CONTROL OF WEEDS IN FIVE HERB CROPS

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SUMMARY

Several herbicides were screened in glasshouse experiments for both pre- and post-emergence use with five herb species, coriander (*Coriandrum sativum*), clary sage (*Salvia officinalis*), dalmatian sage (*S. sclarea*), German chamomile (*Matricaria chamomilla*) and thyme (*Thymus vulgaris*). The most promising treatments were then tested in the field in both spring and autumn. Coriander was tolerant to most of the herbicides tested, while no herbicide was safe on German chamomile. Linuron, chlorbromuron, chloroxuron and prometryn were among the most useful chemicals tested. Based on these results tentative recommendations for weed control during establishment of these crops are given.

Keywords: herbs, weed control, crop tolerance, aromatic plants, essential oil plants.

INTRODUCTION

Culinary herbs and essential oil plants are aromatic plants that are used as flavourings in food and beverages, for their fragrances in pharmaceuticals and industrial products, and as herbal medicines. There is a large international market for this type of product (Simon 1989; Anon. 1986). The possibility of supplying that market with New Zealand grown produce is currently being evaluated with small scale test plantings. However, before the agronomy of any new crop can be studied in detail, it is necessary to be able to grow the crop without interfering weed competition. Herbicide recommendations for use in many herb crops are available in overseas literature (e.g. Mass 1989) but some herbicides are not available in New Zealand or have little effect on the local weed spectrum.

The aim of this study was to develop chemical weed management recommendations through glasshouse and field experiments for five herb species, viz: clary sage (Labiatae, biennial-perennial); coriander (Umbelliferae, annual); dalmatian sage (Labiatae, perennial); German chamomile (Compositae, annual) and thyme (Labiatae, perennial).

MATERIALS AND METHODS

Glasshouse herbicide tolerance experiments

Three experiments were conducted in the glasshouse, each involving pre-emergence and one to three post-emergence applications at different stages of growth. The soil used for all experiments was a Horotiu sandy loam, with 9.1% organic matter and a pH of 5.8. For the smaller seeded species (chamomile and thyme) 10-15 seeds were placed on the surface of uncompacted soil in 11-cm diameter pots and the soil was then compacted with the bottom of a beaker. The larger seeded species were planted (6-8 seeds) in pots not quite full, covered with a 1-cm layer of soil and lightly compacted. Between seven and fourteen herbicides were tested in each experiment, applied both pre- and post-emergence. The pre-emergence treatments were applied the day after planting, after the pots had been sub-irrigated to field capacity. The post-emergence treatments were applied at different stages of growth from two to eight true leaves. All treatments were applied with a moving belt precision sprayer in 300 litres/ha at 200 kPa. Each treatment was applied to four pots which were then laid out on glasshouse benches in a randomised block pattern and grown on for several weeks with both overhead and bottom watering. Visual assessments for plant damage were made at regular intervals.

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Field trials on crop tolerance and weed control

Two field trials were conducted at Rukuhia Horticultural Research Station, one in the spring and the other in autumn, using the least damaging treatments from the glasshouse experiments. The soil type was the same as that used for the glasshouse studies. The larger seeded herbs (coriander and the two sages) were planted at 1-cm depth and five rows per 1.2 m bed with a Stanhay planter. The smaller seeded species were spread by hand onto raised uncompacted beds and then rolled with a smooth roller. The treatments (Table 2) were replicated four times in split randomised blocks with herb species as main plots. The spring trial included both pre- and post-emergence treatments, while the autumn trial had only pre-emergence treatments. The planned post-emergence treatments could not be applied in the autumn due to slow growth of the herbs and bad weather. Individual plots were 5 m x 1.2 m. All treatments were applied with a CO₂ powered precision sprayer at 210 kPa in 300 litres/ha. In the spring trial quizalofop (100 g/ha) was applied over all plots to control the annual summer grasses so only broadleaf weed control was evaluated.

RESULTS AND DISCUSSION**Glasshouse experiments**

Results from the most promising treatments are summarised in Table 1. These show the diverse response of various herb species to the pre-emergence treatments, with coriander being tolerant to all the herbicides listed and German chamomile showing no tolerance at all. There may have been a relationship between seed size and tolerance to herbicides with the smaller seeded species being less tolerant. Coriander has a large seed of approximately 2 mm diameter, the two sage varieties are slightly smaller (1-1.5 mm diameter), while thyme and German chamomile have very small seeds (<0.1 mm). However, any effect of seed size may be indirect because larger seeds were planted deeper and therefore would be less likely to be affected by the surface applied herbicides.

TABLE 1: Damage to five herb species from pre- and post-emergence (6-8 true leaves) herbicide applications in the glasshouse. Mean of up to three experiments planted on 29.6.89, 26.9.89 and 19.1.90.

Treatment	Rate (kg ai/ha)	No. of Exps	% Damage				
			Coriander	Clary sage	Dalmatian sage	German chamomile	Thyme
Pre-emergence							
linuron	0.5	3	2	0	6	100	30
linuron	1.0	3	0	8	6	100	70
prometryn	0.5	3	0	65	30	100	80
prometryn	1.0	3	5	90	30	100	100
chloroxuron	4.0	2	0	25	65	100	100
chlorbromuron	1.0	1	0	0	0	100	25
methazole	1.0	1	0	30	20	100	100
alachlor	2.0	1	0	60	100	100	95
Post-emergence*							
linuron	0.5	3	0	10	20	20	30
linuron	1.0	3	0	30	60	75	90
prometryn	0.5	3	5	85	30	40	60
prometryn	1.0	3	20	95	80	60	100
chloroxuron	2.0	2	0	30	20	60	10
chloroxuron	4.0	2	0	50	60	50	50
chlorbromuron	1.0	1	0	30	85	45	95
methazole	1.0	1	0	30	20	70	100
chloramben	2.0	2	25	100	100	40	30
simazine	1.0	1	0	-	-	-	30

*Post-emergence treatments at 2 and 4 true leaf stages severely damaged all the herb species except coriander.

The early post-emergence treatments (2 and 4 true leaves) severely damaged all the herb species except coriander. The results reported in Table 1 are therefore from later post-emergence applications, 6-8 weeks after sowing (six-eight true leaves, except coriander which had only four true leaves). Relative to the pre-emergence applications, the sages displayed less tolerance and German chamomile and thyme showed more tolerance to the same herbicides. Coriander showed good tolerance to most of the post-emergence treatments at all stages of growth. Kothar *et al* (1989) also found that coriander was tolerant to a range of herbicides including oxadiazon and pendimethalin. However these two herbicides were found to be damaging under New Zealand conditions where a high rate is required to achieve adequate weed control.

Other herbicides tested in the glasshouse at normal use rates included trifluralin, metribuzin, methabenzthiazuron, pendimethalin, ethofumesate, chloridazon, oxadiazon and linuron at 1.5 kg/ha. All caused severe damage, except for chloridazon applied post-emergence to dalmatian sage.

TABLE 2: Damage to five herb species from herbicide treatments applied in spring* and autumn in field trials.

Treatment	Rate (kg ai/ha)	% Damage									
		Coriander		Clary sage		Dalmatian sage		German chamomile		Thyme	
		S	A	S	A	S	A	S	A	S	A
Pre-emergence											
alachlor	2.0	7	-	80	-	-	-	-	-	-	-
linuron	0.5	-	-	-	-	-	-	-	-	10	-
linuron	1.0	37	0	-	10	7	0	-	100	-	30
linuron	1.5	-	-	43	-	-	-	-	-	-	-
chlorbromuron	1.0	-	0	-	0	-	0	-	100	7	0
methazole	1.0	0	-	23	-	7	-	-	-	-	-
prometryn	0.5	-	0	7	30	17	10	-	100	-	70
prometryn	1.0	0	-	-	-	-	-	-	-	-	-
chloroxuron	4.0	0	0	-	0	-	30	-	100	-	60
chloridazon	4.8	-	-	-	-	-	0	-	-	-	-
Post-emergence											
linuron	1.0	15	-	30	-	50	-	70	-	-	-
simazine	1.0	-	-	-	-	-	-	-	-	0	-
prometryn	0.5	-	-	-	-	-	-	25	-	-	-
chloramben	2.0	-	-	-	-	-	-	0	-	-	-
chloroxuron	4.0	15	-	-	-	-	-	65	-	-	-
methazole	1.0	-	-	-	-	40	-	70	-	-	-
chlorbromuron	1.0	-	-	30	-	-	-	-	-	-	-
chloridazon	4.8	-	-	-	-	0	-	-	-	-	-

*
Spring
 Pre-emergence — treated 8.12.89
 — assessed 11.1.90
 Post-emergence — treated 16.1.90
 — assessed 5.2.90
Autumn
 treated 5.4.90
 assessed 24.9.90
 — not tested

Spring field trial

Plant counts made 1 month after planting showed that none of the pre-emergence treatments affected emergence of the herbs. The damage reported below comprised mainly stunting and leaf deformities.

Coriander tolerated (<5% damage) all the pre-emergence treatments except linuron at 1.0 kg/ha (Table 2). The two post-emergence treatments caused some burning (15%) but the plants recovered with no apparent long term effect. All of the pre-emergence treatments applied to clary sage resulted in 20-80% damage to the plants,

except for prometryn (0.5 kg/ha) which caused only slight damage. Despite this initial high level of damage, a very satisfactory crop was produced as the plants soon recovered and grew very well. Both post-emergence treatments to this herb caused moderate burning of leaves but again plants recovered well. Only slight damage to dalmatian sage was caused by methazole and linuron (1.0 kg/ha) pre-emergence, but prometryn (0.5 kg/ha) was more damaging (17%). Post-emergence, chloridazon was well tolerated but the other two treatments resulted in 40-50% damage. No pre-emergence treatments were tested on German chamomile. Most of the post-emergence treatments caused severe damage to this crop, except chloramben which was well tolerated and prometryn (0.5 kg/ha) which caused only moderate crop damage (25%). Thyme showed good tolerance to linuron and chlorbromuron applied pre-emergence and to simazine, applied post-emergence. The herbicides tested here on thyme were also found to be non phytotoxic by Pank *et al* (1982).

The major weeds in the trial were redroot (*Amaranthus powellii*), willow weed (*Polygonum persicaria*), fathen (*Chenopodium album*), black nightshade (*Solanum nigrum*), apple of Peru (*Nicandra physalodes*), summer grass (*Digitaria sanguinalis*) and smooth witchgrass (*Panicum dichotomiflorum*). Linuron, applied pre-emergence, at 1.0 or 1.5 kg/ha gave 95-100% weed control, but only 85% when used at 0.5 kg/ha. Alachlor, chlorbromuron, chloroxuron and prometryn (1.0 kg/ha) all gave 85-90% weed control pre-emergence, while methazole and prometryn (0.5 kg/ha) provided 70-75%. Of the post-emergence treatments, linuron, chloroxuron, methazole and chlorbromuron gave 90-95% weed control, while the others provided only 60-85%.

In the Waikato, weed control of less than 90% (particularly in the spring) in non-competitive crops like these herbs means that the crop is usually overcome by weeds and is smothered out. In these trials very few treatments achieved this but many came very close (80-90%). These treatments were handweeded soon after the January assessment so that the crop could be observed for long-term herbicide effects.

Autumn field trial

Coriander was not affected by any of the treatments (Table 2). Dalmatian sage and thyme did not grow very well in the autumn and although some treatments appeared safe, a worthwhile crop was not established. Chlorbromuron and chloroxuron were both well tolerated by clary sage while linuron and prometryn caused some deformation of the first leaves from which the plants soon recovered and an excellent crop was established.

Although German chamomile established better and grew more vigorously than in spring, it was still killed by all treatments. However, in the control plots where no herbicide was used, the German chamomile grew so well that the weeds were not able to compete and affect the crop.

The major weeds present at this time of year were twincrest (*Coronopus didymus*), hedge mustard (*Sisymbrium officinale*), bitter cress (*Cardamine hirsuta*), annual poa (*Poa annua*) and white clover (*Trifolium repens*). When used in the autumn, linuron and prometryn gave 95-100% weed control while chloroxuron and chlorbromuron provided 85-90% and chloridazon about 60% control.

TENTATIVE RECOMMENDATIONS

Based on these trials the following tentative recommendations for establishing weed free herb crops in the Waikato are proposed.

Coriander: plant in spring or autumn and use pre-emergence applications of either prometryn, chlorbromuron, methazole or chloroxuron depending on the expected weed spectrum. Linuron could also be used at up to 1 kg/ha.

Clary sage: plant in spring or autumn and use linuron pre-emergence at a low rate (0.5-1.0 kg/ha). Clary sage has large leaves and when full grown, competes well with weeds so no weed control should be required in the second season. The plant becomes a perennial if harvested frequently (Husain *et al* 1989).

Dalmatian sage: plant in spring and use linuron (1.0 kg/ha) pre-emergence. Chloridazon can be used post-emergence on any remaining weeds. The growth habit of this sage is open and shrub-like and post-emergence herbicides will be required in subsequent seasons.

German chamomile: plant in autumn at a high seeding rate and no weed control should be necessary.

Thyme: plant in spring (or early in autumn before frosts) and use a very low rate of linuron (0.5 kg/ha) or chlorbromuron. Some hand weeding will be required but after this simazine can be applied post-emergence to keep the crop weed free. Thyme is slow growing but eventually forms a thick mat which prevents weeds from establishing. However, weed control would be required in the following season if the crop becomes open or if establishment is poor.

In the spring some hand-weeding might be required for all herb crops as well as an additional treatment of an appropriate grass herbicide if grass weeds become a problem in the crop.

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HERBICIDES USED

alachlor (Lasso), chloramben (Amiben), chlorbromuron (Maloran), chloridazon (Pyramin), chloroxuron (Tenoran), ethofumesate (Tramat), linuron (Linuron), methabenzthiazuron (Tribunil), methazole (Probe), metribuzin (Sencor), oxadiazon (Foresite), pendimethalin (Stomp), prometryn (Gesagard), quizalofop (Zero), simazine (Gesatop), trifluralin (Treflan)