EFFECT OF DIFFERENT SOIL PREPARATION METHODS AND HERBICIDES ON WEEDS AND ESTABLISHMENT OF CORIANDER

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SUMMARY

Pre emergence application of pendimethalin, linuron or prometryne, and post emergence application of paraquat plus diquat, were evaluated for control of weeds in a coriander (*Coriandrum sativum* L.) oil-seed crop. Seed beds were prepared by either rotary hoeing to a level or raised seed bed, discing followed by tyne harrowing, or grubbing followed by rotary crumbling and power harrowing. Pendimethalin had the least effect on coriander populations and vigour, and gave effective weed control. In the absence of herbicide, rotary hoeing gave best control of field bindweed, and grubbing and power harrowing were more effective on fathen, red dead nettle and shepherd's purse. Herbicide treatment negated these effects.

Keywords: coriander, *Coriandrum sativum* herbicide control, cultivation methods.

INTRODUCTION

Trial plantings at Invermay Agricultural Centre of crops intended for oil extraction have been subjected to intense competition from weeds during the establishment phase. Trials involving pre and early post emergence herbicide applications have allowed most herb crops to develop successfully through the early stages of development (James *et al.* 1991; R.B. Mitchell unpub.). However, the possibility of growing export oil crops with minimal use of herbicides could be of benefit to future markets. Since cultivation techniques can alter the emergence of weeds (Daly and Stevenson 1990; Hartley 1990), different methods of preparing the seed bed which may limit or delay weed emergence, create an opportunity for reduced reliance on herbicides.

This paper reports on a trial where four different methods of ground preparation were used before sowing a crop of coriander (*Coriandrum sativum* L.). Five herbicide treatments were evaluated on each method of soil preparation for their influence on weeds and coriander establishment.

METHODS

The trial was sited at Invermay on a Wingatui silt loam with a pH of 5.3 and an organic carbon level of 3.3%. The area was ploughed in autumn 1992 and disced in early October. On 9 October 1992 three replicates of the four cultivation treatments were carried out with tractor mounted machinery on four main plots each 18 x 5 m. The cultivation treatments consisted of cutting twice with a rotary hoe to a depth of 20 cm to form either a level seed bed or a raised bed, both methods producing fine particle-sized soil; discing twice followed by two passes with trailing tyne harrows, and grubbing twice followed by two passes with a rotary crumbler, then power harrowing. The latter two methods produced very cloddy seed beds.

On 15 October 1992, 125 kg/ha of diammonium phosphate (20% P, 18% N), plus 50 kg/ha muriate of potash (50% K) were applied by hand over the trial area. The length of each plot was divided into six 3 x 5 m subplots, to which the untreated control and

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five herbicide treatments were randomly allocated. Four of these treatments consisted of a pre-emergent application of 1.5 kg/ha pendimethalin (Stomp 330E); 1.0 or 0.75 kg/ha linuron (Linuron 50); and 1.0 kg/ha prometryne (Gesagard 500FW) applied on 19 October 1992. The following day, coriander seed treated with the fungicides disulphide (Thiram 40F) and captan (ICI Captan WDG), was drilled at 15 kg/ha in three passes side-by-side with a cone seeder containing eight coulters set 15 cm apart. On 9 November 1992 when emerged weeds had 1-5 true leaves and were 2-5 cm in height, the fifth herbicide treatment of 0.5/0.3 kg/ha paraquat/diquat (Preeglone) was applied. The coriander seed was re-sown later in the same day on these plots at the same seeding rate and number of rows as sown with the cone seeder using a Planet Junior seed sower. This seeder was more suitable for sowing seed accurately onto the confined plot sizes remaining after the herbicide treatments were allocated.

Coriander plant numbers were recorded in six 0.5 m row lengths randomly selected along the length of the six middle rows of each plot for the pre-emergent treatments on 20 November 1992 and from the post-emergent treatment on 18 December 1992. Further counts and an assessment of plant vigour on a score of 1 (dead) - 10 (luxuriant) were taken on all plots on 7 April 1993. The percentage weed cover and the numbers and species of weeds were recorded on 23 November 1992 in two 0.1 m² quadrats placed at random on each of the three drill runs in each sub-plot (six quadrats per sub-plot). A visual assessment of percentage weed cover was taken on 8 December 1992.

Analysis of variance was performed on coriander densities and vigour, and on weed densities and cover. Density of total weeds in November 1992 was used as a covariate on coriander densities and vigour in November and April to isolate the weed effect on the crop from the herbicide and cultivation effects on the crop.

RESULTS

Treatment effects on total weeds and coriander

Weed cover and total weed density in November were lowest in the pendimethalin and paraquat/diquat treated plots, with plots treated with linuron having slightly ($P<0.05$) more weeds (Table 1). There was no difference among the cultivation methods ($P>0.05$) in total weed density or percent weed cover.

Differences in coriander numbers and vigour were observed for the herbicide treatments (Table 1). In November, 4 weeks after sowing, there were 19.4 (SED=3.52; $P<0.001$) more plants/m in the paraquat-diquat post emergence treatment than in the untreated control and other herbicide treatments (amongst which there were no significant differences ($P>0.05$)), possibly because of either a differential germination rate between the two drill methods, or the extra soil disturbance stimulated germination of dormant coriander seed sown previously. By April, this trend had reversed, with plant numbers significantly lower ($P<0.01$) in the paraquat-diquat treatment than for the mean of those in the untreated plots and pre-emergence herbicide treatments. Actual coriander plant numbers and plant vigour scores were higher in plots treated with pendimethalin than for all other treatments.

There was no difference among cultivation methods ($P>0.05$) in the number of established coriander plants in November, and the following April, in the unadjusted analysis. Using the November average total weed density (127 plants/m², Table 1) as a covariate, adjusted coriander counts in plots rotary hoed with a raised bed (42.5/m) and disced-tine harrowed (39.2/m) were higher than in plots rotary hoeing to a level bed (31.3/m) or grub-crumble-power harrowed (21.3/m, SED = 4.65; $P<0.05$).

There was no interaction between the total weed population and any herbicide treatment which affected coriander populations in November. But the covariate adjustment was significant ($P<0.001$) for coriander density and vigour in April the following year (Table 1). Adjusted to the same November weed density, the number of coriander plants/m row was higher ($P<0.001$) in the untreated plots than in all herbicide treatments except pendimethalin, suggesting that a phytotoxic effect from the other herbicides had occurred.

TABLE 1: Main effects of herbicide on the density and vigour of coriander, and on ground cover and density of weeds.

Herbicide	Total weeds		Coriander				
	Nov 92 % cover	No./m ²	Nov 92 No./m	No./m actual	Apr 93 No./m adj ²	vigour ¹ actual	vigour adj
untreated	16.8	261	61.3	33.8	49.6	3.4	4.9
pendimethalin	1.3	41	61.1	55.5	45.4	6.8	5.8
linuron 1.0	7.8	96	61.8	35.8	32.2	3.8	3.5
linuron 0.75	8.9	115	57.4	29.3	28.0	3.5	3.4
prometryne	11.4	206	60.9	25.4	34.7	3.0	3.9
paraquat/diquat	1.4	41	80.2	21.6	11.6	5.2	4.2
LSD _(0.05)	5.3	63	11.9	12.1	11.5	1.4	1.5

¹ vigour score: 1 = dead, 10 = luxuriant² adjusted for weed density as a covariate**Treatment effects on weed species**

Averaged over all cultivation treatments, no significant ($P>0.05$) herbicide interactions were observed for willow weed (*Polygonum persicaria*) (POLpe), annual mouse-ear chickweed (*Cerastium glomeratum*) (CERgl), wireweed (*Polygonum aviculare*) (POLav), shepherd's purse (*Capsella bursa-pastoris*) (CAPbu) and red dead-nettle (*Lamium purpureum*) (LAMpu) (Table 2). Compared with the densities in untreated plots, the average density over all herbicide treatments was lower only for willow weed (57 cf. 29/m²; SED = 13.0; $P<0.05$) and chickweed (21 cf. 4/m²; SED = 4.7; $P<0.001$). For the individual herbicides, densities of broad-leaved dock (*Rumex obtusifolius*) (RUMob), fathen (*Chenopodium album* agg.) (CHEal), field bindweed (*Convolvulus arvensis*) (CONar) and wireweed were lowest in pendimethalin treated plots; whereas for white clover (*Trifolium repens*), (TRIRE) annual mouse-ear chickweed and "other" (other) weeds, densities were lowest in both pendimethalin and linuron treated plots.

TABLE 2: Main effects of herbicide on individual weed density (No./m²) of different weeds on 23 November 1992.

Herbicide	POLpe	RUMob	CONar	TRIRE	CERgl	CHEal	POLav	CAPbu	LAMpu	Other
untreated	57.2	48.2	11.3	22.4	20.8	11.9	39.7	41.0	4.0	4.6
pendimethalin	27.6	0.7	4.9	2.4	1.1	0.3	0.7	2.6	0.0	1.1
linuron 1.0	30.8	17.8	8.2	2.5	1.9	4.0	27.9	0.7	0.8	1.7
linuron 0.75	34.3	24.6	8.2	6.1	3.2	5.8	26.2	0.7	2.1	4.0
prometryne	36.4	65.0	5.8	16.4	15.7	12.6	32.6	17.1	2.1	2.2
paraquat/diquat	17.8	1.7	1.3	1.9	0.1	0.1	15.1	2.5	0.1	0.6
LSD _(0.05)	34.0	17.4	4.8	4.9	12.1	4.0	26.2	14.9	4.3	2.1
(Herbicide interaction) ¹	ns	***	*	***	ns	***	ns	ns	ns	*

¹ ns not significant; * $P<0.05$; *** $P<0.001$

Significant differences in weed density in untreated or herbicide treated plots cultivated by the different methods occurred in four weed species 4 weeks after sowing (Table 3). In the absence of herbicides, populations of field bindweed were lower in plots cultivated by rotary hoe either to a level or raised bed than in plots cultivated by the grub-crumbler-power harrow. However, populations of fathen and shepherd's purse were lower in the grub-crumbler-power harrowed plots than in plots treated with the other cultivation methods. For red dead-nettle, populations were negligible in plots treated with all methods except for the rotary hoe-level seed bed preparation. Plots treated with the herbicides contained weed populations which were similar ($P>0.05$) to one another, and generally at the same level as the most effective cultivation treatment. There were no significant interactions evident between the different methods of cultivation and the different herbicides.

TABLE 3: Effect of cultivation with and without (+ and -) herbicides on density (No./m²) of field bindweed, fathen and red dead-nettle, 4 weeks after sowing.

Herbicide Cultivation	Field bindweed		Fathen		Red dead- nettle		Shepherd's purse	
	-	+	-	+	-	+	-	+
Rotary hoe - level	5.0	3.2	10.6	4.4	15.0	1.3	45.0	4.1
Rotary hoe - raised	7.8	8.3	13.3	3.6	0.6	0.3	81.1	3.2
Disc-tyne harrowed	12.8	6.1	20.0	4.3	0.6	0.1	28.9	8.9
Grub-crumbler -power harrowed	19.4	5.0	3.9	6.0	0.0	2.3	8.9	2.7
LSD _(0.05)								
within -, + herbicide	10.1	5.3	7.9	3.6	9.0	4.6	29.3	11.9
between -, + herbicide	7.5		6.1		6.6		23.0	

DISCUSSION

Compared with the other herbicides, pendimethalin showed the least phytotoxic effects on coriander populations and vigour in the spring, yet gave the best early control of weeds. Pendimethalin gave more effective control of dock, fathen and wireweed than the other herbicides. It is recommended for further evaluation in controlling weeds in coriander crops. Linuron at 1 kg/ha, because of its effectiveness in weed control and low phytotoxicity, was the next best herbicide of those tested for weed control in coriander crops. Paraquat/diquat solution, because of its high phytotoxicity, and prometryne because of its poor weed suppression, cannot be recommended.

The results here suggest that the choice of cultivation method to use in the absence of herbicides will depend on the species of weeds expected. Rotary hoeing appears to be the best method if the paddock is prone to field bindweed, but grubbing, crumbling and power harrowing the soil prior to sowing is the most effective method for suppressing populations of fathen, red dead-nettle and shepherd's purse. However, the herbicides tended to negate the weed suppression due to cultivation, so where herbicides are to be used, the cheapest cultivation method is recommended.

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