	85.40	9.50	10.82	5.8	21.52		41.34	6.74	
1.	Chlortoluron	24	77	65	94	96	94	93	75	77	99	99	99
2.	Iso-proturon	37	88	96	98	94	96	99	85	87	96	100	98
3.	Chlortoluron	0	0	53	74	59	71	89	51	50	91	95	93
4.	Iso-proturon	19	69	77	49	69	83	88	48	63	68	96	82
5.	Chlortoluron	30	88	93	90	94	93	91	87	83	99	98	99
6.	Iso-proturon	56	77	99	98	95	100	98	92	90	99	97	98
7.	Chlortoluron	50	49	83	54	57	88	76	27	61	100	98	99
8.	Iso-proturon	58	87	92	84	98	91	87	73	84	100	99	100
9.	Chlortoluron	23	52	20	6	50	80	15	2	31	76	66	71
10.	Iso-proturon	33	52	55	42	66	89	55	7	50	90	85	88
11.	Iso-proturon	65	76	0	74	74	91	46	37	58	91	98	95
12.	Metoxuron	17	51	4	40	66	85	37	47	43	87	93	90
13.	Iso-proturon	67	49	49	33	51	93	76	42	58	95	94	95
14.	Hoe 22870	88	94	97	82	80	90	91	93	89	99	99	99
15.	Hoe 22870	85	78	85	58	62	76	89	74	77	62	92	77
16.	Iso-proturon	71	69	70	45	41	95	75	68	67	13	99	56

The assessment of length of seed head gives a measure of seed return. In relation to degree of infestation more than 30 m/m^2 is considered heavy, 10-30 m/m^2 moderate and less than 10 m/m^2 as light infestation. In most circumstances with reasonable crop competition 10 m/m^2 relates to a spring plant population of about 50 m^2, a level at which an economic response to herbicide application is likely. These figures are average and will vary with degree and vigour of tillering which in turn is affected by crop density and vigour.

Table 7 - Alopecurus myosuroides, percentage control 1975

Treatment	Site								
	1	2	3	4	5	6	7	8	Mean
Control m/m^2	17.08	0.28	38.48	8.95	4.46	9.87	38.34	16.29	%
1. Chlortoluron	60	96	73	94	-	52	55	91	74
2. Iso-proturon	82	50	88	92	-	55	71	82	74
3. Chlortoluron	72	71	44	81	97	44	45	79	67
4. Iso-proturon	82	61	69	67	96	36	10	97	65
5. Chlortoluron	73	93	91	97	100	96	88	96	92
6. Iso-proturon	73	89	95	97	95	94	94	99	92
7. Chlortoluron	64	89	93	92	99	95	85	97	89
8. Iso-proturon	94	72	96	84	100	98	95	96	92
9. Chlortoluron	61	89	37	82	98	54	64	21	63
10. Iso-proturon	16	72	64	96	100	93	52	62	69
11. Hoe 22870	26	100	75	98	100	97	96	97	95
12. Hoe 22870	100	100	98	90	92	82	98	99	95
13. Iso-proturon	16	100	50	90	100	95	77	15	68
14. Metoxuron	22	100	0	92	95	72	19	54	57
15. Iso-proturon	32	96	80	61	74	75	51	89	70
16. Iso-proturon	13	100	28	88	92	76	46	65	64

DISCUSSION

The two seasons concerned were highly contrasting with very wet soil conditions in 1974/75 and extraordinary dry conditions prevailing throughout most of the winter of 1975/76 with soil surfaces only being sufficiently moist for adequate soil acting herbicide activity in late December early January. The pattern of weed control was very different with a much lower level of control in the very dry season, particularly from the earlier treatments with chlortoluron and iso-proturon. The yield response from this limited weed control was worthwhile.

In both years the weed control from the post emergence treatments of chlortoluron and iso-proturon (treatments 5, 6, 7, 8) showed a general improvement on the pre emergence treatments on most sites, confirming the trials reported by Hubbard and Livingston (1974).

This led to improved yield response in about half the experiments. Although there was some slight crop check from iso-proturon applied early post emergence (treatments 6 and 8) on some sites this was apparently of no significance in the final yield.

The rising cost of herbicides prompted the testing of half dose rates of chlortoluron and iso-proturon pre emergence (treatments 3 and 4) in both seasons. A. myosuroides control was invariably inadequate but there was a worthwhile yield response in both seasons.

The need for adequate crop competition in securing worthwhile weed control was again illustrated at site 1 in 1976. The crop was very thin (yield level 1.25 t/ha) and only the spring applied foliar acting herbicides were effective.

A. myosuroides control on the direct drilled sites was very variable. Infestation level on the three 1975 sites were moderate to high and the pre-emergence treatments of iso-proturon and chlortoluron gave very poor control on two sites but 80% + control on the remaining site. The post emergence application of both of these chemicals were reasonably effective on all sites presumably because of the larger element of foliar uptake of the herbicide.

Because of the late season and very wet soil conditions, the 1975 spring treatments of all chemicals (treatments 9-16) were extremely late (3/4 to 15/5). Weed control was variable but surprisingly good in some experiments particularly with Hoe 22870, although yield responses were considerably reduced compared with earlier applications in virtually all experiments. In the 1976 experiments where the applications were more timely A. myosuroides control was generally poor with chlortoluron and metoxuron, reasonable with iso-proturon and good with Hoe 22870. The yield response from this spring foliar applied herbicide although worthwhile was always considerably less than the best earlier treatments indicating that the overwintering competition from A. myosuroides significantly affects yields. Thus the place of spring applied Hoe 22870 would seem to be to control the low infestations, use as a sequential application where an earlier application has not been entirely successful or as a sure spring treatment where for some reason no previous treatment has been attempted.

The winter barley results indicated a full tolerance of the chemicals used and an excellent pattern of weed control and yield response similar to that obtained in winter wheat in previous year. The pre emergence and early post emergence treatments gave excellent weed control at two contrasting sites but both weed control and in particular yield response became less with later applications.

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References

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