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WEED CONTROL IN DIRECT DRILLED GREEN SPROUTING BROCCOLI

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Summary

Three chemical weed control trials in green sprouting broccoli (*Brassica oleracea* var *italica*) are reported. Trifluralin, dinitramine, nitralin and bensulide all soil incorporated; bensulide, sulfallate, alachlor, propachlor, nitrofen and chlorthal pre-emergence; and cyanazine post emergence, did not control a sufficiently wide spectrum of annual weeds when applied singly. Cyanazine caused crop injury. Combined treatments were examined and broad spectrum weed control was obtained with trifluralin 0.8 kg/ha soil-incorporated followed by alachlor 1.5 kg/ha or propachlor 3.9 kg/ha pre-emergence.

INTRODUCTION

Green sprouting broccoli is becoming an important processing crop in Canterbury with over 30 ha grown annually for machine harvest. The crop is precision sown in beds to give densities of 16 – 20 plants/m². Broccoli is normally drilled in spring for summer harvest, or in summer for autumn harvest.

Problem weeds in broccoli include fathen (*Chenopodium album* agg), storksbill (*Erodium cicutarium*), spurrey (*Spergula arvensis*), the polygonaceous weeds wireweed (*Polygonum aviculare*), willow weed (*P. persicaria*), and cornbind (*P. convolvulus*) and the cruciferous weeds particularly shepherd's purse (*Capsella bursa-pastoris*). The close spacing at which the plants are grown makes inter-row cultivation difficult and although the crop may suppress late-germinating weeds, an effective means of chemical weed control is necessary in the early stages of crop growth.

Anon (1973) has found variation in the sensitivity of the vegetable brassicas to herbicides, broccoli being the most sensitive. In Canterbury the most widely used herbicide on broccoli is trifluralin, soil incorporated. Although it has given broad spectrum weed control, it will not control cruciferous weeds. Alternative herbicides for broccoli have been evaluated in California, (Fischer *et al* 1971) but no recent experimental work has been reported in New Zealand.

As a preliminary trial suggested a number of safe alternatives to trifluralin, the three trials reported in this paper were conducted to evaluate these treatments singly and as combinations.

EXPERIMENTAL METHODS

A randomized four-block design with a plot size of 7.5 – 12 m² was used in each of the trials. Trial I was carried out in a January

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sown commercial crop in 1976. Trials II and III were sown in September 1976 and January 1977 respectively. Trial I was situated on the Kaiapoi fine sandy loam, whilst Trials II and III were on Waimakariri sandy loam.

Herbicide applications were made with a constant pressure CO₂ knapsack sprayer delivering 340 litres/ha at 200 kPa. Soil treatments were incorporated with a rotary hoe to 5 cm depth.

Soil incorporated treatments were applied 3-6 days pre-sowing. Pre-emergence treatments were applied 1-6 days after sowing and prior to crop and weed emergence. Thomson (1976) reports that moisture is required to activate all the pre-emergence herbicides used, and recommends 8-18 mm following application of alachlor. If insufficient rain had fallen within two days of the pre-emergence applications, irrigation (8-12 mm) was applied. Post emergence applications were made about 6 weeks after sowing when the broccoli was 12-15 cm high.

Detailed weed counts were made approximately 8 weeks after sowing by sampling two to four 0.25 m² quadrats in each plot. In trials I and III the plots were scored for overall weed control at the same time as the weed counts. When the treatments were to be harvested, they were maintained weed free throughout the duration of the trials.

At harvest all marketable heads (diameter greater than 2 cm) from 1 m² in each plot were harvested, trimmed to 15 cm length and weighed.

RESULTS AND DISCUSSION

Table 1 summarizes the weed control and yield data from single herbicide applications, and Table 2 from the herbicide combinations.

Single Herbicides

Of the soil incorporated herbicides, trifluralin provided the best overall control of non-cruciferous weeds. Dinitramine also provided good control of all these weeds except storksbill. Although it gave some control of shepherd's purse and wild turnip (*Brassica campestris*), dinitramine was not considered further because of reported yield reduction in broccoli, (J. McCully pers comm).

Of the pre-emergence herbicides, sulfallate provided the best overall control of the non-cruciferous weeds. Alachlor and propachlor were particularly effective against shepherd's purse and gave some control of wild turnip, but were less effective than sulfallate against storksbill, chickweed (*Stellaria media*), fathen and cornbind.

No suitable post-emergence treatment was found. In trial I cyanazine caused crop injury and reduced yields. In a preliminary trial methabenzthiazuron (1.05 and 2.1 kg/ha) post emergence was also found to be phytotoxic.

Combined Treatments

No single herbicide was found to be effective against the range of weeds present in the trials. Work on cauliflower (Roberts 1972),

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TABLE 1: Weed control and yield means with single herbicides

Treatment	Rate kg/ha	Timing	Trial I					Weed % spurrey cover	Yield t/ha
			fathen	storksbill	chickweed	% weed control cornbind	shepherd's purse		
untreated								99	—
hand weeded			100	100	100	100	100	1	6.17 a
trifluralin	0.8	soil-inc	91	42	80	95	0	58	—
dinitramine	0.6	soil-inc	91	0	88	89	35	32	—
nitralin	1.39	soil-inc	77	0	68	42	0	70	—
bensulide	2.6	soil-inc	27	10	14	0	0	82	—
bensulide	2.6	pre-em	41	14	10	68	4	74	—
sulfallate	5.0	pre-em	82	87	61	63	62	24	6.20 a
alachlor	1.5	pre-em	45	71	57	26	91	24	6.70 a
propachlor	4.0	pre-em	50	64	66	42	96	28	6.30 a
cyanazine	1.5	post-em	32	6	99	100	59	—	4.62 b
CV								—	11.5%
Trial II									
nitrofen	1.92	pre-em	72			67	51		
chlorthal	8.25	pre-em	100			0	0		
Trial III									
trifluralin	0.8	soil-inc	55				4	57	72
trifluralin	1.0	soil-inc	60				5	64	67
alachlor	1.5	pre-em	60				73	88	52

— not assessed

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TABLE 2: Weed control and yield means with herbicide combinations

Treatment	Rate kg/ha	Timing	fathen	<i>Trial II</i>			Weed % cover	Yield t/ha
				% weed control cornbind	shepherd's purse	spurrey		
untreated			100	100	100			2.90B
hand-weeded								—
trifluralin	0.8	soil-inc						—
+ alachlor	1.0	soil-inc	82	60	80			—
trifluralin	0.8	soil-inc						—
+ alachlor	1.5	soil-inc	93	7	81			—
trifluralin	0.8	soil-inc						—
+ alachlor	1.0	pre-em	99	93	90			—
trifluralin	0.8	soil-inc						8.83A
+ alachlor	1.5	pre-em	100	80	99			9.01A
trifluralin	0.8	soil-inc						26.6%
+ propachlor	3.9	pre-em	100	93	100			
CV								
<i>Trial III</i>								
trifluralin	0.8	soil-inc						
+ alachlor	1.5	pre-em	85		66	96	27	
trifluralin	1.0	soil-inc						
+ alachlor	1.5	pre-em	85		87	95	25	
trifluralin	0.8	soil-inc						
+ propachlor	3.9	pre-em	79		53	68	45	
—	not assessed							

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Brussels sprouts (Wood 1972) and cabbage (Roberts and Bond 1975), suggested that a combination treatment would give better control of a mixed population of annual weeds.

Results from Trial I suggested that trifluralin soil incorporated followed by alachlor or propachlor would give good control of the main weed species. In Trial II rates and timing of alachlor in combination with trifluralin were investigated (Table 2). Alachlor was less effective against all weeds soil-incorporated than pre-emergence, and was more effective at the higher rate of application. In Trial III control of shepherd's purse was improved with the higher rate of trifluralin. In Trial III although alachlor and propachlor gave lower control of shepherd's purse than in previous trials they greatly restricted the growth and development of those seedlings which did emerge.

None of the combination treatments appeared to affect crop germination or establishment. In Trial II yields from trifluralin plus alachlor (1.5 kg/ha) or propachlor were significantly better than from the untreated control.

CONCLUSIONS

For the successful production of green sprouting broccoli effective chemical weed control is essential, not only to prevent yield loss but also to facilitate mechanical harvesting. None of the herbicides available could on its own fulfil this requirement, and a combined treatment was needed. Satisfactory results were obtained with trifluralin 0.8 kg/ha soil incorporated followed by alachlor 1.5 kg/ha or propachlor 3.9 kg/ha pre-emergence. Rain or irrigation is necessary following the pre-emergence application as alachlor and propachlor are dependent upon adequate moisture for activation.

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