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INVESTIGATIONS INTO THE CONTROL OF POTATOES WITH SEVERAL POST-EMERGENCE HERBICIDES

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Summary Three pot experiments studied the performance of a number of herbicides against volunteer potatoes. Although most of them had some effect on the potatoes, bentazone, chloreturon, cyperquat, 2,4-D amine, fluothiuron and mefluidide did not achieve practical levels of control. Fosamine (6-10 kg/ha) did not damage the potato plants, or reduce tuber production but many of the daughter tubers failed to produce healthy plants. Metamitron at 8 kg/ha damaged the potato haulm. Glyphosate at 2.0 kg/ha alone and at 1.0 kg/ha when mixed with ammonium sulphate achieved complete kill. Triclopyr (0.5, 1.0 kg/ha) and 3,6-dichloropicolinic acid (0.5 kg/ha) reduced tuber production and lowered their viability. A field experiment studied the performance of these two herbicides and of several standard cereal herbicides against potatoes in a spring barley crop. The cereal herbicides had little effect on the potatoes. Although the performance of triclopyr and 3,6-dichloropicolinic acid was poorer than in the pot experiments, triclopyr at 0.75 and 1.5 kg/ha still reduced the production of viable tubers by 75%. Unfortunately both doses damaged the barley.

Résumé Le comportement de certains herbicides dans la lutte contre les pommes de terre adventices a été étudié dans trois expériences avec des plantes en pots. Le bentazone, le chloreturon, le cyperquat, l'amine du 2,4-D, le fluothiuron et le méfluidide n'ont pas atteint des niveaux de destruction satisfaisants, bien qu'ils n'aient pas été sans influence sur les pommes de terre. Le fosamine (6-10 kg/ha) n' a ni provoqué des dégâts dans les plantes-mères, ni mené a une réduction dans le nombre de tubercules-filles; cependant bon nombre de ces tubercules n'ont pas donné des plantes saines. Le métamitron à 8 kg/ha a provoqué des dégâts dans les fanes. Le glyphosate a 2 kg/ha seul, ou a 1 kg/ha + sulfate d'ammonium a donne une destruction totale. Le triclopyr (0.5 et 1 kg/ha) et l'acide 3,6 dichloropicolinique (0.5 kg/ha) ont réduit le nombre de tubercules produits, ainsi que leur pouvoir germinatif. Dans une expérience de plein champ ayant pour but la lutte contre les pommes de terre adventices dans une culture d'orge de printemps, on a étudié le comportement de ces deux désherbants et de plusieurs désherbants normalement utilisés dans les cultures céréalières. Ceux-ci ont eu peu d'influence sur les pommes de terre. Bien que l'efficacité du triclopyr et de l'acide 3,6-dichloropicolinique ait été moindre que dans les expériences en pots, le triclopyr à 0.75 et 1.5 kg/ha a quand-même diminué de 75% la production de tubercules viables. Malheureusement à ces deux doses le triclopyr a provoqué des dégâts dans l'orge.

INTRODUCTION

Volunteer potatoes or groundkeepers (Solanum tuberosum L.) are difficult to kill with existing herbicides (Lumkes, 1974; Lutman, 1974; Garnier et al., 1977; Sijtsma, 1977). Although glyphosate and aminotriazole will control potatoes (Lutman & Richardson, 1978) they cannot easily be used when the potatoes are growing in a crop. Metoxuron, which will control potatoes in carrot crops, is virtually the only post-emergence selective herbicide available. Thus other selective post-emergence compounds are required to improve the armoury of practical control measures available to farmers and growers.

The performance of new herbicides against perennial weeds is tested regularly at WRO. This paper reports the results of three pot experiments which evaluated the activity of a number of post-emergence herbicides against potatoes. The performance of two of these, triclopyr and 3,6-dichloropicolinic acid were then compared with several standard cereal herbicides in a spring barley field experiment.

METHOD AND MATERIALS

Pot experiments

Three experiments were carried out between 1975 and 1977 and were of randomised block design with three replicates. Each 25 cm pot contained one tuber (3-6 cm diameter) of the cultivar King Edward in 1975 and 1976 and Pentland Crown in 1977. The tubers were planted in May in a light sandy loam soil with added sand, peat and fertilizer and the pots were placed out-of-doors on a paved area. When the plants had started to produce tubers (Table 1) they were sprayed with the herbicide treatments using a laboratory pot sprayer delivering 200 l/ha at a pressure of 2.1 bars. Details of the herbicides tested are given in Tables 2, 3 and 4. The surfactant, Agral 90, was included in all spray solutions at 0.5% v/v final concentration. Herbicide symptoms were noted at intervals after spraying, and after 7-8 weeks the haulm was harvested and weighed. Two to three weeks later the tubers were removed from the pots, counted and weighed (Table 1). These tubers were stored over the winter and in the following spring were replanted. The percentage of tubers producing healthy plants was determined.

Table 1

Details of the three pot experiments

	1975	1976	1977
Planting date	14 May	5 May	3 May
Spraying			
Date	25 June	9 June	15 June
Stage of growth of the potatoes: Haulm	50 cm high Wt 227g/shoot	25-45 cm high Wt 175 g/shoot	18 cm high Wt 40 g/shoot
Daughter tubers	many tubers Wt 73g/tuber	many tubers up to 2 cm diam.	few tubers small
Harvest date (haulm)	14 Aug.	3 Aug.	10 Aug.
" " (tubers)	2 Sept.	26 Aug.	22 Aug.

Table 2

The effects of five herbicides in 1975 on the production of haulm and tubers by potato plants and on the viability of the daughter tubers (Figures in bracket = % of control)

Herbicide	Formul-ation	Dose (kg/ha) a.i.	Haulm fresh wt/ pot (g)	Tuber Number/ pot	Tuber Wt/pot (g)	% tubers with healthy shoots
Fosamine ammonium	48% ac	8.0	208 (81)	25 (71)	691 (90)	16
Triclopyr (triethylamine salt)	36% ac	1.0	233 (91)	27 (76)	70 (9)	1
Mefluidide	48% ec	1.0	324(122)	29 (83)	643 (84)	85
Chloreturon	75% ec	3.0	261(102)	21 (59)	101 (13)	84
Chloreturon + $(NH_4)_2SO_4$	75% ec	3.0+5.0	375(146)	42(121)	361 (47)	74
Cyperquat	36% ec	6.0	301(117)	32 (91)	345 (45)	94
Control			257(100)	35(100)	765(100)	85
Standard errors ±			32	7.4	58	

Table 3

The effects of six herbicides in 1976 on the production of haulm and tubers by potato plants and on the viability of the daughter tubers (Figures in brackets = % of control)

Herbicide	Formul-ation	Dose (kg/ha) a.i.	Haulm fresh wt/ pot (g)	Tuber Number/ pot	Tuber Wt/pot (g)	% tubers with healthy shoots
Fosamine ammonium	48% ac	5.0	195 (91)	20 (88)	585 (96)	100
		10.0	217(101)	18 (79)	602 (99)	13
Triclopyr (triethylamine salt)	36% ac	0.5	168 (78)	12 (53)	52 (9)	28
		1.0	116 (54)	3 (12)	16 (3)	25
3,6-dichloropicolinic acid (alkanolamine salt)	30% ac	0.125	211 (98)	14 (63)	246 (40)	19
		0.25	191 (89)	21 (91)	329 (54)	23
2,4-D amine	32% ac	0.75	280(130)	26(115)	495 (81)	97
		1.5	109 (51)	26(115)	491 (80)	95
Metamitron	70% wp	4.0	330(153)	29(126)	470 (77)	100
		8.0	315(146)	15 (65)	119 (20)	98
Metamitron + Actipron*	70% wp	4.0	337(157)	17 (75)	393 (64)	98
		8.0	361(168)	19 (82)	296 (49)	100
Bentazone	48% ac	5.0	304(141)	23(100)	556 (91)	88
Control			215(100)	23(100)	611(100)	82
Standard errors ±			38	4.1	93	

*Actipron = isoparaffinic oil 5% final concentration

Table 4

The production of haulm and tubers by potato plants and assessments of the viability of the tubers, following treatment with five herbicides in 1977 (Figures in brackets = % of control)

Herbicide	Formulation	Dose (kg/ha) a.i.	Haulm fresh wt/ pot (g)	Tuber Number/ pot	Tuber Wt/pot (g)	% tubers with healthy shoots
Fosamine ammonium	48% ac	3.0	61 (88)	17(108)	395(106)	34
		6.0	72(105)	16 (98)	271 (73)	0
Triclopyr (triethylamine salt)	36% ac	0.5	66 (96)	4 (23)	11 (3)	0
		1.0	49 (71)	1 (8)	3 (1)	0
Triclopyr (ester)	48% ec	0.5	49 (71)	1 (6)	1 (1)	0
		1.0	43 (62)	1 (6)	1 (1)	0
3,6-dichloropicolinic acid (alkanolamine salt)	30% ac	0.125	87(126)	17(108)	262 (70)	14
		0.25	83(121)	18(113)	195 (52)	14
Fluothiuron	25% ec	5.0	96(139)	7 (46)	221 (59)	86
Glyphosate	(MON 0139) 48% ac	1.0	58 (84)	22(136)	92 (25)	0
		2.0	30 (44)	1 (6)	2 (1)	0
Glyphosate + $(NH_4)_2SO_4$	48% ac	1.0+5.0	35 (51)	1 (8)	3 (1)	0
		2.0+10.0	9 (14)	1 (2)	1 (1)	0
Glyphosate + phosphate*	48% ac	1.0+2%	52 (75)	24(150)	71 (19)	0
		2.0+2%	10 (15)	1 (6)	1 (1)	0
Control			69(100)	16(100)	374(100)	92
Standard errors ±			10	3.5	35	

*phosphate = phosphonic acid neutralised with NaOH.

Field Experiment

On 29 March 1977 fifteen tubers (cv. King Edward) 2-3 cm in diameter, were buried approximately 5 cm deep in each 5 x 3 m plot. Spring barley (cv. Maris Mink) at 147 kg/ha was drilled into half the plots on 31 March and into the remainder on 22 April. The nine herbicide treatments (Table 5) were applied to the potatoes in the early drilled barley plots on 26 May (barley 4½-5½ leaves; 2 tillers) or on 1 June (barley 4½-6 leaves; 1-3 tillers; 1 node). Those in the late drilled barley plots were sprayed either on 1 June (barley 4-5 leaves; 1-3 tillers) or on 17 June (barley 5-7 leaves; 1-3 tillers, 1-3 nodes). All treatments were applied with a modified Oxford Precision Sprayer with a 2 m boom delivering 250 l/ha at a pressure of 2.1 bars. The number of potato plants on all plots was recorded at each application. At the end of August, just prior to the cereal harvest, the number of potato plants per plot, the weight of their haulm and the number and weight of tubers in each plot were also recorded. Samples of tubers from each plot were stored and the effects of the treatments on sprout production monitored. Any damage from the treatments to the barley was assessed on 4 July.

This experiment was of split plot design with three replicates.

RESULTS

Pot experiments

Fosamine. In all three experiments fosamine had virtually no effect on the haulm or on the production of daughter tubers (Tables 2, 3, 4). Despite this apparent lack of activity, a high proportion of these tubers failed to produce healthy plants, less than 16% at doses between 6 and 10 kg/ha. The remainder although they did not rot either failed to sprout or produced weak and deformed plants.

Triclopyr. This herbicide caused severe epinasty in the potato plants, in some cases as soon as 2 hrs after treatment, but none of the treatments reduced haulm weight significantly (Tables 2, 3, 4). However, they all reduced the weight of tubers produced, and in 1976 and 1977 tuber number as well. At the 1.0 kg/ha dose in these years tuber production was reduced by at least 90%. Most of the tubers that were produced rotted during the winter and thus very few healthy plants were produced from tubers from plants treated with triclopyr. There was little difference in activity in 1977 between the amine salt and the ester formulations.

3,6 Dichloropicolinic acid. Apart from causing epinastic responses soon after spraying and a slight reduction in the weight of tubers/pot this herbicide at both 0.125 and 0.25 kg/ha had no significant effect on the growth of the potatoes (Tables 3, 4). However, less than 30% of the tubers produced healthy plants in 1976 and less than 15% in 1977.

Glyphosate. In 1977 glyphosate at 1.0 kg/ha did not kill the haulm completely although it did kill the apex and stunt the plants. Damage from the 2.0 kg/ha dose was much more severe. The 1.0 kg/ha dose did not reduce tuber number but reduced their weight by 75% and the 2.0 kg/ha dose almost totally prevented tuber production (Table 4). None of the surviving tubers produced healthy plants. The addition of ammonium sulphate improved the performance of the lower dose but the phosphate did not.

Metamitron. This herbicide caused some foliar damage, particularly when mixed with Actipron but this was not reflected in lowered haulm weights and tuber numbers (Table 3). The 8 kg/ha dose reduced tuber weights significantly. However, virtually all the daugher tubers produced healthy plants.

Others. Melfluidide, 2,4-D and bentazone had very little or no effect on the potatoes (Tables 2, 3). Chloreturon, cyperquat and fluothiuron caused some chlorosis and scorch and a small reduction in the production of tubers but had no effect on their viability (Tables 2, 4).

Field experiment

Potato plant survival. As the potatoes emerged over a long period, starting in April and continuing into June, the number of plants present at each of the spray dates differed. Only 40% of the tubers planted had produced plants by 26 May but by 17 June 73% had emerged. Less than 20% of the potato plants present at spraying were still present at the end of August, irrespective of the date of application or the treatments. Indeed, only 14% survived on the untreated controls. There were indications that a slightly higher proportion of plants survived in the early drilled barley compared with late drilled.

The weight of haulm/plot at the end of August shows a similar picture, although this assessment includes those plants that emerged after the treatments had been applied. There were no differences in haulm weight between the treated plots and the controls, but those treated on 26 May in the early drilled barley and on 1 June in the late drilled, weighed more than those sprayed later.

Table 5

The effect of 9 herbicide treatments on the tuber production and viability of potatoes growing in spring barley. The data are the average of four herbicide applications (Figures in brackets = % of control)

Herbicide	Formulation	Dose (kg/ha) a.i.	Tuber Number/ plot	Tuber Wt/plot (g)	% tubers with healthy shoots
Cyanazine + MCPA	30+6.6% sc*	1.54	16.0 (99)	43.3 (99)	89
" + "	"	3.08	13.6 (84)	34.9 (80)	92
3,6-dichloropicolinic acid + mecoprop	1.25+56% ac	0.05+2.24	13.2 (81)	34.0 (78)	85
" "	30+50% ac	0.15+2.24	12.6 (78)	33.2 (76)	68
" "	30+50% ac	0.3 +2.24	10.5 (65)	28.8 (66)	69
triclopyr (triethylamine salt)	36% ac	0.75	10.7 (66)	28.5 (65)	39
"		1.50	8.0 (49)	20.7 (47)	50
dicamba + mecoprop + + MCPA	31.6% ac	1.77	14.7 (91)	40.9 (93)	81
ioxynil + bromoxynil + dichlorprop	55% ec	0.77	13.8 (86)	37.9 (87)	94
Control			16.2(100)	43.8(100)	94
Standard errors ±			1.05	3.40	

*sc = suspension concentrate

Tuber production. The potato plants on the untreated plots produced 16 tubers/ plot weighing 44 g (Table 5). Cereal planting date and application date had no effect on the performance of the herbicides. The mixture containing the higher rates of 3,6-dichloropicolinic acid and both the triclopyr treatments reduced the number and weight of tubers significantly (Table 5). The 1.5 kg/ha dose of triclopyr was the most active, halving tuber production. None of the other treatments had a significant effect. The viability of the tubers was appreciably reduced by the 3,6-dichloropicolinic acid and triclopyr treatments.

Crop damage. Triclopyr, particularly at 1.5 kg/ha damaged the barley, causing chlorosis, stunting and delayed maturation.

DISCUSSION

Most of the herbicides tested in these experiments had some effect on the potatoes but their performance was often not good enough to achieve practical levels of control. For example, the two urea herbicides studied, chloreturon and fluothiuron caused chlorosis and scorched the leaves, but reduced the number of tubers produced by less than 50% (Tables 2, 4). The performance of a third photosynthetic inhibitor, metamitron, was not as good as had been expected from other trials although it did damage the potato plants and reduced tuber yields at 8 kg/ha

(Table 3). Good control of potatoes has been reported by Hack (1975) with 8-10 kg/ha and by Cohen et al. (1977) using over 10 kg/ha. It is possible that the 8 kg/ha dose used in our experiments was too low. Because of metamitron's excellent selectivity in sugar beet it may have some practical potential for the control of potatoes in this crop.

Two growth regulators were tested in the three pot experiments, fosamine and mefluidide, the latter had no effect on the potatoes but although the former did not damage the haulm or reduce tuber production it reduced the viability of the daughter tubers. Doses in excess of 6 kg/ha prevented more than 80% of the tubers producing plants (Tables 2, 3, 4). Thus this compound may have some practical potential although its lack of activity in the year of treatment is a disadvantage. As it was developed for use in industrial and other non-crop situations (Niehuss & Roediger, 1974) further work is required to determine its effects on temperate crops.

The two picloram derivatives, triclopyr and 3,6-dichloropicolinic acid achieved some encouraging results in the pot experiments. In 1975 and 1977 triclopyr at 1.0 kg/ha totally prevented the production of viable tubers (Tables 2, 4). The performance of 3,6-dichloropicolinic acid was not quite so good but potentially practical levels of control were achieved with 0.25 kg/ha, warranting its testing in the field trial. Previous work had shown that both triclopyr and 3,6-dichloropicolinic acid were tolerated by cereals (Gilchrist & Page, 1976; Mayes et al., 1976; Richardson & Parker, 1977) and thus the field experiment was carried out to evaluate the possible selectivity between barley and volunteer potatoes. This showed that it was difficult to apply herbicides to potatoes in barley owing to the late emergence of the potatoes. However, despite this difficulty, both the 0.75 and 1.5 kg/ha doses of triclopyr reduced the number of viable tubers produced by 75% (Table 5). The 3,6-dichloropicolinic acid mixtures were not very effective although their performance was better than the other cereal herbicides tested. This confirms work reported by Lumkes (1974) which showed that most herbicides had little effect on potatoes. Although the activity of both the two picloram derivatives in the field experiment was not as good as that achieved in the pot experiments, that of triclopyr still produced practical levels of control. Unfortunately triclopyr at both doses damaged the barley, stunting the crop and delaying maturity. The damage from the 0.75 kg/ha dose was a little unexpected as Richardson & Parker (1977) had shown that barley tolerated 0.8 kg/ha.

Glyphosate, which had been reported by Lumkes (1974), Sijtsma (1977) and ourselves (Lutman & Richardson, 1978), to give good control of potatoes, again achieved complete kill in the 1977 pot experiment. Similarly, the enhancement in performance from ammonium sulphate in pot experiments already reported (Lutman & Richardson, 1978) was confirmed.

These experiments have shown that volunteer potato control may be possible with a number of herbicides. Glyphosate and high rates of triclopyr will control potatoes in non-selective situations whilst metamitron, fosamine and lower rates of triclopyr may have some potential for their control in selective situations and warrant further study. The screening of new herbicides and growth regulators, and herbicide mixtures, and the investigations into the use of additives will continue.

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GLASSHOUSE SCREENING OF HERBICIDES

FOR WEED BEET CONTROL

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Summary Various herbicides for the control of weed beet were examined in glasshouse trials. Many pre- and post-emergence products were investigated and several potentially useful materials were found and are tabulated. Limited observations under field conditions have confirmed these results.

INTRODUCTION

During recent years weed beet have attained increasing importance as a problem in the sugar beet crop. A few infestations are of such magnitude that in some areas sugar beet growing is severely hindered and the future of the crop on certain fields is in doubt, unless the problem can be reduced to manageable proportions. Control of weed beet by selective chemical means in the sugar beet crop is not possible because of the similarity of the weed beet to commercial beet. Various workers (Pinchenez et al. 1977, Cohen 1977) have tried non-selective herbicides applied mechanically or by means of impregnated gloves designed for wild oat control (Longden 1974, Breay 1975) but some damage of other plants has resulted from unintentional uptake of the herbicide. Attempts have also been made to cut the bolters but some weed beet of extreme annual habit tend to grow and shed seed below the level of the sugar beet crop. Others branch after being cut and subsequently produce viable seed below the level of any subsequent cutting.

In view of the above difficulties it was decided in consultation with the A.R.C. Weed Research Organisation to set up a glasshouse trial in 1976 to evaluate a series of post-emergence herbicides with the object of controlling weed beet in a range of agricultural crops. In the following year a pre-emergence trial was conducted with the same objective and in addition some post-emergence treatments were examined at the same time.

METHOD AND MATERIALS

Experiment 1

After reference to previous pot screening work at the Weed Research Organisation a range of products was chosen together with appropriate doses which it was hoped would give good control of weed beet.

Annual wild beet from a source in Italy were sown in 9 cm pots on 15 January 1976 and placed in a glasshouse with the thermostat set to maintain a temperature of 13°C. The beet were thinned out 40 days later to 4 plants per pot and sprayed with various treatments the next day, 25 February, when the beet were in the 2 true leaf stage. The sprayer used was the Weed Research Organisation pot sprayer set to apply

345 l/ha with Tee jet 8002 nozzles at 2.07 bar. A visual vigour score was taken 14 days after spraying just prior to "harvest". The beet were then counted and the weight of plants, cut to soil level, was recorded.

At this stage the beet on the untreated controls were in the 4-6 true leaf stage.

Experiment 2

Commercial sugar beet seed, being more easily obtained was used in place of weed beet in this trial, and was sown on 19 January in a glasshouse with the thermostat set to maintain a temperature of 17°C. 10 sugar beet seeds (cv. Sharpes Klein Monobeet) were sown per 9 cm pot. Pre-emergence treatments were then applied using the Weed Research Organisation pot sprayer. Application rate was 417 l/ha and Tee jet 8002E nozzles were used at 2.07 bar.

Post-emergence sprays were applied on 3 February using the same sprayer. Application rate was 345 l/ha and Tee jet 8002 nozzles were used at 2.07 bar. The beet were in the fully expanded cotyledon stage.

Plant counts and vigour scores were made 13 and 22 days after the pre-emergence spraying (7 days after the post-emergence spraying). The trial was "harvested" 28 days after pre-emergence and 13 days after post-emergence applications when the beet numbers, their vigour and beet weight per pot (cut to soil level) were taken.

RESULTS

Experiment 1 (table 1)

Isoproturon gave good control at the two higher rates (1.0, 2.0 kg) whilst chlortoluron and metoxuron were effective at their highest rates only (2.0 kg). The addition of Actipron enhanced the effect of these herbicides.

None of the purely translocated weedkillers (Dowco 290, MCPB, MCPA and Mecoprop) was really effective. Extreme distortion was evident but no loss of plant was observed. Ioxynil was very effective and produced total kill at the highest dose. All rates of bentazone resulted in a complete 'kill' of the weed beet.

Experiment 2 (table 2)

The natural variability of sugar beet and the difficulty of growing sugar beet in artificial conditions with the subsequent variable emergence made estimation of anticipated emergence very difficult. This was more evident in the pre-emergence trial where small numbers of plants are involved and therefore it resulted in high standard errors. Nevertheless the trial demonstrated some useful treatments.

There were noticeable vigour reductions with many of the treatments when assessments were taken at full emergence (13 days after spraying) but little reductions in plant numbers. The post-emergence treatments had not been applied at this time.

Table 1

Results of post-emergence screening herbicides for control of weed beet, 1976
(Results expressed as % untreated)

TREATMENT kg a.i./ha		Beet vigour score at harvest	Beet number at harvest	Weight of plants per pot	Weight per plant
Chlortoluron	0.5	40	92	27	29
"	1.0	24	83	18	22
"	2.0	10	42	6	10
"	0.5+Actipron 5.6 l	13	50	5	8
"	1.0+ " "	0	8	1	2
"	2.0+ " "	3	8	1	4
Isoproturon	0.5	17	67	9	14
"	1.0	3	25	2	9
"	2.0	0	0	1	3
"	0.5+Actipron 5.6 l	3	17	2	7
"	1.0+ " "	0	8	1	2
"	2.0+ " "	0	0	0	0
Metoxuron	0.5	20	92	17	19
"	1.0	24	58	15	23
"	2.0	3	17	1	6
"	0.5+Actipron 5.6 l	13	83	9	11
"	1.0+ " "	10	25	4	16
"	2.0+ " "	3	8	1	4
Dowco 290*	0.05	98	100	92	92
"	0.10	101	100	99	99
"	0.20	94	100	95	95
Nitrofen	0.75	24	75	18	20
"	0.50	13	67	7	11
"	3.00	10	33	4	8
Bentazone	0.50	0	0	0	0
"	1.00	0	0	0	0
"	2.00	0	0	0	0
MCPB	0.5	34	100	44	44
"	1.0	30	100	45	45
"	2.0	24	100	30	30
MCPA	0.5	24	100	35	35
"	1.0	17	100	13	13
"	2.0	17	100	14	14
Ioxynil	0.1875	3	25	1	6
"	0.373	3	8	1	3
"	0.75	0	0	0	0
Mecoprop	0.75	44	100	42	42
"	1.5	34	100	41	41
"	3.0	17	83	15	16
Untreated (actual value)		100 (9.89)	100 (4.00)	100 (7.476)	100 (1.869)
Standard error between any two treatments		±3.6	±9.7	±4.1	±4.2
Standard error between any treatment and untreated control		±3.0	±8.0	±3.4	±3.4
Standard error per plot		±0.619 or 24.4%	±0.674 or 29.8%	±0.5372 or 29.7%	±0.1363 or 27.6%

*3,6 dichloropicolinic acid

Table 2

Results of screening pre- and post-emergence herbicides for control of weed beet, 1977
(Results expressed as % untreated)

TREATMENTS (kg a.i./ha)			1 February Beet Vigour	1 February Beet No.	10 February Beet Vigour	10 February Beet No.	At "harvest" Beet Vigour	At "harvest" Beet No.	At "harvest" Beet Fr.wt /pot	At "harvest" Beet Fr.wt /plant
Methabenzthiazuron	0.5	pre-em.	79	95	66	67	59	66	52	84
	1.0	"	56	80	24	11	11	11	7	26
	2.0	"	59	99	15	7	6	7	1	10
Isoproturon	0.15	"	74	125	66	52	62	51	41	84
	0.30	"	68	84	33	37	22	37	18	48
	0.60	"	59	110	21	19	22	18	17	24
Chlortoluron	0.25	"	97	118	81	79	73	81	81	76
	0.50	"	91	110	78	101	76	99	75	80
	1.00	"	79	110	63	86	48	77	45	53
Terbutryne	0.25	"	74	103	15	15	3	4	1	6
	0.50	"	50	84	0	0	0	0	0	0
	1.00	"	47	84	0	0	0	0	0	0
Metoxuron	0.375	"	88	122	72	94	70	88	76	82
	0.750	"	74	122	48	79	36	66	43	62
	1.500	"	56	76	33	15	25	15	9	31
Cyanazine	0.25	"	65	106	39	30	31	26	16	52
	0.50	"	50	118	18	19	11	15	5	19
	1.00	"	59	95	0	0	0	0	0	0
	0.5	post-em.			60	105	36	77	37	49
	1.0	"			42	60	22	15	7	46
	2.0	"			18	56	0	4	0	2
Dimefuron	0.125	pre-em.	82	95	90	86	76	92	89	98
	0.250	"	59	110	33	34	25	33	29	29
	0.500	"	53	103	0	0	0	0	0	0
	0.25	post-em.			108	116	107	106	122	121
	0.50	"			99	97	98	99	107	114
	1.00	"			102	101	101	99	104	109
Untreated (actual value)			100 (8.50)	100 (6.58)	100 (8.33)	100 (6.67)	100 (8.92)	100 (6.83)	100 (3.127g)	100 (0.449g)
Standard error between any two treatments			±8.1	±13.2	±12.8	±12.3	±10.4	±12.5	±13.6	±15.1
Standard error between any treatment and untreated			±6.6	±10.8	±10.5	±10.0	±8.5	±10.2	±11.1	±12.4
Standard error per plot			20.8%	25.3%	50.5%	44.1%	47.3%	50.6%	63.6%	56.6%

At harvest (28 days after pre-emergence spraying, 13 days after post-emergence) many of the treatments had significantly reduced the beet vigour but only a limited number of treatments reduced beet number to a marked extent. Terbutryne gave a 96 per cent reduction in beet numbers even at the lowest dose (0.25 kg). Methabenzthiazuron gave good control at the two higher rates (1.0, 2.0 kg). Cyanazine gave 85 per cent control at 0.5 kg pre-emergence and complete control at 1.0 kg, whilst post-emergence it gave 85 per cent control at 1.0 kg and 96 per cent control at 2.0 kg. Dimefuron gave complete control at 0.5 kg pre-emergence but post-emergence activity was non-existent.

Some products gave reasonable control only at the highest dose, whilst chlortoluron and metoxuron were unsatisfactory pre-emergence.

DISCUSSION

These two experiments suggest several possibilities for the control of weed beet in a range of agricultural and horticultural crops. Table 3 gives a comprehensive list of commercially available products containing the herbicides under test which had given encouraging results. Even some of the less successful materials may give a satisfactory degree of control when competition by the planted crop is taken into consideration. This was found to be the case with hormone weed killers by Perowne et al. (1978) who indicated that good growth of a cereal crop combined with the herbicidal effect of a contact or hormone type herbicide prevented seed production.

Observations by the authors on labelled beet plants in a barley crop showed ioxynil to give complete control of weed beet. An opportunity was taken in 1977 to examine a selection of herbicides in a vining pea crop sited on the area of a sugar beet variety trial in 1973 where several varieties bolted very badly. Observations were made both before and after the peas were harvested. A mixture of bentazone and MCPB had given excellent control 7 days after spraying, whilst after harvest both this mixture and a mixture of cyanazine + MCPB were almost free from weed beet seedlings. Observations in the surrounding commercial crop indicated that a pre-emergence application of terbutryne+terbuthylazine also gave outstanding control.

This list covers a large range of both agricultural and horticultural crops and should provide the opportunity to control weed beet at most stages in the crop rotation. By doing so it is hoped that the weed beet infestation can be reduced to manageable proportions by the time sugar beet is grown again.

Caution must however be taken in extrapolating the rates used in glasshouse trials to the field where activity is often very different. Nevertheless useful confirmation relating to the activity of the products tested in the glasshouse has been borne out in the limited observations made in commercial crops where normal rates of application have been employed.

Acknowledgements

The authors wish to express their appreciation to Dr. K. Holly and Mr. W.G. Richardson of the Weed Research Organisation and their colleagues for their helpful advice and assistance, and for the use of the facilities of the Weed Research Organisation.

Table 3

Chemicals which have controlled weed beet in glasshouse experiments made by the Norfolk Agricultural Station at the Weed Research Organisation

Chemical	Product	Crops in which it may be useful
1. Pre-emergence of weed beet		
Terbutryne	Prebane 500 L	Winter wheat & winter barley
Terbutryne+terbuthyalazine	Opogard 500 L	Peas & potatoes
Methabenzthiazuron	Tribunil	Winter cereals & perennial rye-grass seed crop, spring barley
Cyanazine	Fortrol	Peas, maize, narcissus & tulips, cereals
Cyanazine+atrazine	Holtox	Maize, raspberry
Cyanazine+linuron	Stay-Kleen	Potatoes
Dimefuron+carbetamide	Pradone Plus	Winter oil seed rape
2. Post-emergence of weed beet		
Bentazone	Basagran	French, navy+runner beans and narcissus
Bentazone+dichlorprop	Basagran DP	Cereals in general
Bentazone+MCPB	Basagran MCPB	Peas & Cereals
Ioxynil	Totril	Onions, leeks & shallots
Ioxynil+bromoxynil	Oxytril CM	Spring & undersown cereals
Ioxynil+bromoxynil+dichlorprop	Oxytril P	Spring cereals
Ioxynil+bromoxynil+dichlorprop	Certrol E	Spring cereals
Ioxynil+bromoxynil+dichlorprop+MCPA	Tetroxone	Cereals
Ioxynil dichlorprop MCPA	Certrol PA	Cereals
Ioxynil,bromoxynil+mecoprop	Brittox	Wheat,barley, oats
Ioxynil+linuron	Certrol-Lin	Onions, leeks, spring wheat, spring barley
Ioxynil+mecoprop	Actril C	Cereals
Isoproturon	Arelon liquid Hytane 70 WP Tolkan	Winter wheat, winter barley
Isoproturon+ioxynil+bromoxynil	Twin-Tak	Wheat and barley
Chlortoluron	Dicurane 500 L	Winter wheat, winter barley
Metoxuron	Dosanex Dosaflo	Winter wheat, winter barley & carrots
Metoxuron+simazine	Fylene	Winter wheat & winter barley
Cyanazine	Fortrol	Peas, narcissus, tulips & onions on fen soils, cereals
Cyanazine+MCPA	Blagal	Cereals
Cyanazine+MCPB	Vortrix	Peas

In some cases this list may not include all products containing the noted active ingredients. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Chemicals underlined are those which gave useful control of weed beet in the glasshouse trials.

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THE USE OF TCA TO CONTROL VOLUNTEER BARLEY IN RYE-GRASS CROPS GROWN FOR SEED

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Summary The effects of TCA applied at 4-10 kg/ha in November on volunteer barley growing in two Rye-grass crops were assessed. Complete eradication of the weed was achieved at one site by applying >4 kg/ha. Moderate reductions were achieved at the second site by all doses at 13 weeks but these increased to 92 to 96% after 23 weeks. None of the doses applied reduced Rye-grass seed yield.

INTRODUCTION

TCA has been used for the control of volunteer winter wheat in the Netherlands. A dose of 5 kg/ha applied between mid-September and mid-October gave good control in seed crops of Smooth Meadow-grass (Liefstingh and Vreeke, 1971, Bor and Vreeke, 1974). When used for the control of *Alopecurus myosuroides*, the tolerance of Perennial Rye-grass cv. S.23 to a dose of 6.7 kg/ha was reported by Jeater, 1957. As volunteer cereals have become a problem in Rye-grass seed crops in Great Britain (Oswald and Haggar, 1978), it was relevant to investigate the efficacy of TCA at different doses for the control of barley growing in two Rye-grass seed crops. Effects on the barley were assessed in terms of visible effects on herbage and reductions in vegetative tiller numbers. Crop damage was measured by visible effects on herbage and by assessment of seed yield.

METHOD AND MATERIALS

Details of the two experiments are shown in table 1.

Treatments

TCA was applied at 4, 6, 8 and 10 kg a.i. ha^{-1} with an unsprayed control for comparison in both experiments. All treatments were applied in 337 l/ha aqueous spray solution at 2.07 bar pressure with Tee jets fitted to a 2.5 m boom on an Oxford Precision Sprayer.

The conditions at spraying on experiment 1 were temp. 12.0°C, r.h. 90%, cloud cover 70% with the foliage dry. On experiment 2, temp. 13.0°C, r.h. 89%, cloud cover 100% with the foliage wet.

Assessments

Treated plots were compared to unsprayed controls for the amount of green material present. If no green material was visible, a score of 0 was given. If the amount of green material was equal to that on unsprayed control plots then a score

Table 1

Details of experiment sites, management and assessments

	Experiment 1	Experiment 2
Location	Pitt, Hants	Itchen Abbas, Hants
Soil type	Silt loam	Silt loam
Crop	Perennial Rye-grass cv. S.23	Italian Rye-grass cv. Sabalan
Age of crop	6 weeks	8 weeks
Pre-spray management	Crop direct sown after Spring barley. 55 kg/ha N + 55 kg/ha P_2O_5 + 80 kg/ha K_2O in seedbed	Crop sown as experiment 1. 70 kg/ha N + 70 kg/ha P_2O_5 + 70 kg/ha K_2O in seedbed
Post-spray management	100 kg/ha N split in March and April applications	Grazed by cattle from 15 March to 3 May, 1978 90 kg/ha N on 4 May, 1978
Crop growth at spraying	7.5 cm high. 4.5 leaves per plant. 50% of plants tillering	As experiment 1 except 60% of plants tillering
Weed " " "	15 cm high. 1.5 tillers per plant	15 cm high. 2.5 tillers per plant
Replicates	3	3
Plot size (m)	7.5 x 2.5	7.5 x 2.5
Date of spraying	8 November 1977	7 November 1977
Rainfall - 6 weeks after spraying (mm)	144.6	138.6
Assessments		
Visual scores	9, 13, 24, 28 and 34 weeks after spraying	As experiment 1
Tiller counts	8 February and 21 April 1978	As experiment 1
Crop seed yield	8 August 1978	10 July 1978

of 9 was given. Intermediate effects were scored between 0 and 9. Each plot was scored by two people independently and the mean of the two scores was recorded.

The effects of the herbicide treatments on tiller numbers of volunteer barley were measured by counting all tillers growing within four 30 cm x 30 cm fixed wire quadrats on each plot. The quadrats were placed 1.5 m apart diagonally across the plots leaving a 0.9 m discard at each end.

The same fixed wire quadrats were used to measure the yield of Rye-grass seed. All fertile tillers present in each quadrat were harvested using hand shears when the moisture content of the seed was approximately 40%. The seed was dried by air draught to approximately 14% moisture content before threshing. It was then cleaned to 97% purity using a mini Petkus cleaner. The amount of clean seed from each plot was then weighed.

RESULTS

Effects on herbage

The scores showed that volunteer barley was reduced by all treatments (Fig. 1). Complete reduction was achieved on experiment 1, 13 weeks after spraying and on experiment 2, 24 weeks after spraying. Effects on Rye-grass differed between the two experiment sites. There was little effect on experiment 2, even at the high dose but reductions ranging from 25 to 60% were recorded on experiment 1. The maximum effect on the crop was reached 24 weeks after treatment.

Effects on volunteer barley

All doses significantly reduced the number of tillers present when assessed 13 weeks after spraying (table 2). The reduction was complete in experiment 1 and very significant in experiment 2, where the weed infestation was heavier. There was no recovery after 24 weeks in experiment 1 and further reductions had occurred in experiment 2. During this period the level of infestation on untreated areas fell at both locations.

Effects on Rye-grass seed

There was no significant effect on any of the herbicide treatments on the yield of Rye-grass seed at either experiment site (table 3).

Table 2

Mean effects of TCA on volunteer barley growing in two Rye-grass seed crops. Expressed as numbers of vegetative tillers per sq.m.

Time after spraying	13 weeks		24 weeks	
TCA dose ($kg\ ha^{-1}$)	Experiment No. 1	Experiment No. 2	Experiment No. 1	Experiment No. 2
0	118	252	31	123
4	0	95	0	10
6	0	60	0	2
8	0	78	0	4
10	0	71	0	5
LSD ($p = 0.01$)	-	81.6	-	4.4

DISCUSSION

These results indicate that effective control of volunteer barley was achieved by TCA applied at doses between 4 and 10 kg/ha, without damage to Perennial and Italian Rye-grass cultivars, in terms of seed yield.

It is not clear why complete control was achieved 13 weeks after spraying on one site and only 38-62% control on the other site. Soil types were the same and amounts of surface litter present were similar. Also, rainfall for a six week period after spraying was not significantly different at the two locations (table 1). One possibility is that the slightly more mature plants at site 2 could have resulted in a more resistant weed.

Although the effects of TCA on Rye-grass seed yield were measured, information

Fig. 1. The effects of TCA on green material.
Expressed as visible scores after treatment.

Scored 0 = No green material visible
9 = No visible effect

EXPT. 1 (—) EXPT. 2 (---)

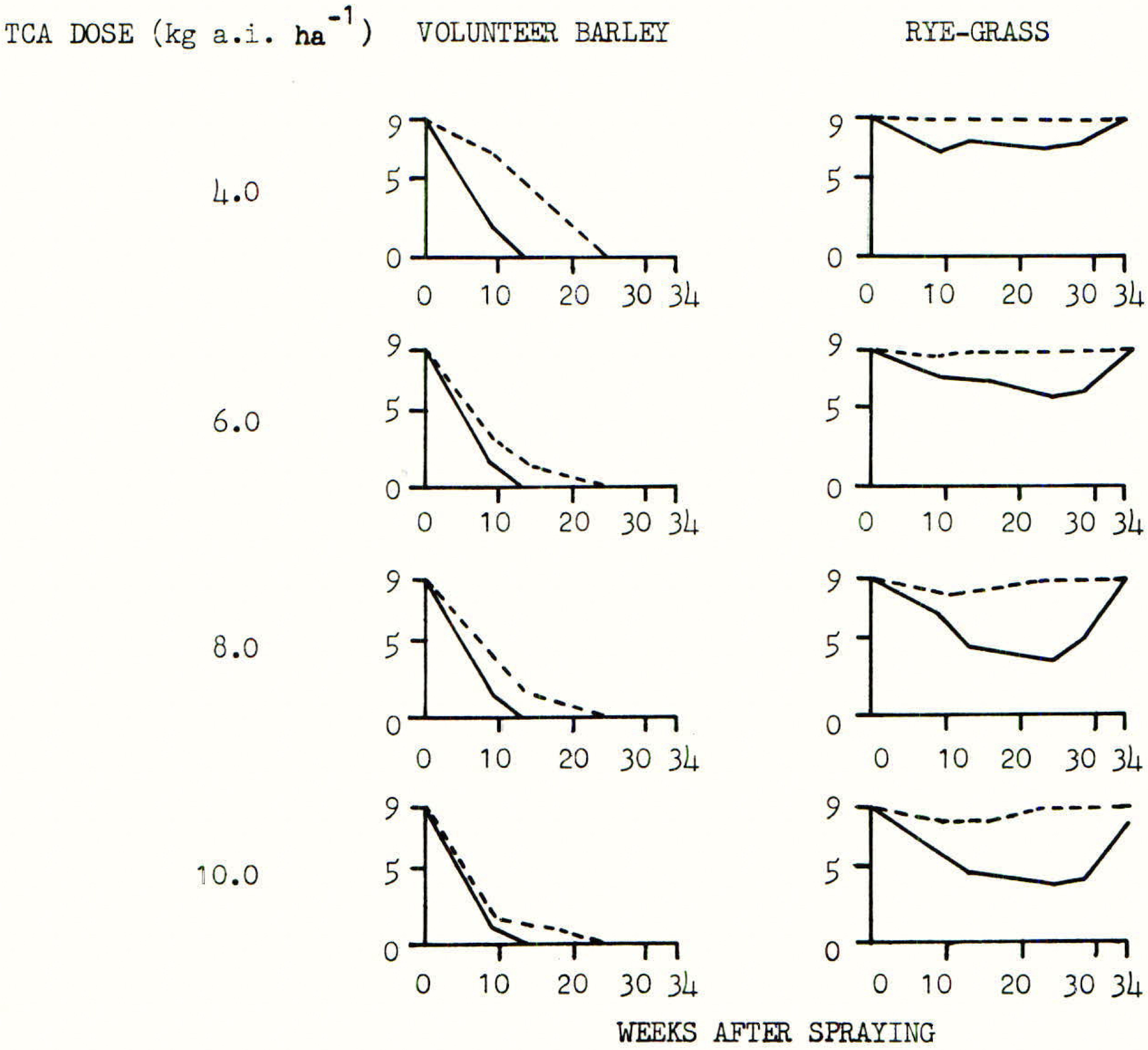

Table 3

Mean effects of TCA on the yield (g/m^2) of seed from two Rye-grass crops

TCA dose ($kg\ ha^{-1}$)	Experiment 1 PRG cv. S.23 Yield	Experiment 2 IRG cv. Sabalan Yield
0	86.0	92.8
4	86.8	69.0
6	87.9	94.4
8	96.8	89.4
10	72.3	92.4
LSD ($p = 0.05$)	NS	NS

on seed germination is needed. The seed from both experiments described in this report was harvested before ripening so that there would be no loss due to the harvesting technique. Consequently an accurate germination test was not possible. Also, the present experiments were carried out in early November; as weed competition would start in September, the effects of earlier spraying should be assessed. It should be borne in mind however that removal of the competition from the volunteer barley did not affect the yield of Rye-grass seed. There was no increase in yields from treated plots when compared to unsprayed controls (table 3). Therefore the economic benefits of applying TCA for the control of this weed need to be confirmed in future work.

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NOTES

Proceedings 1978 British Crop Protection Conference - Weeds

HERBICIDAL CONTROL OF VOLUNTEER CEREALS IN WINTER RAPE OVER FOUR SEASONS

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Summary In U.K. trials carbetamide and alloxydim sodium were applied to established winter rape and carbetamide plus dimefuron was applied both before and after crop emergence, principally to combat self-sown cereals.

Yield response to post-emergence treatment of carbetamide was reliable and generally positive but response to pre-emergence treatment with added dimefuron was uncertain. Weed control with pre-emergence treatment was unsatisfactory in a dry early Autumn.

Alloxydim sodium showed promise for controlling cereals at young crop stages and the development of a combined grass and broad-leaved herbicide with flexible timing in the Autumn should be the main aim.

INTRODUCTION

The shedding of small grain, fast combine-operating speeds, and the 'straw trail', all conspire to produce volunteer cereals. The drilling of autumn rape most conveniently follows the early harvesting of winter barley (and sometimes winter wheat). There is little time between the two crops to carry out the stale-seedbed technique or other weed control practices. Volunteer winter cereals are of course hardier than spring cereals. Thus there is a problem.

The winter oilseed rape crop is very competitive when growing away in the spring, but from establishment until mid-March it does have a long period of vulnerability to weed invasion.

Over four seasons we have been combatting weeds in rape with various herbicidal remedies, starting with carbetamide in 1974, then adding dimefuron both pre- and post-crop emergence, and very recently testing alloxydim sodium. This chemical and carbetamide are primarily grass herbicides whereas dimefuron has only a slight effect on grasses.

This report describes the salient lessons learnt and conclusions reached in the volunteer cereal context.

METHODS AND MATERIALS

The trials took place in 11 counties in England. The early replicated trials, mainly on 1974/75 commercial winter rape crops, were based upon treatment with carbetamide at 2.1 kg/ha made in December or January. Plot size was 4 x 50m, replicated twice, and 411 litres of water per ha were applied by means of a single-wheeled, pump-operated 'large plot' sprayer. Yields were taken from the whole plot, less discards, using the farmer's combine harvester.

Post-drilling pre-crop emergence evaluation of the 4 to 1 mixture of carbetamide and dimefuron mainly at 1.6 + 0.4 kg/ha was conducted over two seasons by means of user trials. Large unreplicated plots running the full length of the field (less headlands) were treated with the farmers' own equipment, delivering 200-300 litres of water per ha, in comparison with post-emergence carbetamide at 2.1 kg/ha alone or with dimefuron at 0.7 kg/ha - the 3 to 1 mixture. The rate of both carbetamide and dimefuron is reduced for pre-emergence treatment for crop tolerance reasons. Small untreated areas were arranged and a range of soil types was covered. The rapeseed yields in 1977 were taken with the farm combine harvester from two cuts totalling approximately 0.05 ha.

In the small-plot experiments, started in Autumn 1977, the new chemical alloxydim sodium was applied early after crop emergence at doses from 0.56 to 1.5 kg/ha in 243 l of water per ha. There were four replicates and plot size was 2.5 x 8 m.

Volunteer cereal numbers were assessed in $\frac{1}{2}m^2$ quadrats, using 6 quadrats in the user trials and 2 per plot in the small-scale work.

The formulations based on carbetamide were all wettable powders: 70% w/w a.i. ('Carbetamex'); 3 to 1 and 4 to 1 mixtures with dimefuron were 80% and 50% w/w total a.i. respectively, though in the first season a tank-mix of 3 to 1 and carbetamide formulations was used to achieve the 4 to 1 doses. Alloxydim sodium was in the form of a soluble powder containing 75% w/w a.i.

RESULTS

A farm survey of the post-emergence effect of 2.1 kg carbetamide per ha on volunteer cereals is given in Table 1.

Comparison of carbetamide with standard products is intentionally omitted from Table 2, and data on 1975/76 trials with carbetamide plus dimefuron are not included here, because of previous publication (Pink 1976).

Tables 3 and 4 give the results of pre-emergence weed control with carbetamide plus dimefuron in 1976/77 and 1977/78 crops. Table 5 also covers the most recent season and gives the first results in rape in the U.K. with alloxydim sodium.

Yields were calculated in terms of clean seed at 10% moisture content.

Table 1

Farm Results with carbetamide at 2.1 kg/ha on Volunteer Cereals in Rape and other overwintered crops - 1973/74

Volunteer Cereal	Total sites	No. of sites in given category of control: Complete	Very Good	Good	Satisfactory	Poor
Barley	35	0	25	5	5	0
Wheat	6	0	3	3	0	0
Oats	2	0	0	1	1	0
	43 (25 in w. rape)					

Table 2

Control of Vol. Barley and Yield Response to Carbetamide - Replicated Trials 1974/75

Sprayed: Dec./Jan. Weeds Assessed: April/May Harvested: August

Site Location	Mean nos. vol. barley/m^2 in control	Vol. barley as % of total weed numbers (bulk)	Carbetamide 2.1 kg/ha			Other grass weeds present
			% control of barley nos.	% yield response	control yield tonnes/ha	
Bubbenhall, Warks.	30	6 (17)	100	- 7	2.16	Poas
Sherston, Warks.	31	14	Excellent	+ 168	0.73	Poas, blackgrass*
Sedlescombe, Sussex.	68	44 (55)	100	-	-	Poas
Writtle,** Essex.	84	100 (100)	88	+ 44	1.48**	None
Wollaston, Northants.	137	53	Good	+ 122	1.24	None

* high population - 140/m^2 in control

** 1973/74 season and seed uncleaned

Table 3

Comparison of Oilseed Rape Yields following applications of Carbetamide and Dimefuron to combat Volunteer Cereals - User Trials 1976/77

Timing	Carbetamide + Dimefuron kg a.i./ha	Yields of clean seed, tonnes/ha (10% moisture) Combe, Berks.	Fyfield, Essex.	Aldermaston, Berks.	Sutton Cheyney, Warks.	Hullbridge, Essex.	Fairford, Glos.
Pre-emergence	1.6 + 0.4	0.97	1.59	1.91	2.79	2.80*	2.94
	2.1 + 0.7	1.40	1.60	1.78	2.89	3.50	3.06
Post-emergence	2.1 + 0	1.54	-	1.78	2.45	3.65	1.84
Weeds present other than cereals		wild oats couch grass	Stellaria		Matricaria +	Veronica & Stellaria	

* 2.0 + 0.5 kg/ha

\+ cereals removed by pre-sowing application of TCA

Table 4

Effect on Volunteer Cereals of Carbetamide/dimefuron applied post-drilling pre-emergence - User Trials 1977

Site Location	Soil Type	Problem cereal	Date of assessment	Nos. per sq metre carb. + dim. (1.6 + 0.4 kg/ha)	Control
Stradbroke, Suffolk.	loam		18/10	6	6
Fairford, Glos.	clay loam	Volunteer barley	21/12	8	16
Belton, Leics.	clay loam		31/10	12	49
Biddenham, Beds.	sand		27/10	13	50
Sutton Cheyney, Warks.	sandy loam		23/12	66	62
Burnham Market, Norfolk.	clay loam		19/10	12	70
South Raynham, Norfolk.	clay loam	vol. wheat	19/10	8	12
				% ground cover	
Golden Green, Kent.	silt loam	"	16/11	3	100
Wareside, Herts.	sandy clay loam	vol. oats	19/12	17	100

Table 5

Percentage Control of Volunteer Cereal bulk (nos. x ht.) with Alloxydim sodium - Replicated Trials 1977/78

Site location:	East Hanningfield, Essex.	Writtle, Essex.	Walsham-le-Willows, Suffolk.	
Rape Variety/Growth Stage:	Primor/Cot. to 3-leaf	Rapora/2-3 leaves	Primor/3-4 leaves	Crop
Cereal, Growth Stage:	Barley, 1-leaf to 2 tillers	Barley, 2 leaves to 1 tiller	Wheat, 2 leaves to 3 tillers	effect
0.56 kg a.i./ha	93	92	-	nil
0.94 "	99	99	100	nil
1.50 "	99	99	100	nil
Control population (Nos./m^2)	60	38	8	-
Dates sprayed/assessed	18.10/5.1	27.10/22.2	25.10/23.2	

DISCUSSION

The importance of volunteer cereals in oilseed rape and other overwintered crops is highlighted in Table 1, with the not unexpected result that barley was more prevalent than either wheat or oats. Populations on control plots in the late Autumn ranged from 6 to 70 plants per sq m (Table 4).

In the early work a limitation of carbetamide was revealed. It causes stunting of rape at the 2-leaf stage, and, although the aim was to spray at 3-4 leaves, wet weather set in so that treatment was not possible until December or January. Yield responses were achieved (Table 2), but could they have been greater with earlier treatment?

In general, as volunteer cereal populations increased there was an increased yield response to treatment with carbetamide; at one site (Bubbenhall) there was a negative response due to a low barley population and ingress of unsusceptible broad-leaved weeds; at another site (Sherston) yield was greatly enhanced due to the additional control of blackgrass.

The significant feature of some of the pre-emergence plots in the 1976 user trials was the greener leaf and stronger root of young rape plants from which barley competition had been removed in the seed-bed; these plots stood out in the late Autumn, but, except on straw trails, the post-emergence treatments eventually produced crops which looked as good and it was disappointing that at only one site (Aldermaston) did the pre-emergence carbetamide plus dimefuron show a yield advantage (Table 3). The problem was that the early removal of cereals led to the invasion of other weeds, such as wild oats at Combe, which were dealt with better by later post-emergence applications.

Recent results from the 1977 pre-emergence user trials show the perils of this time of application in winter rape. By contrast to the previous year conditions were extremely dry: there was no control of cereals at two sites and reduced control at others, so that the expected increase in crop vigour did not occur. Disappointingly, at two sites (not reported here), there was also unacceptable crop damage.

Our experience with TCA is somewhat limited. In one user trial (Table 3) pre-sowing application was safely followed by both pre- and post-emergence treatment of carbetamide and dimefuron mixtures. In fields contiguous to our trials TCA has been used on established crops at 8 and 16 kg/ha with slight and severe scorch respectively, insufficiently safe for a recommendation. The compromise now in vogue is a post-drilling pre-emergence treatment at 8-11 kg/ha but there might be a hazard here to post-emergence follow up treatments if a crop is not vigorous or TCA has been overdosed. Hopefully, and if economics allow, the onset of new herbicides that can be applied for volunteer cereal control immediately after the emergence of rape seedlings, will obviate this problem.

Alloxydim sodium, whose properties are discussed elsewhere at this conference (Ingram 1978), is one such herbicide. The results in Table 5 show that it can be applied safely to winter oilseed rape from the cotyledon to 3-leaf stage and exercise excellent control of volunteer barley and volunteer wheat to boot. A chemical tolerated at the young growth stage could be doubly desirable under alternate wet and dry conditions such as prevailed last Autumn when there was often an early and late germination of winter rape.

If a broad-leaved weed control component, preferably with residual action, and with similar safe properties, could be found and added to a grass killer, an ideal herbicide mixture would be produced for the winter rape crop. This is the challenge and future prize that awaits to-day.

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References

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