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POST-EMERGENCE CONTROL OF WILD OATS (AVENA FATUA) AND COUCH (AGROPYRON REPENS) IN VINING PEAS

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Summary In 1978, four replicated experiments were carried out in commercial crops of vining peas for processing, to assess the usefulness of alloxydim-sodium and dichlofop-methyl in controlling *Avena fatua*, and alloxydim-sodium and trifop-methyl in controlling *Agropyron repens*. Alloxydim-sodium and dichlofop-methyl gave good control of wild oats, but control was less reliable with dichlofop-methyl when applied to wild oats after the tillering growth stage. Both materials were safe to the crop. Excellent control of *Agropyron repens* was achieved with alloxydim-sodium and trifop-methyl. Initial effects of the latter on the peas were severe, although final yields were not reduced significantly.

Résumé En 1978, on a fait quatre expériences répétées sur une culture commerciale des pois, pour estimer l'utilité d'alloxydim-sodium et dichlofop-methyl dans la lutte contre *Avena fatua* et d'alloxydim-sodium et trifop-methyl contre *Agropyron repens*. Alloxydim-sodium et dichlofop-methyl ont maitrisé bien la folle avoine, mais le contrôle était moins efficace quand dichlofop-methyl était appliqué sur la folle avoine au stade de tallage. Tous les deux applications étaient inoffensives aux pois. Une excellente maitrise de *Agropyron repens* résultait de l'application d'alloxydim-sodium et de trifop-methyl. Le premier effet de trifop-methyl sur les pois était sévère même à la moindre dose (1.4 kg a.i./ha), bien que le rendement final ne fût pas diminué.

INTRODUCTION

Peas are unable to compete effectively with wild oats (*Avena fatua*) and in me situations with couch (*Agropyron repens*). Heavy infestations of wild oats can sult in yield reduction of over 60% (Gargouri & Seeley, 1972). If these weeds e not controlled, serious problems can occur during vining; stoppages are caused, rk rate reduced, harvest losses are increased and extra cleaning of the viners is quired.

Effective treatments using applications of tri-allate liquid incorporated e-sowing (Armsby & Gane, 1962, 1964), or tri-allate granules pre-sowing or e-emergence (King, 1976), are available for wild oat control. However, corporation techniques are not always possible under adverse soil and weather nditions, and in any event wild oat populations can be unpredictable. Post-ergence treatment with barban (Armsby & Reynolds, 1960; Armsby & Gane, 1962, 1964) s been used for many years in peas, but the material is not highly selective, and lies partly on crop competition for its full effect. Dichlofop-methyl post-ergence gives excellent control of wild oats (King & Handley, 1977), and has ttle adverse effect on the peas even at three times the recommended dose, but application must be made before tillering growth stage for the wild oats for maximum effect.

Existing methods for control of couch in peas were limited to cultivations, autumn application of dalapon, TCA and paraquat, or pre-emergence paraquat in the spring. Now clearance has been given for the use of glyphosate which may be applied to couch in the autumn or spring, but there are no means of selective post-emergence control of Agropyron repens in peas.

In 1977, a preliminary experiment showed trifop-methyl to be a highly effective post-emergence treatment against couch, and although the peas showed severe initial damage, yields were not reduced. Screening tests at the Weed Research Organisation (Richardson & Parker, 1978), showed another post-emergence material, alloxydim-sodium to be active against wild oats and couch, and selective in peas. Preliminary field experiments at PGRO showed tolerance of the susceptible pea variety Vedette to doses of over 2.4 kg a.i./ha of alloxydim-sodium and 2.0 kg a.i./ha of trifop-methyl. Therefore in 1978, four replicated experiments were carried out in vining peas, two evaluating wild oat control using alloxydim-sodium and dichlofop-methyl, and two to assess couch control, using alloxydim-sodium and trifop-methyl.

METHOD AND MATERIALS

In 1978 experiments with randomised block layout and four replications were carried out in commercial crops of vining peas. Dichlofop-methyl (36% w/v e.c. formulation) and alloxydim-sodium (75% w/w w.p.) were used to control wild oats in peas cv. Galaxie on a very fine sandy loam soil at Magdalen, Norfolk (site 1) and on a clay loam at Thorpe Latimer, (Lincs.), (site 2) in cv. Dark Skinned Perfection. Trifop-methyl (36% w/v e.c.) and alloxdim-sodium were applied to control couch on a very fine sandy loam at Coldham, Cambs. (site 3) in peas cv. Dark Skinned Perfection, and on a clay loam at Potton, Beds. (site 4) in cv. Scout. Before treatment, assessments were made for growth stages of the crop, wild oats and couch and for populations of wild oats and numbers of couch shoots, these are shown in table 1.

Table 1

Crop, wild oat & couch assessments before spray application

Site	Treatment date	Crop assessments: Height cm.	Crop assessments: No. expanded leaves	Wild oat assessments: Leaf wax	Wild oat assessments: Plants No/m^2	Growth stage
1	5/6	13	6	Poor	2*	Mainly tillering, upto 4 tillers 15 cm high, a few 2 leaf stage.
2	23/5	10	4	Good	4	Mainly 2 to 3 leaf stage.
				Couch assessments	Shoots No/m^2	
3	11/5	10	4	Moderate	206	13 cms high range just emerging to 20 cms & tillering.
4	9/5	5	2	Moderate	57	5-10 cms high, 2-3 leaves.

The materials were applied with a van der Weij plot sprayer and Birchmeier cone nozzles using 220 l/ha water, and a pressure of 2.1 kg/cm^2. Plot size was 10 m^2. Assessments were made after application and during the season for effects on the crop, and for wild oat and couch control. Broad-leaved weeds were controlled with approved post-emergence herbicides at least seven days after application of the experimental materials. At harvest, for sites 1 and 2 the number and weights of wild oat plants and panicles were recorded. At sites 3 and 4 the number of couch shoots were recorded at harvest and samples of rhizomes taken from each treatment at site 4. Sections of rhizomes were tested for viability to see whether they had been killed by chemical uptake. The peas were harvested at the green freezing stages of maturity, and threshed using a plot viner. Pea yields were measured and maturity recorded using a tenderometer.

Samples of peas from plots treated with alloxydim-sodium at different sites were canned or frozen and the produce assessed for possible taints by the Campden Food Preservation Research Association. Further samples were taken for residue analysis.

RESULTS

Crop effects

Peas were healthy and had moderate or good pea wax at the time of treatment, with the exception of those at site 1, which had suffered primary infection with downy mildew (*Peronospora viciae*). Assessments for crop damage were made on several occasions after application, and are shown in Tables 2 and 3.

Table 2

Crop assessments

Material	Rate kg a.i./ha	Site: / Date:	1 16/6	2 7/6	1 30/7	2 2/8
alloxydim-sodium	0.75		9.7	9.1	10	10
"	1.00		9.2	8.7	10	10
"	1.25		8.2	8.0	10	10
"	2.50		6.7	7.2	10	10
dichlofop-methyl	1.25		9.0	9.0	10	10
untreated	-		10.0	10	10	10

Key: 0 = no crop damage, 7 = acceptable, 10 = no effect.

Slight stunting and speckled necrotic spots on lower leaves were observed on plots treated with alloxydim-sodium. The stunting increased for the higher rates, but even here the effects were only temporary and had grown out before harvest. In spite of the poor wax on pea leaves at site 1, there was little effect on the crop. Only a very slight distortion of upper leaves was observed from dichlofop methyl and crop effects were negligible.

Table 3

Crop assessments

Material	Rate kg a.i./ha	Site: Date:	3 16/5	4 29/5	3 30/5	4 20/6	3 31/7	4 19/7
alloxydim-sodium	1.13		9.0	9.0	9.5	9.5	10	10
"	1.69		8.5	9.0	9.2	9.5	10	10
"	2.25		8.5	8.5	9.1	9.0	10	10
trifop-methyl	1.40		8.1	8.6	9.2	9.0	10	10
"	2.00		6.8	8.2	8.0	9.0	10	10
"	2.80		6.2	7.0	6.9	8.8	10	10
Untreated	-		10	10	10	10	10	10

Key: 0 = no crop damage, 7 = acceptable, 10 = no effect.

At sites 3 and 4 similar effects were observed for alloxydim in the form of slight chlorosis and necrosis on lower leaves, but the crop soon recovered. The effects of trifop-methyl were more damaging and resulted in epinasty of the growing points of the crop, folded leaves and twisted tendrils. At the higher rates epinasty on newly developing foliage was more severe and damage in the form of stunting, necrosis on lower leaves and loss of 'bloom' on the crop was observed. These effects remained for some time, but the crop recovered by harvest.

Control of wild oats

The results of wild oat counts and measurements of weight of the plants appear in table 4.

Table 4

Percentage reduction in number and weight of wild oat plants & panicles

Material	Rate kg a.i./ha	Site:	% reduction No. plants 1	2	Wt. plants 1	2	No. panicles 1	2	Wt. panicles 1	2
alloxydim-sodium	0.75		88	88	95	17	99	98	99	99
"	1.00		99	93	100	97	100	97	100	98
"	1.25		88	99	96	99	100	98	99	99
"	2.50		94	100	98	100	99	100	99	100
dichlofop-methyl	1.25		57	88	78	96	80	93	80	94
L.S.D. @ P =0.0			62.9	22.4	34.9	28.8	56.7	38.3	57.9	38.2
Significance at P = level			0.05	0.001	0.001	0.001	0.01	0.001	0.05	0.001
S.E. as % of general mean			58.9	19.0	29.7	23.4	47.3	31.3	48.0	30.9
No. wild oats or panicles on untreated /m^2			1.7	3.6	-	-	96	3.4	-	-
Wt. " " " tonnes/ha			-	-	1.33	1.58	-	-	0.06	0.14

Table 4 shows that both materials gave excellent control of wild oats at site 2 where they were sprayed before tillering stage. At site 1 alloxydim-sodium was very effective in reducing the numbers and weights of wild oat plants and panicles, but control of number of wild oat plants with dichlofop-methyl was poor, where the material was applied at a more advanced growth stage. However, dichlofop-methyl caused wild oat growth to be severely checked and number and weight of panicles were effectively reduced. The rate of alloxydim-sodium had no significant effect of the numbers and weights of wild oat plants and panicles.

Control of couch

The results of shoot counts appear in table 5.

Table 5

Percentage reduction in number of couch shoots at harvest

Material	Rate kg/a.i./ha		% reduction no. couch shoots	
		Site:	3	4
		Date:	31/6	19/7
alloxydim-sodium	1.13		93 ***	95 ***
"	1.69		96 ***	96 ***
"	2.25		97 ***	98 ***
trifop-methyl	1.40		95 ***	98 ***
"	2.00		97 ***	87 ***
"	2.80		96 ***	93 ***
L.S.D. @ P = 0.05			15.4	23.6
S.E. as % of general mean			12.5	19.5
No. couch shoots on untreated/m^2			219	82

* significantly different from untreated at P = 0.05
** " " " " " P = 0.01
*** " " " " " P = 0.001

It can be seen in Table 5 that at both sites there was a significant reduction in the number of couch shoots for all the treatments. There was no significant difference between the effect of alloxydim-sodium and trifop-methyl or between the rates applied.

Examination of couch rhizomes taken from each treatment at site 4, and tested for viability, showed that all those from the untreated plots sprouted whereas the majority of those treated with alloxydim-sodium and trifop-methyl had been killed and were not viable.

Other weed control

Most broad-leaved weeds appeared to be resistant to alloxydim-sodium, dichlofop-methyl and trifop-methyl with the exception of Fumaria officinalis which was controlled by trifop-methyl. Observations at site 2 showed that seedling Italian ryegrass (Lolium multiflorum) was killed by alloxydim-sodium and dichlofop-methyl at the rates tested.

Yield and maturity

The yield and maturity data appears in tables 6 and 7.

Table 6

Yield and maturity, sites 1 & 2

Material	Rate kg a.i./ha	Site:	Yield (% of untreated) 1	2	Maturity (tenderometer reading) 1	2
alloxydim-sodium	0.75		107	112	139	91
"	1.00		111	109	131	91
"	1.25		113	108	137	90
"	2.50		106	113	135	89
dichlofop-methyl	1.25		105	111	136	91
untreated			100	100	131	87
Yield of untreated (tonnes/ha)			4.7	4.5	-	-
Significance @ P = 0.05			NSD	NSD	NSD	NSD
S.E. as % of general mean			12.3	9.7	3.4	2.5

At sites 1 and 2, although there was a trend for the herbicide treatments to give higher yields than untreated plots, these differences were not statistically significant. The type of herbicide and the rate of application had no significant effect on yield. There were no significant differences in maturity at either site.

Table 7

Yield and maturity data site 4

Material	Rate kg a.i./ha	Site:	Yield (% of untreated) 4	Maturity (tenderometer reading) 4
alloxydim-sodium	1.13		116	94
"	1.69		119	94
"	2.25		110	92
"	1.40		107	94
"	2.00		107	94
"	2.80		111	92
herbicide mean	-		112 **	93
untreated	-		100	92
Yield of untreated (tonne/ha)			6.8	-
Significance @ P = 0.05			SD	NSD
S.E. as % of general mean			8.3	2.8
LSD as % of herbicide mean & untreated			5.6	-

** significant difference from untreated @ P = 0.01

Yields for site 3 are not presented since due to the wet condition of the crop losses from the viner were considerable and resulting data unreliable. At site 4 the mean of the herbicide treatments gave significantly higher yields than the untreated control. Maturity was not affected by either herbicide or rate of application and was similar for untreated and treated plots. There were no significant differences between yields for alloxydim-sodium and trifop-methyl, or rates of application.

Produce quality

Canned and frozen samples of peas from plots treated with alloxydim-sodium at different sites were assessed for taints by the Campden Food Preservation Research Association, and in 1978 no taints were found in any of the samples. Further taint data is required before the materials alloxydim-sodium and trifop-methyl can be given clearance for use on peas for processing. Dichlofop methyl has already been given taint clearance for peas.

DISCUSSION

The results of these initial experiments suggest that alloxydim-sodium can be an effective post-emergence treatment in peas for the control of wild oats, even when they are in advanced stages of tillering. The wild oat plants were affected within a few days of treatment and were eventually killed. Symptoms were in the form of necrosis, stunting and root inhibition, similar to the effect produced by dichlofop-methyl and trifop-methyl. Rates of 1.00 kg a.i./ha and above gave excellent control, and there was not much difference between control achieved with 1.00 kg a.i./ha and the 2.50 kg a.i./ha in the two experiments. Dichlofop-methyl, on the other hand, gave a complete kill of wild oats when applied before tillering, but oats at a more advanced growth stage were only partly damaged and control was not as effective. Dichlofop-methyl has been shown to have a wide margin of crop safety in previous experiments, and similarly alloxydim-sodium seems to be very selective. In the absence of crop effects, the removal of competition from wild oats could have been expected to give yield increases over the untreated control as shown in table 6, but these were not statistically significant. Alloxydim-sodium, dichlofop-methyl and trifop-methyl do not appear to affect the maturity of peas harvested at the green stage.

Both alloxydim-sodium and trifop-methyl gave more than 90% reduction in couch shoots at site 3, where visual assessments showed considerable suppression by the weed of the untreated crop, and effective control at site 4 resulting in yields which were significantly greater than untreated plots for all application rates. Tests on couch rhizomes showed that the majority had been killed by both materials. Initial effects on the peas in the form of distortion, stunting and necrosis on lower leaves were severe for trifop-methyl even at the rates of 2.0 kg a.i./ha, but eventually the crop recovered and there was no apparent loss in yield. Alloxydim-sodium appears to be a more selective material. In a preliminary screening test cv. Vedette (which shows sensitivity to many herbicides), and Maro, and at sites in 1978 using varieties Scout, Dark Skinned Perfection and Galaxie, alloxydim-sodium appeared very safe to the pea crop even at 2.5 kg a.i./ha. Tests have shown (Richardson & Parker, 1977) that there is a long period of persistence of trifop-methyl in the soil which may limit its use in peas where cereals or grass crops follow. Alloxydim-sodium could thus have an advantage, since soil persistence is comparatively short (Richardson & Parker, 1978).

It is hoped that further work will be carried out with these materials in peas and other legumes for control of wild oats and couch, at a range of growth stages, and under different growing conditions.

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DI-ALLATE AND TRI-ALLATE IN MIXTURES FOR THE CONTROL OF ANNUAL GRASSES AND BROAD-LEAVED WEEDS IN SUGAR BEET

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Summary Comparisons were made between di-allate and tri-allate alone and in tank mixture with lenacil, metamitron or chloridazon. Di-allate was similar to tri-allate in effect on the crop and weeds. These chemicals retained these similarities when tank-mixed with lenacil, metamitron or chloridazon. The intrinsic differences in weed control spectrum between lenacil, metamitron and chloridazon were also evident in these mixtures. All mixtures gave good weed control but an order of effectiveness can be given:-

metamitron mixtures > lenacil mixtures > chloridazon mixtures

Crop safety was also good but there were small differences:-

metamitron mixtures were safer than > chloridazon mixtures > lenacil mixtures.

All treatments applied gave excellent control of *Avena fatua*. Thus, where *Avena fatua*, other annual grasses and broad-leaved weeds are a problem, the use of di-allate or tri-allate in tank mixture provides an effective solution.

Résumé Des comparaisons ont été faites entre le di-allate et le tri-allate utilisés seuls et en mélange extemporané avec le lénacil, le métamitron ou le chloridazon. L'action du di-allate tant sur la culture que sur les mauvaises herbes a été identique à celle du tri-allate. Ces 2 produits ont eu le même effet lorsqu'ils ont été combinés au lénacil, au métamitron ou au chloridazon. Les différences intrinsèques en ce qui concerne le contrôle des adventices sont également apparues entre le lénacil, le métamitron et le chloridazon, dans ces combinaisons. Toutes ces combinaisons ont apporté une bonne destruction des mauvaises herbes selon l'ordre d'efficacité suivant:-

mélanges avec métamitron > mélanges avec lénacil > mélanges avec chloridazon

La sélectivité sur culture fut également bonne avec toutfois quelques petites différences:-

mélanges avec métamitron plus sélectifs que > mélanges avec chloridazon > mélanges avec lénacil.

Tous les traitements effectués ont très bien détruit *Avena fatua*. En conséquence, lorsque l'*Avena fatua*, d'autres graminées annuelles et des dicotylédones presentent un problème, l'emploi du di-allate ou du tri-allate en mélange extemporané apporte une solution efficace.

INTRODUCTION

Di-allate (AVADEX) and tri-allate (AVADEX BW) have been used successfully for sixteen years for control of Avena fatua and Alopecurus myosuroides.

Di-allate is recommended for use in sugar beet, red beet, oilseed rape, cabbage, cauliflower, Brussels sprout, kale and turnip.

Tri-allate is recommended for use in wheat, barley, peas , beans and carrots.

Both chemicals are volatile and require incorporation with soil to prevent evaporation.

In sugar beet crops, broad-leaved weeds are usually found in association with annual grasses. Di-allate gives some control of broad-leaved weeds (Bray and Hilton 1970). However, to achieve the high level of control required in sugar beet, a follow-up herbicide treatment is necessary.

Earlier work (Bray and Hilton 1970) showed that di-allate followed by pre-emergence chloridazon** at full rate, caused some reduction in beet seedling numbers and/or vigour. This was generally eliminated by following di-allate with chloridazon at two-thirds rate. Sequences of di-allate and full rate lenacil were also tried. These caused crop damage which was diminished by following di-allate with lenacil at two-thirds rate.

Following a succession of dry springs in the mid 1970's, recommendations were made for pre-drilling incorporation of several herbicides to improve weed control, where dry weather follows drilling. These recommendations applied to herbicides such as metamitron and chloridazon, which are normally applied to the soil surface. During this period a cycloate + lenacil tank-mix was introduced for pre-plant incorporation use only.

This work introduced the possibility of tank-mixes of di-allate with lenacil, metamitron or chloridazon incorporated pre-drilling for the control of annual grasses and broad-leaved weeds.

In 1978 a series of experiments were designed to investigate di-allate and tri-allate alone and in mixtures with lenacil, metamitron and chloridazon.

The location and relevant site details of these trials are listed in Table 1.

METHOD AND MATERIALS

The trials were carried out in commercial crops using 20 m^2 plots replicated four times. The treatments were applied with - trials 1, 2 and 3 - an Oxford Precision Sprayer with T-jets at 250 l/ha and a pressure of 1.4 bars. Trials 4 and 5 a Van der Weij plot sprayer with Birchmeir cone nozzles at 250 l/ha and a pressure of 2.5 bars.

The formulations used were di-allate 40% w/v, tri-allate 40% w/v, cycloate 72.7% w/v, lenacil 80% w/w, metamitron 70% w/w, chloridazon 80% w/w.

The implements used for incorporation were those normally used for final seed-bed preparation. The equipment used varied but all appeared to give adequate incorporation.

** formerly pyrazone.

Table 1

Trial Site Details

Site number	1	2	3	4	5
Site location	N.Norfolk.	Glos.	N.Yorks.	Notts.	Lincs.
Soil type	L.S	S.L	V.F.S.L.	Zy.C.L.	S.C.L.
Date of application	5/4	6/4	14/4	5/4	6/4/78
Date of drilling	5/4	6/4	15/4	6/4	7/4/78
Sugar beet variety	Nomo	Nomo	Bush mono	Vitomo	Amono/Nomo
Soil temp at applic °C	9	7	6	8	7
Air temp at applic °C	12	11	9.5	11	11
Rain after treatment mm:					
1 week	3.1	2.7	5.7	1.0	3.6
4 weeks	43.1	25.6	50.6	38.9	43.1
lenacil dose	400 g	560	720	840	720
chloridazon dose	1.36 Kg	1.76	2.4	3.2	3.2
metamitron dose	3.50 Kg	3.50	3.5	3.5	3.5
cycloate +) dose	2.04 Kg	2.33	2.54	4.00	3.63
lenacil)	400 g	440	560	840	720

L.S = Loamy sand. S.L = Sandy loam.

V.F.S.L. = Very fine sandy loam. Zy.C.L. = Silty clay loam.

S.C.L. = Sandy clay loam.

Assessments of crop stand and weed control was made soon after beet emergence, a visual score of crop vigour was made just prior to the leaves meeting in the row. Counts made were of:-

Avena fatua - whole plot; broad-leaved weeds - 4 x 0.25 m^2 quadrats /plot; crop emergence - trial 2, 4 x 5 m lengths row/plot - trials 1, 4 and 5, 5 x 1 m length row/plot.

RESULTS

Effect on sugar beet: Assessment of crop emergence (Table 2) and crop vigour (Table 3) showed that di-allate was similar to tri-allate in having little noticeable effect.

When di-allate or tri-allate were mixed with metamitron, crop safety was excellent with no appreciable reduction in crop emergence or vigour. Mixtures with chloridazon were also generally safe except in trial 5 where noticeable reductions in crop emergence (15%) and crop vigour (7%) occurred. Mixtures with lenacil caused some reduction in emergence at trials 1 and 2 (average 5%) with a 12% vigour reduction at trial 5.

The standard treatment, cycloate + lenacil, resulted in excellent crop emergence and only one instance of reduction in crop vigour (10%) at trial 5.

When examining the figures, it is obvious that the results from trial 5 are a typical. Subsequent examination of the trial area showed that although the field was a sandy clay loam, variations in soil type occurred due to small areas with a higher sand content. The result of this has been localised over-dosing.

Table 2

Sugar beet emergence as % of untreated

Treatment.	Dose Kg a.i/ha*	Norfolk.	Glos.	Notts.	Lincs.
di-allate	1.4	98	106	116	86
	1.6	91	100	121	86
tri-allate	1.4	96	102	110	84
	1.6	89	108	101	83
di-allate	1.2 + lenacil	100	97	116	91
	1.4 "	94	99	116	101
	1.6 "	102	99	114	96
tri-allate	1.2 + lenacil	85	88	118	101
	1.4 "	94	91	130	104
	1.6 "	91	100	122	99
di-allate	1.2 + chloridazon	107	103	116	92
	1.4 "	97	101	113	90
	1.6 "	109	95	117	87
tri-allate	1.2 + chloridazon	97	99	113	74
	1.4 "	105	99	117	77
	1.6 "	93	106	110	89
di-allate	1.2 + metamitron	104	100	116	92
	1.4 "	112	98	122	97
	1.6 "	110	99	117	93
tri-allate	1.2 + metamitron	110	94	117	94
	1.4 "	109	98	110	96
	1.6 "	109	95	117	95
cycloate	+ lenacil	100	109	117	110
untreated no/m length row		4.32	5.05	3.85	6.65
L.S.D. (P = 0.05)		4.3	NS	NS	NS
S.E.	+/-	2.16			

* for full details of application doses see Table 1.

Table 3

Sugar beet vigour as % of untreated

Treatment.	Dose Kg a.i/ha.	Norfolk.	Glos.	Notts.	Lincs.
di-allate	1.4	100	103	100	97
	1.6	100	101	100	100
tri-allate	1.4	100	106	100	100
	1.6	100	104	100	100
di-allate	1.2 + lenacil	98	97	99	90
	1.4 "	98	96	99	93
	1.6 "	98	98	99	82
tri-allate	1.2 + lenacil	98	93	98	90
	1.4 "	98	93	98	90
	1.6 "	98	94	98	85
di-allate	1.2 + chloridazon	100	103	98	95
	1.4 "	100	102	97	92
	1.6 "	100	101	97	82
tri-allate	1.2 + chloridazon	100	104	100	95
	1.4 "	100	104	100	100
	1.6 "	100	104	98	95
di-allate	1.2 + metamitron	100	101	99	90
	1.4 "	100	96	98	95
	1.6 "	100	97	98	92
tri-allate	1.2 + metamitron	100	93	95	90
	1.4 "	100	96	98	95
	1.6 "	100	96	96	92
cycloate	+ lenacil	98	102	99	90
untreated control		100	100	100	100
L.S.D. (P = 0.05)		NS	15.54	NS	NS
S.E.			+/- 7.77		

Effect on Avena fatua. Table 4 gives details of % weed control. In these trials, the same control of A.fatua was achieved whether di-allate or tri-allate were applied.

The mixtures can be placed in order of effectiveness:

lenacil $>$ cycloate + lenacil $>$ metamitron $>$ chloridazon.

However, all treatments gave excellent control of A. fatua.

Effect on annual broad-leaved weeds. On average tri-allate and di-allate gave similar control of broad-leaved weeds. Both gave moderate control (70% +) of Capsella bursa-pastoris, Chenopodium album, Myosotis arvensis, Polygonum persicaria, Sinapis arvensis, Solanum nigrum and Tripleurospermum maritimum spp. inodorum. However, to achieve consistently excellent weed control, mixture was necessary.

Mixture with lenacil gave good control (85% +) of Polygonum lapathifolium, S.arvensis, Stellaria media, S. nigrum and T.maritimum spp. inodorum. However, this mixture gave poor control (less than 50%) of Polygonum aviculare and Viola arvensis.

Chloridazon mixtures gave good control of P.lapathifolium, P.persicaria, S.arvensis, S. nigrum and T.maritimum spp. inodorum. Control of Polygonum convolvulus and S.media was poor.

Table 4

Weed control as % of untreated

Treatment	Dose Kg a.i/ha*.	Avena fatua	Capsella bursa-pastoris	Chenopodium album	Myosotis arvensis	Polygonum aviculare	Polygonum convolvulus	Polygonum lapathifolium	Polygonum persicaria	Silene alba	Sinapis arvensis	Stellaria media	Solanum nigrum	Tripleurospermum maritimum spp. inodorum	Urtica urens	Viola arvensis
di-allate	1.4	96	32	32	30	42	28	39	36	63	85	16	66	26	0	51
	1.6	91	53	40	51	55	30	53	50	73	52	18	35	0	0	42
tri-allate	1.4	91	0	21	47	54	29	0	60	55	74	31	50	19	14	15
	1.6	91	67	43	23	69	45	0	56	36	69	26	90	13	0	15
di-allate	1.2 + lenacil	96	89	75	76	45	53	97	75	88	93	85	97	98	82	22
	1.4 "	97	83	71	78	40	61	95	61	50	86	97	88	97	69	12
	1.6 "	98	71	63	78	52	52	86	72	50	88	68	88	94	78	48
tri-allate	1.2 + lenacil	95	79	82	72	40	51	86	51	54	82	96	88	98	84	27
	1.4 "	96	77	74	70	61	61	95	52	67	99	93	100	95	79	42
	1.6 "	97	73	66	77	40	50	95	65	75	91	88	97	94	75	24
di-allate	1.2 +chloridazon	95	83	69	72	66	45	90	79	42	86	61	93	90	69	53
	1.4 "	94	70	73	80	68	25	87	79	42	92	60	93	97	72	32
	1.6 "	91	86	82	75	52	42	73	85	42	91	49	72	95	72	41
tri-allate	1.2 +chloridazon	93	86	65	67	36	63	92	89	42	88	41	100	79	48	44
	1.4 "	95	83	61	73	55	50	89	92	94	91	23	98	95	49	35
	1.6 "	90	74	84	80	68	30	84	83	81	87	49	98	96	59	37
di-allate	1.2 +metamitron	95	99	98	96	83	15	99	92	77	68	88	94	100	99	42
	1.4 "	95	98	97	91	78	24	77	85	31	74	87	94	99	92	35
	1.6 "	95	99	90	98	83	41	92	86	62	63	58	98	99	98	35
tri-allate	1.2 +metamitron	94	99	96	95	91	7	81	79	31	62	71	90	100	98	27
	1.4 "	93	99	99	100	96	4	78	86	46	60	89	98	100	100	44
	1.6 "	92	99	97	96	91	5	95	84	46	77	68	94	99	98	42
cycloate	+ lenacil	95	88	87	85	68	53	90	76	31	99	77	69	97	65	52
number of trials		2	2	3	1	1	2	1	1	1	1	2	1	1	1	1

Metamitron mixtures gave the widest spectrum of weed control with good control of C.bursa-pastoris, C.album, M.arvensis, P.aviculare, P.lapathifolium, P.persicaria, S.nigrum, T.maritimum spp.inodorum and Urtica urens. This mixture gave poor control of P.convolvulus, V.arvensis and Silene alba.

Cycloate + lenacil gave good control of C.bursa-pastoris, C.album, M.arvensis, P.lapathifolium, S.arvensis and T.maritimum spp.inodorum. Control of S.alba was poor.

DISCUSSION

These trials have confirmed the excellent A.fatua control to be achieved with di-allate or tri-allate alone or in mixture. They have also expanded on the published data (Bray and Hilton, 1970) on control of broad-leaved weeds.

This previous work indicated that sequential applications of di-allate at two-thirds rate followed by chloridazon at two-thirds rate would result in good weed control and crop safety. The 1978 results show that these aims were achieved with tank-mixtures of di-allate or tri-allate at full rate in mixture with chloridazon at two-thirds rate.

The other major conclusion of this previous work was that sequences of di-allate at two-thirds rate followed by lenacil at two-thirds rate would also give good weed control and crop safety. Other work (Bray, 1970) showed that when incorporated, the rate of lenacil needed to be reduced by 50% to maintain sugar beet safety. 1978 results have shown that by using tri-allate or di-allate at full rate in tank-mix with one-half to one-third rate of lenacil and incorporated, good weed control and acceptable crop safety can be achieved.

Metamitron was not in commercial use when this earlier work was carried out. Results from 1978 trials establish metamitron mixtures as having excellent crop safety and weed control.

All the treatments tested resulted in excellent A.fatua control and the choice of which treatment to use in any particular instance would be decided by the expected broad-leaved weed flora. Each tank-mix having a different weed spectrum.

Therefore, where A.fatua, other annual grasses and broad-leaved weeds are a problem, the use of di-allate or tri-allate in tank-mixture provides an effective solution.

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