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WEED CONTROL IN DIRECT DRILLED LETTUCE

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Summary

Five seasonal trials with direct drilled lettuce (*Lactuca sativa*) on the Patumahoe clay loam soil type are reported where the major weed was twin cress (*Coronopus didymus*). For winter lettuce propyzamide at 1.5 kg/ha gave superior weed control without crop damage. Mixtures of sulfallate plus chlorpropham gave good control in all trials without crop damage at normal rates. Chlorpropham alone at 1.5 kg/ha gave only limited weed control while carbetamide, benfluralin and trifluralin all gave poor weed control. Bayer NTN 6867 caused excessive crop damage at the 4.5 kg/ha rate necessary to give adequate weed control.

INTRODUCTION

The Pukekohe district grows about 182 ha of lettuce annually (almost a quarter of the crop for the whole of New Zealand) of which 98% is direct drilled. Detailed information on the use of pre-emergence herbicides for direct drilled lettuce is limited. Previous trial reports have dealt mainly with transplanted crops (Thompson 1960; Boyce 1963). Webster (1961, 1962) recommended chlorpropham as likely to give the best results on direct drilled lettuce.

Cox (1970) listed chlorpropham, sulfallate and their combination as recommended treatments with benfluralin and propyzamide as tentative treatments. Subsequently the latter two chemicals have been recommended (Cox 1975).

This paper reports five trials conducted at the Horticultural Research Station, Pukekohe which were aimed at determining desirable herbicide rates for commercial lettuce crops at various drilling dates on the Patumahoe clay loam soils.

METHOD

The main herbicides tested (Table 2) were propyzamide, chlorpropham and sulfallate with the latter two as mixtures. Others included in some of the trials were Bayer NTN 6867, benfluralin, carbetamide and trifluralin.

Herbicide rates chosen were the minimum levels expected to provide adequate weed control on the Patumahoe clay loam soil type. Higher rates (1.5 times or 2 times) were included to check crop tolerance. Rates of chlorpropham and sulfallate were increased between the winter Trial 1 and the remainder under warmer soil temperatures (see Table 1).

Benfluralin and trifluralin in Trial 1 were the only herbicides incorporated before drilling. All the other herbicides were applied on the day after sowing and sprinkler irrigation (between 12 and 25 mm) was applied within 3 days on all trial sites for chemical activation and crop germination.

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Each trial had six replications using 7 x 1.5 m plots. Three rows per plot 30 cm apart were sown using a Stanhay precision seeder with sowing depth controlled at 10-15 mm depending on soil conditions.

Pelleted seed was used in Trial 1 and bare seed in the others using cv 'Triumph' in Trials 1 and 2, cv 'Great Lakes' in Trials 3 and 4 and cv 'Greendale' in Trial 5. Sowing dates were 14 May 1974, 17 March 1975, 3 February 1976, 5 October 1976 and 6 January 1977.

Seedling weeds were allowed to reach the first true leaf stage (21-30 days after sowing) for identification before weed control assessment. Weed populations in the hand weeded controls (HWC) were assessed by counting with two to four 25 x 25 cm quadrats per plot. Effectiveness of weed control was assessed on all plots by visual observation. After weed control assessment all plots were hand weeded and kept clean.

The lettuce were thinned to a spacing of 25 or 30 cm between plants depending on sowing date to leave 63 or 78 plants per plot plus guards.

Plot yields were recorded in Trials 1, 2 and 3. Old stock seed was supplied for Trial 4 and physiological necrosis resulted in a poor stand; the trial was terminated after weed assessment. *Sclerotinia* disease reduced plant numbers before harvest in Trial 5 and yield was recorded on the first 50 disease free heads in each plot. Yields were not recorded from trifluralin treatments in Trial 1 due to poor weed control and excessive crop competition.

RESULTS

Weed control

The spectrum of weeds in the untreated controls for each trial site is shown in Table 1. Twin cress was the major weed species and occurred in high numbers particularly in the first sowing of May 1974.

The level of weed control achieved by each treatment in the five trials is shown in Table 2. Mean scores of 20 percent or less indicate acceptable weed control.

Propyzamide at 1.5 kg/ha gave excellent weed control (Trial 1) but in general higher than recommended rates (3 kg/ha) were necessary to give adequate weed control in subsequent sowings under warmer soil temperatures. Trial 5, sown in early January, was the exception where excellent weed control was achieved with 1.5 kg/ha of propyzamide. In this trial site 25 mm of sprinkler irrigation was applied the day after herbicide application then over the next two days 80 mm of rain fell.

Good control in all trials was achieved with sulfallate/chlorpropham mixtures. The 5 + 1.5 kg/ha rate in spring and summer sown trials controlled most weeds. Trials 3, 4 and 5 indicated that a higher rate of sulfallate up to 7.5 kg/ha may be warranted to increase the twin cress kill. Carbetamide at 3 kg/ha and in combination with chlorpropham 1.5 kg/ha gave unacceptable weed control. Bayter NTN 6867 at 4.5 kg/ha gave adequate weed control. Benfluralin and trifluralin both failed to provide twin cress control.

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TABLE 1: Weed species for five trial sites as No./m² on untreated plots

Weed	Trial Sown	1 14.5.74	2 17.3.75	3 3.2.76	4 5.10.76	5 6.1.77
twin cress (<i>Coronopus didymus</i>)		1372	544	423	700	180
speedwell (<i>Veronica persica</i>)		139	7	77	60	65
spurrey (<i>Spergula arvensis</i>)		83	1	1	48	—
annual mouse-ear chickweed (<i>Cerastium glomeratum</i>)		69				
dock (<i>Rumex obtusifolium</i>)		44	1	12	12	3
poa annua (<i>Poa annua</i>)		36	3	22	3	
fumitory (<i>Fumaria</i> spp)		27		26		
sow thistle (<i>Sonchus oleraceus</i>)		21	1	7		3
black nightshade (<i>Solanum nigrum</i>)		19	12	5	100	1
groundsel (<i>Senecio vulgaris</i>)		13	1	1	9	
hawkbeard (<i>Crepis capillaris</i>)		11		301		
chickweed (<i>Stellaria media</i>)		8				
redroot (<i>Amaranthus powellii</i>)			7	9	7	1
scarlet pimpernel (<i>Anagallis arvensis</i>)			3	4		
shepherd's purse (<i>Capsella bursa-pastoris</i>)			3	2	43	3
portulaca (<i>Portulaca oleacea</i>)			1	6	4	3
willow weed (<i>Polygonum persicaria</i>)			1	3	21	1
fathen (<i>Chenopodium album</i> agg)				2		
white clover (<i>Trifolium repens</i>)				28	1	
plaintain (<i>Plantago lanceolata</i>)				4		
wireweed (<i>Polygonum aviculare</i>)					13	1
Mean soil temperature °C at 10 cm depth for the month of drilling		12.3	18.5	16.9	13.5	18.3
Days elapsed between drilling and first harvest		139	98	79	—	76

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TABLE 2: Mean weed control rating five trial sites as percentage of weed cover in untreated controls

Treatment	kg/ha	Trial No. and sowing date				
		1	2	3	4	5
		14.5.74	17.3.75	3.2.76	5.10.76	6.1.77
Bayer NTN 6867	3	—*	—	23	—	—
Bayer NTN 6867	4.5	—	25	10	—	—
Bayer NTN 6867	6	—	—	—	—	—
Bayer NTN 6867	9	—	12	—	—	—
benfluralin	1	92	—	—	—	—
benfluralin	2	73	—	—	—	—
benfluralin + chlorpropham	1 + 0.6	61	—	—	—	—
carbetamide	3	—	57	—	—	—
carbetamide + chlorpropham	3 + 1.5	—	27	36	50	23
chlorpropham	0.6	63	—	—	—	—
chlorpropham	1.2	36	—	—	—	—
chlorpropham	1.5	—	48	73	74	28
chlorpropham	3	—	32	33	40	14
propyzamide	1.5	12	43	58	23	18
propyzamide	3	—	23	30	4	3
sulfallate	5	40	43	30	42	13
sulfallate	7	41	—	—	—	—
sulfallate	7.5	—	—	—	34	4
sulfallate	10	—	17	15	15	3
sulfallate + chlorpropham	2.5 + 1.2	23	—	—	—	—
sulfallate + chlorpropham	5 + 0.6	27	—	—	—	—
sulfallate + chlorpropham	5 + 1.5	—	18	20	24	1
sulfallate + chlorpropham	7 + 2	—	13	13	—	—
sulfallate + chlorpropham	7.5 + 1.5	—	—	—	9	0
sulfallate + chlorpropham	10 + 1.5	—	—	—	7	0
trifluralin	0.8	85	—	—	—	—
trifluralin	1.6	77	—	—	—	—

*blanks indicate treatments not included.

Yield results

Yield data are shown in Table 3. There were no significant differences in yield between herbicide treatments in Trial 1. All plots produced good yields for winter grown crops. In Trial 2 Bayer NTN 6867 caused excessive crop damage significantly reducing yields. Overall low yields in this trial resulted from patchy growth, small heads and flood damage before harvest. Heavy yields were produced in Trial 3 and Bayer NTN 6867 at 6 kg/ha was the only herbicide which reduced yields.

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TABLE 3: Total harvest yield tonnes/ha

Treatment	Rate kg/ha	Trial No. and sowing date			
		1 14.5.74	2 17.3.75	3 3.2.76	5* 6.1.77
Bayer NTN 6867	3	—	—	52.9 a	—
Bayer NTN 6867	4.5	—	12.0 bc	—	—
Bayer NTN 6867	6	—	—	40.2 b	—
Bayer NTN 6867	9	—	4.2 c	—	—
benfluralin	1	30.5 ab	—	—	—
benfluralin	2	30.5 ab	—	—	—
benfluralin + chlorpropham	1 + 0.6	31.2 a	—	—	—
carbetamide	3	—	13.6 bc	—	—
carbetamide + chlorpropham	3 + 1.5	—	14.0 bc	55.2 a	36.8 de
chlorpropham	0.6	31.3 a	—	—	—
chlorpropham	1.2	30.9 ab	—	—	—
chlorpropham	1.5	—	15.1 abc	53.8 a	41.2 bc
chlorpropham	3	—	13.9 bc	52.6 a	30.2 f
propyzamide	1.5	31.2 a	18.1 a	52.6 a	47.5 a
propyzamide	3	—	17.9 a	55.8 a	45.2 a
paraquat/diquat	0.5	31.8 a	—	—	—
sulfallate	5	29.8 ab	13.5 bc	56.6 a	40.8 bc
sulfallate	7	31.0 a	—	—	—
sulfallate	7.5	—	—	—	40.2 bc
sulfallate	10	—	13.4 bc	52.3 a	38.7 bcd
sulfallate + chlorpropham	2.5 + 1.2	31.2 a	—	—	—
sulfallate + chlorpropham	5 + 0.6	30.5 ab	—	—	—
sulfallate + chlorpropham	5 + 1.5	—	13.4 bc	51.9 a	41.5 b
sulfallate + chlorpropham	7 + 2	—	13.3 bc	54.8 a	—
sulfallate + chlorpropham	7.5 + 1.5	—	—	—	38.9 bcd
sulfallate + chlorpropham	10 + 1.5	—	—	—	34.5 e
Hand weeded control		28.2 b	15.5 ab	54.8 a	38.2 cd
CV %		7.0	18	7.2	4.9

* Mean yield 50 heads in kg/plot as opposed to t/ha for trials 1, 2 and 3

Plots treated with 1.5 or 3 kg/ha propyzamide produced yields significantly (5%) higher than all other herbicide treatments in Trial 5. This was consistent with performance in the other trials. Chlorpropham at 3 kg/ha and sulfallate/chlorpropham 10 + 1.5 kg/ha significantly depressed yields compared with the hand weeded control.

DISCUSSION

For the winter lettuce crop propyzamide clearly gave the best weed control. New Zealand label registration for this herbicide recommends a rate of 1.5 kg/ha and restricts application to the cooler months from May to August. The trials reported indicate that propyzamide may have a place for use outside the months specified.

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Paxman and Forgie (1972) who describe trial application of propyzamide on pastures, showed a marked decrease in herbicide response between winter and spring. The good weed control reported with propyzamide in the January lettuce sowing (Table 2) is thought to be due primarily to the high soil moisture status over the first few days after sowing.

Crop yield comparisons in the summer Trials 2 and 5 show higher yields for propyzamide treatments than the accepted sulfallate/chlorpropham mixtures. Propyzamide at rates above 1.5 kg/ha plus adequate soil moisture may provide good spring and summer control. There is however some reluctance to suggest high rates for commercial application because herbicide residues may affect subsequent susceptible crops (Cudney *et al* 1974). Growers in the Pukekohe area have already accepted and applied herbicide treatments recommended from the trial series.

Some major cost savings have been achieved as a result of reducing the need for hand hoeing. This applies particularly to the winter period when problem weed species are difficult to kill with mechanical or hand hoeing techniques. Commercial use of propyzamide has already shown that resistant Compositae weed species such as groundsel, sow thistle and rayless chamomile (*Matricaria matricarioides*) are likely to increase. Future herbicide use on lettuce crops may require alternation of different programmes to prevent build up of problem weeds.

From the trial series reported further studies are warranted to test sulfallate/chlorpropham mixtures for May to July drilled lettuce. Evaluation of higher rate effect on both crop and weeds are required as an alternative to propyzamide.

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