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WEED RESEARCH ORGANISATION

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THE DEVELOPMENT OF SELECTIVE HERBICIDES FOR KALE IN THE UNITED KINGDOM

2. The Methylthiotriazines

Methylthiotriazines - eg ametryne, desmetrybe & prometryn

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Summary

Seventeen field experiments were carried out in 1961 and 1962 to investigate the performance of some methylthiotriazines for the control of annual weeds in kale. Chenopodium album was consistently controlled by 3-6 oz/ac of desmetryne, ametryne and simetryne; Urtica urens and Stellaria media were also susceptible. Of the other species present only Polygonum persicaria and P. convolvulus were susceptible at somewhat higher doses. The investigation on the tolerance of kale included such aspects as the effects of soil and foliage treatment, the reaction at different stages of growth, the tolerance of different strains, and the reaction of weed-free kale to foliar applications. It was concluded that kale is more tolerant of desmetryne than of ametryne or simetryne, and that there is a sufficient degree of selectivity to allow its use for the control of C. album.

INTRODUCTION

The background to this investigation on kale was described by Elliott and Cox, (1965). Hoping to find new forms of selectivity for use in the kale crop, the Weed Research Organization started a field evaluation programme in 1961 which involved some 23 chemicals. In May 1961 it became evident that several of the methylthiotriazines were producing interesting selectivity between Chenopodium album and kale. In view of the possible importance of this finding, additional field experiments of various types were started in 1961 and 1962. The results of this work together with the results of investigations carried out subsequently by other organizations to follow up the preliminary findings were published at the Sixth British Weed Control Conference in November 1962, (Elliott and Cox, 1962; Baker, Holmes and Pfeiffer, 1962; Powell, 1962). In the spring of 1963, desmetryne appeared on the commercial market in the United Kingdom for the control of C. album in kale.

The 17 field experiments which are reported, were concerned wholely or partly with prometryne, ametryne, simetryne and desmetryne. Some contained other herbicides and information on these will be presented in a later report.

EXPERIMENTAL METHODS

The experiments, all within 30 miles of Oxford consisted of randomised blocks with 2-4 replicates; plot size varied from 26 x 2 ft to 30 x 12 ft according to the application technique. Logarithmic spraying equipment (Hartley, Pfeiffer and Brunskill, 1956; Fryer, 1956) was used in 4 experiments, the remainder were sprayed with either an Oxford Precision Sprayer (Fryer and Elliott, 1954) or a tractor-mounted sprayer. In most experiments the volume rate was about 80 gal/ac and this pressure 30 lb/in^2 unless otherwise stated. The herbicides were formulated as wettable powders and were applied at doses of 2-32 oz/ac. No additional surfactant was used.

In thirteen experiments the treatments were applied when the kale had 2-4 leaves. Of the remainder one was sprayed post-sowing, two pre-emergence and one when the kale had 7-9 leaves. In all but one of the experiments the kale was of the Marrowstem strain. The weeds were the natural populations of the experimental areas. In 5 experiments the weeds were removed as soon after the emergence of the kale as possible by hoeing and hand-weeding.

Assessments on weeds and kale were normally by counts of living plants in random quadrats. Vigour was usually rated by two independant observers who carried out their inspections of each plot on the same day and without a knowledge of the chemicals or treatments that had been applied: the following scale was used:-

10 = no visible effect
8 = slight check to growth
6 = severe check with possible slight mortality
4 = severe check plus about 50% kill
2 = " " " " 75% kill
0 = 100 per cent kill

Kale yields were taken by cutting similar areas of each plot, and weighing the produce immediately in the field. The weights that are given are normally fresh weights, and cutting was timed to ensure that excessive quantities of external moisture were not present. Further details of the assessments used are given in the tables of results.

RESULTS

1961 Experiments

Soil Treatments

In experiment no. AA.1.61. the four triazines were applied to a sandy loam soil on the 28th April and incorporated immediately by means of a

rotary cultivator. The kale was drilled 3 days later. The effects on the kale after emergence may be seen in Table 1.

Table 1

The effect of incorporated pre-sowing treatments on kale. (AA.1.61.)

Means for each treatment adjusted to nearest whole number.

Chemical	oz/ac	Appearance at 2-leaf stage	Vigour at 6-8 leaf stage	Kale plants in 2 rows x 10 yd per plot at 2-leaf stage
Simetryne	2	None	10	95
	8	None	10	80
	16	Some chlorosis	8	76
Ametryne	2	None	10	95
	8	Some chlorosis	10	83
	16	Chlorosis	8	61
Desmetryne	2	Slight chlorosis	10	80
	8	Chlorosis	10	88
	16	"	10	80
Prometryne	2	None	10	95
	8	None	9	61
	16	Slight chlorosis	9	61
Control		Normal	10	84

The same treatments were applied, in experiment AA.2.61, to the soil surface on 5th May, 2 days after the kale was drilled. Rainfall was slight over the next 5 weeks (0.15 in. during the period 6th May - 12th June), although the moisture present in the soil provided good growth. Counts of the kale plants

were made on the 25th May. The population was extremely uniform over the trial area (a mean of 7.0 plants per yd of row) and provided no indication of mortality due to the chemicals. Similarly vigour scores made on 3rd July brought to light no differences in kale growth that might be attributed to the chemicals.

It appeared from the results of experiment AA.1.61 that when placed in the rooting zone, the methylthiotriazines could produce chlorosis of the leaves of kale, and that some mortality could occur at doses approaching 16 oz/ac. The fact that similar treatments applied to the soil surface in AA.2.61 had not resulted in such effects, might be due to a real protection being provided by the soil, or to failure of the chemicals to reach the root zone because of the low rainfall after application.

Foliar Treatment

This experiment (AA.3.61) contained simetryne, ametryne and prometryne which were applied at 2,8 and 16 oz/ac to weed-free kale on 14th June. The results may be seen in Table 2.

Table 2

The effect of foliar treatments on kale. (AA.3.61)

Chemical oz/ac		Scores for vigour 1 week after spraying	Scores for vigour 1 month after spraying	Fresh wt. of shoots from an area 18x4ft/plot
Simetryne	2	5.0	5.7	97.3
	8	2.7	4.7	85.7
	16	0.3	0.7	11.7
Ametryne	2	5.7	9.0	90.3
	8	2.0	3.7	46.0
	16	1.0	2.7	28.3
Prometryne	2	6.7	9.7	97.7
	8	3.3	4.7	67.7
	16	2.7	3.0	54.7
Control mean		10.0	10.0	111.3
P = 0.05 L.S.D.		-	-	16.3
% S.E.		-	-	11.4

The results indicated that the three chemicals were much more active on kale as foliar treatments than when applied to the soil. The lowest dose of 2 oz/ac resulted in an initial set-back one week after spraying from which the kale largely recovered in the case of ametryne and prometryne but not of simetryne. However, all the yields tended to be below control by a difference bordering on significance. Increasing the dose to 8 and 16 oz/ac resulted in a set-back from which the crop did not recover.

On the 30th May a selectivity experiment (AA.12.61) was started in which C. album growing in young kale was treated with logarithmically descending doses of the four triazines; the starting dose was 32 oz/ac. Assessment was on a visual quantitative basis.

The evidence from this experiment (Table 3) was that all four chemicals were more toxic to C. album than they were to kale, but prometryne was less active and less selective than the others. A month after spraying, simetryne, ametryne and desmetryne appeared to have achieved a selective control of C. album with but a mild check to the kale at doses of 2-4 oz/a.

A similar experiment (AA.13.61) was started on 28th June. The principal weed in this case was Sinapis arvensis. The results may be seen in Table 4. Here again the methylthiotriazines showed greater toxicity to the weed than to the crop.

Table 3

Effect of post-emergence treatments on kale and C. album (AA.12.61)

Mean scores by one observer 9 days (a) and 23 days (b) after spraying, corrected to nearest whole number above.

Chemical		dose oz/ac								
		27.0	20.2	14.6	11.2	8.3	6.2	4.6	3.5	2.6	1.9
Simetryne	a. kale	0	0	0	1	1	1	4	5	7	8
	a. C.album	0	0	0	0	0	0	0	0	3	6
	b. kale	0	0	0	1	1	3	5	7	9	9
	b. C.album	0	0	0	0	0	0	0	0	4	5
Ametryne	a. kale	0	0	0	3	1	4	6	7	8	9
	a. C.album	0	0	0	0	0	0	1	4	8	9
	b. kale	0	0	0	3	2	4	7	8	8	9
	b. C.album	0	0	0	0	0	0	0	1	4	9
Desmetryne	a. kale	0	0	2	3	4	6	8	7	8	9
	a. C.album	0	0	0	0	0	0	0	0	4	8
	b. kale	0	0	2	4	4	5	8	8	8	9
	b. C.album	0	0	0	0	0	0	0	0	3	8
Prometryne	a. kale	1	1	3	6	7	8	9	10	10	10
	a. C.album	0	0	0	3	4	6	7	9	10	10
	b. kale	1	1	2	3	6	7	8	9	10	10
	b. C.album	0	0	0	2	2	7	9	9	10	10

Two further experiments on C. album were carried out in 1961. AA.16.61 involved logarithmic applications of ametryne and desmetryne to a dense stand of the weed 14-16 in. high with a second and younger emergence present. Kale was present but it was smothered by the weed.

Table 4

Effect of post-emergence treatments on kale and S. arvensis (AA.13.61)

Mean scores by one observer 6 days (a) and 16 days (b) after spraying, corrected to nearest whole number above.

Chemical			dose oz/ac 25.3	18.6	13.6	9.9	7.2	5.3	3.8	2.9	2.1	1.6
Simetryne	a.	kale	0	0	0	0	0	1	4	6	8	9
		S.arvensis	0	0	0	0	0	0	2	2	3	4
	b.	kale	0	0	0	0	1	3	6	7	7	8
		S.arvensis	0	0	0	0	0	0	3	4	5	6
Ametryne	a.	kale	0	0	0	2	3	4	7	8	10	10
		S.arvensis	0	0	0	0	0	0	1	2	7	7
	b.	kale	0	0	1	3	5	8	9	9	10	10
		S.arvensis	0	0	0	0	0	0	2	4	6	7
Desmetryne	a.	kale	2	1	4	6	8	8	9	10	10	10
		S.arvensis	0	0	0	0	2	4	6	7	3	8
	b.	kale	3	5	6	7	8	8	8	10	10	10
		S.arvensis	0	0	0	0	1	3	5	6	8	8
Prometryne	a.	kale	1	1	2	2	5	7	8	10	10	10
		S.arvensis	0	0	0	0	0	2	6	7	8	10
	b.	kale	1	4	5	4	7	8	8	9	9	10
		S.arvensis	0	0	0	0	0	3	5	6	7	7

The chemicals were applied on the 11th July, and their effects were assessed 8 days later. Both had caused considerable damage to C. album when applied at doses in the range of 4-8 oz/ac.

The other experiment (AA.20.61) involved finite plots of late-sown kale at 3-4 true leaf stage that had become infested with weeds, C. album (7-8 in. high) being dominant. Ametryne, simetryne and desmetryne were applied on 16th August at 3.2, 6.4 and 9.6 oz in 50.4 gal/ac (Table 5). All three chemicals provided substantial kill of C. album, though the counts made on the 6th September indicated that the lowest dose of 3.2 oz/ac was marginal in that a small proportion of C. album plants had survived. A difficulty in the assessment of this experiment was caused by the density of C. album; it

was not possible to count the sub-dominant weeds or the kale on the control plots without damaging the vegetation and therefore affecting the yield results. A sample weeded area outside the experiment gave an average of 11.6 kale plants per yard of row which was a little higher than the counts on the treated plots. All the treatments resulted in yields of kale substantially above those of the controls. The best all-round treatment was 6.4 oz/ac of desmetryne which had provided a complete kill of C. album, the least adverse affect on the kale and the highest yield.

Table 5

Effect of post-emergence treatments on kale and C. album (AA.20.61). Means for each treatment; vigour scores correct to nearest whole number above.

	oz/ac	Numbers of live C.album plants per yd^2 21 days after spraying	Numbers of live kale plants per yd of row 21 days after spraying	Fresh wt. of kale in lb/plot at harvest
Ametryne	3.2	5.5	9.9	41.0
	6.4	0.0	8.6	47.0
	9.6	0.0	6.7	28.7
Simetryne	3.2	28.0	10.9	41.0
	6.4	0.6	8.7	40.3
	9.6	0.0	7.4	41.3
Desmetryne	3.2	13.7	9.6	44.0
	6.4	0.0	10.8	52.0
	9.6	0.0	9.7	42.7
Untreated control	-	151.8	-	3.1
Sample from outside experimental area	-	-	11.6	-

1962 Experiments

Soil-applied treatments

The 1961 experiments had shown that the herbicides were capable of activity through the soil. This aspect was examined further in experiment AA.1.62 in which desmetryne and ametryne at 3, 6 and 12 oz/ac were applied to a sandy loam soil and mixed in by rotary cultivator immediately before the kale was planted. Desmetryne caused insignificant mortality of kale plants at rates up to 6 oz/ac (Table 7). Ametryne appeared to be more toxic and at 12 oz/ac caused the death of more than half of the kale plants. Owing to the weed control provided by the two herbicides, the kale on all the treated plots grew more vigorously than that on the controls and gave higher yields.

Foliar treatments to weed-free crops

In experiment AA.2.62 ametryne, simetryne and desmetryne were applied on 16th June at 3, 6, 9 and 12 oz/ac to weed-free kale at the 2-3 true leaf stage. The subsequent growth of the crop was assessed at intervals afterwards.

Nine days after spraying all the chemicals had produced some chlorosis on the leaves of the kale plants and this effect was enhanced by increasing the dose (Table 7). Counts of kale plants made one month after spraying showed that a small reduction in plant numbers had occurred on all the treated plots (a maximum of 8% on those treated with 12 oz/ac simetryne). The subsequent growth of the kale was vigorous, and differences due to the treatments disappeared on all the plots except those that had received 12 oz/ac. In order to check on the final outcome, these affected plots and the controls were harvested. Against the control yield of kale of 24.4 tons/ac the yields after application of 12 oz/ac desmetryne, ametryne and simetryne, were respectively 23.8, 23.2 and 23.1 tons/ac.

Time of application relative to kale growth

To obtain information on changes in the tolerance of kale at different growth stages, an experiment (AA.3.62) was carried out in which desmetryne was applied at 3, 6 and 12 oz/ac to clean kale at four growth stages between 2 and 8 true leaves. The crop was observed during the post-spraying period, and yields were taken (Table 7). Two effects were apparent. The effect of increasing the dose was to enhance the depressive effect on the crop, and in this respect young kale was more susceptible to damage than that which was at a more advanced stage of growth at the time of spraying. In this experiment desmetryne showed a greater activity on the kale than in AA.1.62, which was carried out earlier in the year.

Reaction of different strains of kale

Eight strains were sown in rows 9 in apart at two densities equivalent to sowing rates of 2.5 and 4.7 lb/ac (AA.4.62). At appropriate intervals, gaps were left between the rows to allow the passage of a logarithmic sprayer mounted on a Landrover. Ametryne, simetryne and desmetryne were applied on 6th July at a starting dose of 24 oz/ac. The half-dose distance of the sprayer was 6.23 yd. The kale had 3-4 true leaves when sprayed and 7-9 true leaves when assessed 2 weeks later. The intention was to produce a range of scorch symptoms by means of a descending dose so that its occurrence on individual strains could be seen and assessed. The results are given in Table 6.

Table 6

Effect on kale foliage of logarithmically descending doses (AA.4.62). Mean minimum doses in oz/ac at which chlorosis of kale foliage was visible.

	Ametryne		Simetryne		Desmetryne	
Plant density:	Low	High	Low	High	Low	High
Strain of Kale:-						
Miln's Marrowstem	6.2	5.9*	7.7	6.2*	10.2	9.3*
Suttons "	7.6	6.1	5.8	7.4	9.3	9.8
Cannell's Thousandhead	7.4	5.9	7.4	6.2	11.7	11.5
Hurst's "	7.8	6.4	8.3	7.4	9.8	9.3
Webb's "	8.3	7.4	7.8	8.3	10.2	11.0
Cannell's Canson Dwarf	7.6	5.9	6.4	6.4	9.3	9.1
Mean of five strains (excluding Miln's)	7.7	6.4	7.1	7.1	10.1	10.1

* Results suspect due to different habit of growth in edge rows.

Although the figures suggest some differences between strains, in reality these were extremely small. All the strains showed a greater resistance to desmetryne than to ametryne or simetryne.

Weed control in the growing crop

There were six experiments concerned with this aspect (AA.6, 11, 12, 13, 16 and 17.62). Desmetryne, ametryne and simetryne were applied at a range of doses. Assessments were by vigour scores, plant counts and in one case by yield. The results are given in Table 7.

T A B L E 7

THE RESULTS OF 1962 EXPERIMENTS

Means for each Treatment

(i)

Experiment Number	Date of Herbicide Application	Date of Assessment	Control Value	CHEMICAL AND DOSE IN OZ/AC						
				DESMETRYNE				AMETRYNE		
					3	6	12	3	6	
AA.1.	2 May	10 July	155		145	156	130	133	141	
		24 Aug	7.0		8.7	9.0	9.7	8.0	9.7	
		24 Aug	31.5		35.0	36.0	37.0	32.0	36.0	
		12/14 Nov	77.4		91.2	96.3	91.0	88.3	93.7	
AA.3.	18 Aug	28 Dec	7.8		6.3	4.4	2.2	S.E. = 14%P		
	27 Aug	28 Dec			7.4	6.1	5.5	= 0.05		
	7 Sept	28 Dec			7.0	6.4	5.8	S.D. = 1.5		
	17 Sept	28 Dec			7.1	6.7	5.9			
				3	6	9	12	3	6	9
AA.2.	16 June	25 June	10.0	10.0	9.5	7.3	6.5	9.0	6.5	6.3
		17 July	1112	1127	1064	1062	1050	1149	1167	1096
		17 Dec	24.4	-	-	-	23.8	-	-	-
AA.6	21 June	4 July	10.0	7.2	5.5	4.5	0.0	7.5	4.5	3.5
			10.0	5.2	2.2	0.7	0.0	6.7	1.2	0.7
			10.0	2.0	1.2	0.0	0.0	6.0	2.2	0.0
				2	4	8	10	2	4	8
AA.11.	23 June	9 July	10.0	6.0	3.0	1.8	0.0	5.0	3.0	1.3
			10.0	7.3	4.7	2.5	1.2	7.2	6.7	5.7
			10.0	7.3	5.3	4.3	3.0	8.0	5.7	6.0
		1 Nov	13.7	18.6	17.2	18.4	20.4	13.7	19.1	19.4

	SIMETRYNE				SUBJECT OF ASSESSMENT	TYPE OF ASSESSMENT
12						
68					Kale	No. of plants per 6 yd of row
10.0					Kale	Score for vigour
38.0					Kale	Mean height of plants, in.
85.7					Kale	Yield in lb/plot from 6 yd length of 2 rows
					Clean kale	Yields in tons/ac after spraying at 4 growth stages
					Clean kale	" " " " "
					Clean kale	" " " " "
					Clean kale	" " " " "
12	3	6	9	12		
5.5	8.8	6.7	5.3	5.3	Clean kale	Scores for vigour
1069	1112	1064	1092	1030	Clean kale	Numbers of plants on 4 x 14 ft row lengths per plot
23.2	-	-	-	23.1	Clean kale	Yields in tons/ac on 10 yd x 2 rows per plot
0.0	8.5	5.2	4.0	0.0	Kale	)
0.0	7.7	3.5	1.2	0.0	Polygonum persicaria	) Scores for vigour
0.0	5.5	0.2	0.2	0.0	Chenopodium album	)
10	2	4	8	10		
0.7	6.3	3.0	1.8	0.0	Chenopodium album	)
2.8	8.0	6.7	3.0	1.0	Polygonum persicaria	) Scores for vigour
3.3	9.0	7.0	6.5	5.0	Kale	)
18.0	19.2	17.0	17.6	17.3	Green kale	Yields in tons/ac

T A B L E 7

THE RESULTS OF 1962 EXPERIMENTS

Means for each Treatment

Experiment Number	Date of Herbicide Application	Date of Assessment	Control Value	CHEMICAL AND DOSE IN OZ/AC						
				DESMETRYNE				AMETRYNE		
				2	4	8	10	2	4	8
AA.12.	24 May	4 June	23.3	35.3	26.3	33.3	34.3	26.0	40.7	36.0
			6.1	0.3	0.0	0.7	0.0	4.7	0.0	0.3
			34.9	0.7	0.3	0.0	0.0	4.0	0.0	0.0
			21.7	20.7	8.3	2.3	1.3	12.3	5.0	1.3
			17.2	6.3	1.3	0.0	0.0	11.0	0.3	0.0
			23.4	7.7	2.3	3.0	0.7	19.0	2.0	2.0
			39.9	72.0	62.3	66.7	48.0	97.3	70.0	61.7
			2.8	4.3	2.7	1.3	1.0	11.7	2.0	1.3
			115	130	127	119	110	139	100	83
AA.13	20/21 Aug	29 Aug	181	223	179	139	124	186	182	142
		26 Sept	10.0	9.0	7.7	7.2	4.5	7.7	9.0	7.7
			10.0	0.7	0.0	0.0	0.0	0.5	0.7	0.2
				2	4	6	10	2	4	6
AA.16	13 Aug	27 Aug	24.0	26.7	24.3	7.7	12.0	20.0	18.0	10.3
			44.0	52.0	32.0	8.0	5.3	27.7	18.3	6.0
			54.0	62.7	67.3	58.7	54.3	59.3	32.0	43.7
AA.17	10 Aug	12 Sept	10.0	10.0	10.0	9.3	-	9.0	9.7	6.3
			10.0	7.9	4.3	0.3	-	3.3	7.3	0.3
			10.0	8.7	5.3	1.7	-	3.3	5.7	1.0

SIMETRYNE					SUBJECT OF ASSESSMENT	TYPE OF ASSESSMENT
10	2	4	8	10		
26.7	29.3	36.7	35.7	31.7	Polygonum aviculare	)
0.0	0.0	0.7	0.0	0.0	Polygonum convolvulus	)
0.0	0.3	0.0	0.0	0.3	Chenopodium album	)
0.0	2.7	8.7	2.0	0.0	Veronica species	) No. of plants in 4 x 18
0.0	0.0	0.0	0.3	0.0	Stellaria media	) in quadrats per plot.
0.3	3.7	6.3	0.7	0.3	Capsella bursa-pastoris	)
41.0	40.3	88.0	64.3	38.3	Poa species	)
0.7	1.3	4.3	3.3	0.3	Viola tricolor	)
47	127	125	116	102	Kale	No. of plants in 15 x 5 ft row lengths per plot
116	184	133	96	72	Kale	No. of plants in 10 x 9 ft row lengths per plot
5.7	9.0	6.5	5.0	3.7	Kale	Scores for vigour
0.0	0.5	0.0	0.0	0.0	Chenopodium album	Scores for vigour
)	2.		6	10		
11.0	29.7	8.7	13.3	12.0	Spergula arvensis	No. of live plants in 4 x 2 ft row lengths/plot 1st emergence
6.0	36.3	7.7	7.7	3.0	Spergula arvensis	No. of live plants in 3 x 3 ft quadrats per plot 2nd emergence
49.0	48.3	52.3	57.3	48.0	Kale	No. of live plants in 4 x 2 ft row lengths per plot
-	10.0	10.0	9.0	-	Kale	)
-	9.7	9.3	6.0	-	Turnip	) Scores for vigour
-	5.7	5.7	1.0	-	Spergula arvensis	)

C. album occurred as a weed in four of the experiments, and in all four it showed susceptibility as in 1961. A dose of 3-6 oz/ac of any one of the herbicides was sufficient to provide control.

Polygonum spp. occurred in three of the experiments. P. persicaria showed much the same trend of susceptibility as had been shown by C. album but for an equivalent control a slightly higher dose was required. In the one experiment which contained P. convolvulus, this species was well controlled at doses above 2 oz/ac. In contrast, P. aviculare, which occurred in one experiment, was not controlled by 12 oz/ac of any of the chemicals.

S. arvensis occurred in two experiments, and in one of them (AA.16.62) there were two distinct age groups of the weed which were assessed separately. Although this species showed some susceptibility to the higher doses, it appeared as though at least 8 oz/ac would be required to give a control of even young plants.

Of the other weeds that were present in minor quantities in experiment AA.12.62, S. media appeared to be susceptible, C. bursa-pastoris and Veronica spp. were intermediate, and P. annua and V. tricolor appeared resistant. However, this information was not supported by any weight of experimental evidence.

During the period of 2-3 weeks after spraying the kale suffered some chlorosis and check, the effects of which were more marked at the higher doses. Thereafter it showed a capacity to grow away. In experiments AA.12 and AA.16 the numbers of kale plants on the different plots were counted 2 and 4 weeks respectively after spraying. Of the chemicals only desmetryne had not produced a reduction in numbers on the plots treated with doses of up to 6 oz/ac. This lesser activity on the crop shown by desmetryne was also evident in the yields taken from experiment AA.11.62 in which all treatments gave a higher yield than the unsprayed controls but desmetryne gave the highest yield on the plots treated with the highest dose (10 oz/ac), see table 7.

DISCUSSION

It was the general experience in these experiments that desmetryne proved consistently capable of controlling C. album at a dose that would provide an acceptable degree of safety for healthy kale. The chemical was limited in its spectrum of weed control. Useful controls of U. urens and S. media were obtained, and the results indicated some susceptibility on the part of P. persicaria and P. convolvulus though the margin of selectivity was rather narrow. For these reasons the chemical, though useful, could not by any means be regarded as the complete answer to the weed problems of kale.

An examination of the scores for the vigour of the kale during the 2-4 weeks after spraying in the experiments indicates that the chemical did vary in its general level of toxicity to the crop. Doses that caused mild transitory chlorosis in most of the experiments did in one or two cases cause rather more severe effects though these usually passed off as the crop compensated by vigorous growth during the mid-summer period. These two deficiencies in performance, the limited spectrum of weed control and variation in toxicity dictated the course of subsequent experimentation.

Since this work was carried out, extensive areas of kale crops have been treated with desmetryne annually. In general the susceptibility of the weed and the tolerance of kale observed in the experiments reported here have been confirmed.

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