WEED CONTROL IN CARROT, ONION AND BRASSICA CROPS

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Summary

Triazines, especially propazine, applied pre-emergent, gave good results in spring-sown carrots, but the post-emergent materials, DCMA and light aromatic oil, gave superior results in summer. No treatment used on onions was fully satisfactory. Turnips have shown some tolerance to triazines at low rates.

EXPERIMENTAL

THE RESULTS reported are from trials conducted during the spring, summer and autumn, 1961-62. Most of the trials were on the Wanganui clay loam soil at the Department of Agriculture Experimental Area, Marton, but some results from an observational trial at Palmerston North on alluvium from Tokomaru silt loam are reported. All materials, except the light aromatic oil, were applied in water at 40, 45 or 50 gal per acre. The trials at Marton were replicated four or five times in randomized blocks, while the observational trial at Palmerston North was replicated twice. In the following discussion, quantities of chemicals are expressed as active ingredient per acre.

WEATHER

The weather, particularly rainfall, during the trial period was abnormal and affected all trials to some degree. Rainfall in inches for the periods concerned at the two locations were as follows:

			Marton	Palmerston North
September	.....	.....	4.82	—
October	.....	.....	0.71	0.72
November	.....	.....	1.40	1.05
December	.....	.....	0.58	0.95
January	.....	.....	6.35	—
February	.....	.....	1.80	—
March	.....	.....	3.18	—
April	.....	.....	3.57	—

CARROTS

Three trials were laid down. Trials A and B were yield trials conducted at Marton in which half of each plot was kept weed-free and the time spent hand-weeding treatments recorded. Treatments are given in Tables 2 and 3. Trial C was conducted at Palmerston North. Pre-em. treatments were propazine 1 and 2 lb, HOE 2747 0.8 and 1.6 lb, chlorpropham and amiben at 4 lb and CDEC 12 lb. Post-em. applications of DCMA 4 and 8 lb and aromatic oil at 40 gal per acre were made. Other data concerning the three trials are given in Table 1.

WEED CONTROL

In the spring-sown Trial A, initial control of the heavy infestation of spurrey (*Spergula arvensis*), redshank (*Polygonum persicaria*), and nightshade (*Solanum nigrum*) by all treatments was excellent. The dry conditions which prevailed from mid-October greatly reduced the amount of subsequent weed invasion and so masked differences in residual weed control properties. Results of an assessment of weed cover on the unweeded sections are given in Table 2.

TABLE 1: TREATMENTS OF TRIAL PLOTS

	<i>Trial A</i>	<i>Trial B</i>	<i>Trial C</i>
Seed sown	Sept 8, 1961	Dec. 15, 1961	Oct. 25, 1961
Sprayed:			
Pre-em.	Sept. 14, 1961	Dec. 18, 1961	Oct. 27, 1961
Post-em. (DCMA)	—	Jan. 24, 1962	Nov. 10, 1961
" (aromatic oil)	—	Feb. 1, 1962	Nov. 28, 1961
Soil condition at pre-em. spraying	Wet	Very dry	Dry
Rainfall after pre-em. spraying (in.)			
0 to 2 weeks	3.00	Nil	0.40
2 to 8 weeks	1.40	8.00	1.90

TABLE 2: TRIAL A — PER CENT. WEED COVER THREE MONTHS AFTER SOWING

<i>Treatment</i> (lb)	<i>Weed Cover</i> %
Control	100
Propazine 1	10
Propazine 2	1
Prometryne 1	40
Prometryne 2	10
G34360 1	40
G34360 2	20
Amiben 4	20
Chlorpropham 4	20

Prometryne 2 lb was weed-free except for a few flatweeds. Survivors on the other triazine treatments were redshank, nightshade and flatweeds. Amiben gave poor control of later germinating nightshade, while chlorpropham was invaded by sowthistle (*Sonchus oleraceus*), twin cress (*Coronopus didymus*) and flatweeds.

In Trial B, where an initial infestation of spurrey with some dock (*Rumex obtusifolius*), redshank and fathen (*Chenopodium album*) was soon smothered by vigorous nightshade, post-em. treatments gave outstandingly the best weed control as is shown in Table 3.

TABLE 3: TRIAL B — EFFECT OF TREATMENTS ON WEEDS

<i>Treatment</i> (lb)	<i>Relative Numbers* 7 weeks</i> <i>after Sowing Crop</i>		<i>Weed Rating†</i> <i>15 weeks</i> <i>after Sowing Crop</i>
	<i>Spurrey</i>	<i>Nightshade</i>	
Control	100	100	9
Propazine 1	30	80	8
Propazine 2	10	50	5
Prometryne 1	20	60	8
Prometryne 2	10	40	7
G34360 1	30	50	9
G34360 2	20	30	6
HOE 2747	0.8	25	60
HOE 2747	1.6	5	50
Chlorpropham	4	0	50
Amiben	4	0	20
DCMA	4	0	10
DCMA	8	0	0
Aromatic oil 40 gal	5	15	15

* Weed numbers: Control = 12 spurrey, 8 nightshade per sq. ft.

† Weed rating: 1 = very few weeds; 9 = very severe weed infestation.

Dock, redshank and fathen were not sufficiently well distributed to obtain accurate information on them but it was noted that all were eliminated by the post-em. treatments, while HOE 2747 appeared to control docks and fathen better than the triazines. On treatments where control of nightshade was inadequate, this species grew vigorously and soon dominated both the crop and other weeds.

In the observational Trial C, where weeds were a mixture of redshank, spurrey, nightshade and fathen, the light aromatic oil gave excellent control of all species. In the dry conditions HOE 2747, which gave excellent control of fathen and, at the high rate, good control of other species, was superior to propazine where a fair number of redshank and small numbers of other species, except spurrey, survived. DCMA, particularly at the high rate, was initially very good but was invaded by later germinating nightshade and redshank. Weed control by both chlorpropham and CDEC was poor.

CROP YIELDS

Yield data from Trial A harvested February 8, 1962, and Trial B harvested May 2-3, 1962, are given in Tables 4 and 5 respectively.

TABLE 4: TRIAL A — CARROT YIELD
(tons per acre)

Treatment (lb)	Sprayed and Hand Weeded*		Sprayed and not Hand Weeded*	
	Yield	% of weeded control	Yield	% of weeded control
Control	22.3 a	A 100	2.0 †	9
Propazine 1	22.7 a	A 102	20.3 ab	AB 91
Propazine 2	22.6 a	A 101	23.1 a	A 104
Prometryne 1	19.7 abc	AB 88	16.8 bcd	BC 75
Prometryne 2	18.8 bc	AB 84	17.0 bcd	BC 76
G34360 1	21.7 ab	AB 97	18.4 bc	ABC 83
G34360 2	18.0 c	B 81	15.6 cd	BC 70
Chlorpropham 4	20.2 abc	AB 91	14.6 cd	C 66
Amiben 4	19.0 bc	AB 87	14.3 d	C 64
C.V.		10.7%		14.8%

* Weeded and unweeded yield data analysed separately.

† Omitted from analysis.

TABLE 5: TRIAL B — CARROT YIELD
(tons per acre)

Treatment (lb)	Sprayed and Hand Weeded*		Sprayed and not Hand Weeded*	
	Yield	% of weeded control	Yield	% of weeded control
Control	24.1 a	AB 100	0.0 †	0
Propazine 1	23.5 ab	ABC 98	2.7 †	11
Propazine 2	25.6 a	A 106	14.2 bcd	ABC 59
Prometryne 1	23.4 ab	ABC 97	2.4 †	10
Prometryne 2	24.7 a	AB 103	8.8 e	C 37
G34360 1	23.9 a	AB 99	1.3 †	5
G34360 2	25.1 a	AB 104	9.7 de	BC 40
HOE 2747 0.8	25.4 a	A 105	3.9 †	16
HOE 2747 1.6	24.3 a	AB 101	14.1 bcd	ABC 59
Chlorpropham 4	24.2 a	AB 100	10.4 de	BC 43
Amiben 4	24.6 a	AB 102	12.5 cde	ABC 52
Dicryl 4	20.4 bc	BC 85	16.8 abc	AB 70
Dicryl 8	19.2 c	C 80	19.4 a	A 81
Aromatic oil 40 gal	23.8 ab	ABC 99	18.2 ab	A 76
C.V.		9.1%		23.7%

* Weeded and unweeded yield data analysed separately.

† Omitted from analysis.

No effect on carrot numbers was found in Trial A. Probably because of the higher than optimum seeding rates, the slight reductions in the carrot numbers caused by most treatments in Trial B were not reflected in the yields, except in the case of DCMA applied at the 1 to 2 leaf stage which, though causing severe burning and retardation of survivors, significantly reduced yields at both rates. The greater solubility of G34360 in the initially very wet conditions may account for its marked effect on yields in the spring trial, while the lack of effect on yields from this and other pre-em. treatments in the summer trial was probably due to the high plant numbers and the rapid dissipation of herbicidal effects through high temperatures and adequate moisture.

In Trial C, CDEC caused obvious stunting and reduction in numbers, while propazine 2lb and HOE 2747 1.6lb both caused some retardation of growth and a possible reduction of numbers. Chlorpropham, amiben, aromatic oil and DCMA, which in Trial C was applied at the cotyledon stage, had no apparent adverse effect. The difference in DCMA effect between the two trials, presumably due to application at different stages of carrot growth, is of interest and worthy of further investigation.

ONIONS

One trial is described. Seed of Pukekohe Long Keeper was sown on September 8, 1961, and the treatments shown in Table 6 applied pre-em. on September 14, 1961, so that the trial was subjected to the same weather conditions as carrot Trial A. As in the carrot trials, half of each plot was kept weed-free until the crop was harvested on March 2, 1962. Owing to severe weed competition in the later stages of the trial, no bulbs were harvested on the unweeded areas.

Onions were counted four and eight weeks after spraying and again at harvest. Results are given in Table 6.

TABLE 6: ONION NUMBERS PER 10 FT ROW

<i>Treatment (lb)</i>	<i>Oct. 14, 1961</i>		<i>Nov. 7, 1961</i>		<i>Mar. 2, 1962</i>	
Control	90 b	A 100	90 a	A 100	57 a	AB 100
CDAA-T	4 105 a	A 117	87 a	A 97	58 a	AB 102
Prometryne	0.5 93 ab	A 103	73 b	A 81	51 ab	AB 89
Prometryne	1 65 c	B 72	54 c	B 60	43 b	B 75
Simetryne	1 89 b	A 99	87 a	A 97	60 a	A 105
Simetryne	2 88 b	A 98	87 a	A 97	60 a	A 105
Chlorpropham	4 11 †	12	7 †	8	6 †	11
C.V.	11.2%		11.8%		14.1%	

† Omitted from analysis.

Onion yields were not significantly affected by any treatment except chlorpropham which reduced yields by 85%.

WEED CONTROL

A heavy infestation of spurrey, redshank and nightshade occurred throughout the trial area. Results of weed seedling counts and later estimates of weed cover are given in Table 7.

The severe effect of chlorpropham was probably due to the wet and relatively warm conditions immediately after spraying. The highly significant reductions in onion numbers caused by prometryne 1 lb indicate too narrow a margin of crop tolerance for the safe use of the material in this crop. It seems probable in view of the tolerance of the onions that higher rates of simetryne could be used. Under the conditions of this trial, CDAA-T was useless as a weedicide.

TABLE 7: EFFECT OF TREATMENTS ON WEEDS

Treatment (lb)	Relative Numbers* 4 weeks after treatment			Relative Weed Cover 6 weeks 11 weeks after after treatment treatment	
	Spurrey	Redshank	Nightshade		
Control	100	100	100	90	100
Prometryne 0.5	0	30	30	20	70
Prometryne 1	0	10	10	10	40
Simetryne 1	10	60	80	60	100
Simetryne 2	0	40	40	20	80
CDAA-T 4	20	90	90	60	100
Chlorpropham 4	2	3	2	5	30

* Weed numbers: Control = 22 spurrey, 14 redshank, 16 nightshade per sq. ft.

BRASSICAS

In a preliminary observational trial in the autumn of 1961, brassicas showed some tolerance to ametryne and simetryne, although the latter was extremely toxic as a post-em. spray. In the following spring, trials were laid down with ametryne and simetryne at $\frac{1}{4}$, $\frac{1}{2}$ and 1 lb and G34361 and G34698 at $\frac{1}{2}$ and 1 lb on swedes, choumoellier and turnips. The swede and choumoellier trials were a failure owing to the dry conditions but the turnip trial was more successful. Seed (Hardy Green Globe) was drilled and treatments applied on December 15, 1961, when the soil was extremely dry, and no germination of crops or weeds occurred until rain fell two to three weeks later. Eight inches of rain fell from early January to mid-February and growing conditions were excellent.

EFFECT OF WEEDICIDES ON CROP

Turnip counts six weeks after treatment showed that the only material to have an adverse effect on numbers was G34698 which caused reduction of 10% at $\frac{1}{2}$ lb and 60% at 1 lb. Growth and vigour of survivors on these treatments and to a less extent on the high rates of G34361 and ametryne was initially retarded but in the excellent growing conditions these effects soon disappeared.

WEED CONTROL

Results of plant counts on control and those treatments where a weedicide effect was apparent are given in Table 8.

TABLE 8: WEEDS PER SQUARE FOOT SIX WEEKS AFTER TREATMENT

Treatment (lb)	Spurrey		Nightshade		Dock	
Control	34 a	A 100	8 a	A 100	6 a	A 100
Simetryne 0.25	*	100	*	100	*	100
Simetryne 0.5	*	100	*	100	*	100
Simetryne 1	20 b	B 58	7 a	A 94	6 a	A 90
Ametryne 0.25	*	100	*	100	*	100
Ametryne 0.5	12 c	C 37	7 a	A 86	6 a	A 86
Ametryne 1	3 d	D 8	5 b	B 65	3 bc	BC 53
G34361 0.5	*	100	*	100	*	100
G34361 1	6 d	D 17	5 b	B 60	4 ab	AB 67
G34698 0.5	4 d	D 13	3 c	C 37	2 c	C 37
G34698 1	<1	1	<1	10	<1	8
C.V.	18.4%		15.9%		21.9%	

* Not counted, no apparent effect.

Weeds on all treatments were soon smothered by extremely vigorous turnip growth and two months after treatment the crop was practically weed-free.

In a further trial turnips, swedes and choumoellier were drilled on March 19, 1962, and sprayed pre-em. on March 20, 1962, with the treatments shown in Table 9. Soil at laying down was dry on the surface but fairly moist underneath. In the three weeks after spraying 0.21 in. rain fell and a further 3.50 in. to the end of April. Germination and establishment of turnips was good and choumoellier fair but that of swedes was slower and less satisfactory owing to the dry conditions and out-of-season sowing.

Results of plant counts are given in Table 9.

TABLE 9: BRASSICAS PER 10 FT ROW SEVEN WEEKS AFTER TREATMENT

<i>Treatment (lb)</i>		<i>Turnip</i>	<i>Choumoellier</i>	<i>Swede*</i>
Control		67 a	A 100	34 a
Simetryne	1	68 a	A 103	33 a
Simetryne	2	68 a	A 102	34 a
Ametryne	0.5	68 a	A 102	33 a
Ametryne	1	67 a	A 101	34 a
Ametryne	2.5	38 a	B 58	21 ab
G34361	1	69 a	A 104	31 a
G34361	2	50 bc	AB 76	20 ab
G34698	0.5	63 ab	A 95	29 a
G34698	1	48 c	AB 72	14 b
C.V.		16.4%		19.5%

* Swede data not analysed.

All treatments which reduced numbers, whether significantly or not, also retarded growth. These effects were slight, moderate-severe, and severe on turnips, choumoellier and swedes respectively, effects by G34698 being the most severe. No herbicidal effect was noted until rain fell about three weeks after treatment. A relationship then became apparent between crop growth and herbicidal effect, with the rapidly growing turnips much less affected than the slow-growing swedes. Probably when rain fell and the chemicals were activated, the turnips had passed the most susceptible stage, while swedes were still vulnerable. However, it is apparent from the results achieved in the two trials, that turnips have sufficient tolerance to some at least of these materials to warrant further testing. The degree to which choumoellier and swedes share this tolerance has not been clearly shown.

Since few of the weeds present were those likely to be encountered at the usual time of sowing brassica crops, a detailed examination of weed control effects was not attempted.

DISCUSSION

Because of the species' tolerance to many of the herbicides now available, considerable scope exists for the use of weedicides in carrot crops. In view of this tolerance, such herbicidal properties as a wide weed-control spectrum and satisfactory residual life have become the factors most likely to determine suitability. The trials with this crop have demonstrated not only the improvement in yield likely to result from adequate weed control but also the

degree to which even partial control facilitates and reduces subsequent weeding. Even the least efficient weedicides under the poorest conditions reduced the amount of supplementary weeding required by at least 50%, while the most efficient under favourable conditions eliminated all real need for it. So, where weeds are expected, the question is not whether to use a weedicide but which one.

Because of its demonstrated lack of effect on the crop and greater residual effect against weeds, propazine is the most satisfactory of the triazines for use in carrots, particularly in cooler spring conditions and possibly in autumn, although its reported lack of effect on grasses (Thompson, 1961) would limit its usefulness at the latter season. However, in summer conditions where its herbicidal effects may be severely limited by inadequate moisture or rapidly dissipated through high temperature and moisture levels, it has been much less successful than the post-em. materials DCMA and light aromatic oil.

Although DCMA showed greater herbicidal efficiency than the light aromatic oil, it had a fairly severe adverse effect at the two-leaf stage, on the numbers, growth and consequent yield of carrots. In both trials where it was used, light aromatic oil gave very good results from a single application, but it is probable that in many instances more than one application would be necessary. Although chlorpropham has a shorter residual life than propazine, it performed well under cool conditions but is unsatisfactory for summer use. Amiben gave excellent initial results under either conditions but its value was greatly reduced by poor residual effect. HOE 2747, although fairly similar in effect to propazine, appeared to be less affected by the "paralysis" of herbicidal effect which, under dry conditions, is a particular weakness of the triazines.

The prospect for chemical weed control in onions is much less hopeful. None of the materials used in the trial described in this paper showed much promise, the margin of crop tolerance for propazine, the most effective material, being too narrow. But again, even the relatively ineffective treatments reduced the need for supplementary hand-weeding 50% or more.

Although results from the use of triazines in turnips are reasonably encouraging, much more work is needed to determine whether the obviously narrow margin between satisfactory weed control and acceptable crop damage is sufficient to permit practical use of these materials in brassica crops.

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REFERENCE

Thompson, F. B. 1961: *Proc. 14th N.Z. Weed Control Conf.*, p.174.