HERBICIDE TOLERANCE AND WEED CONTROL IN CULINARY HERBS

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SUMMARY

Six culinary herbs, peppermint (*Mentha x piperita*), spearmint (*Mentha smithiana*), lemon balm (*Melissa officinalis*), oregano (*Origanum vulgare*), thyme (*Thymus vulgaris*) and sage (*Salvia officinalis*) were tested for their tolerance to a range of herbicides. Data are given on herb yield and weed control following a number of herbicide treatments applied both pre- and post-planting and for some herbs applied over established plants in the winter. All herbs showed good tolerance to trifluralin and, except sage, to terbacil. Terbacil also gave good weed control.

Keywords: culinary herbs, herbicide tolerance, weed control

INTRODUCTION

In medieval times herbs were used to help preserve food or to disguise the flavour when preservation failed. In recent times the use of herbs has undergone a revival as a culinary art rather than as a necessity. Data collected by the New Zealand Trade Development Board highlight six herbs for which consumption is increasing world-wide.

These herbs were peppermint, spearmint, lemon balm, oregano, thyme and sage, all belonging to the Labiate family. These plants are all known to grow in New Zealand but little is known about their productivity under New Zealand conditions. As the product of these herbs is based on the subtle flavour of the leaf, any weed contamination would be highly undesirable.

The growth habit of these herbs, especially the mints, lemon balm and oregano, would preclude mechanical weed control. Though non-chemical weed control may ultimately be desirable, it may not be possible to grow these herbs in New Zealand without some herbicide assistance. Few data are available on the herbicide tolerance of these herbs so work was commenced in 1991 to test their tolerance to a range of herbicides.

METHOD

In spring 1991 a three replicate trial was laid down on newly cultivated land. Herbicides (Table 1) were applied by precision boom sprayer in 200 litres/ha at 210 kPa. Pre-plant herbicides were applied on 28.11.91 and trifluralin (Triflur 40) incorporated within 2 h by rotary hoe to 100 mm, post-plant herbicides on 24.12.91, and post-emergence herbicides in early January. Five bare rooted seedlings of each herb were transplanted 20 cm apart in single rows across each plot, with 40 cm between species, between 3-12.12.91. For convenience all herb species were planted in the same order in each plot. Plot size was 1.2 x 3.0 m. No spearmint or sage was available for the 1991 trial.

Weeds were assessed visually, then counted, on whole plots, and removed on 15.1.92. Thereafter plots were kept weed free to measure the herbicide tolerance of the herbs. On the dates shown in Table 1 the herbs were cut to 5 cm and the dry weight recorded. The mint was dug out, as it was invading the other herbs, so total plant production, largely stolons, was recorded. Lemon balm was harvested twice.

In mid-winter, all vegetation, weeds and herbs, was chopped with an orchard mulcher. Plots with at least three plants of each herb were re-randomised into four

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replicates of the treatments shown in Table 2. All herbs had green foliage when treated on 21.8.92. Weed growth was assessed twice and herb vigour three times in October 1992.

In spring 1992 the more promising treatments from the first trial were tested again. Four split-plot trials were laid down between 27.10.92 and 23.11.92 as plant material became available with one or two herbs in each trial. The main treatments were cultivation with a rotary hoe before planting, stale seed bed sprayed with paraquat/diquat (Preeglone) before planting and trifluralin pre-plant soil incorporated by rotary hoe. Sub-treatments varied with herb and are shown in Table 3. Untreated sawdust was spread round the mints to a depth of 10 cm after planting. Herbicides were applied, as above, a few days before planting each trial. Each trial had four replicates of main treatments and sub-treatments giving 40-48 (0.5 x 1 m) plots for each herb, with six plants in a grid pattern spaced 25 cm apart.

Weed seedlings were counted about a month after treatment in six 250 x 150 mm quadrats/plot in each trial and weeds were removed from the hand weeded plots which were then kept weed free. Weeds were counted again on whole plots of the other treatments in February and then removed. Herbs, except oregano, were harvested one to three times during the season, depending on growth, by cutting foliage to 5 cm above ground, and fresh weight recorded.

TABLE 1: Density and percent cover of weeds and yield of transplanted peppermint, lemon balm, oregano and thyme following herbicide treatments in 1991.

Treatment (kg ai/ha)	Weeds 15.1.92		Herb yields Dry Wt (g)/plot (5 plants)				
	No./m ²	% cover	Peppermint 21.1.92	Lemon Balm 5.2.92	Oregano 16.3.92	Thyme 10.5.92	Thyme 10.3.92
untreated	NC ¹	95	17	0	10	0	5
hand weeded	0	0	29	119	164	79	85
Pre-planting							
diuron 1.5	NC	75	25	78	212	52	52
linuron 1.0	NC	67	20	82	166	65	48
metribuzin 0.5	30 b ²	18	8	131	190	76	35
pendimethalin 1.5	12 c	6	28	198	190	76	94
propyzamide 1.5	63 a	47	20	84	153	46	36
simazine 3.0	15 c	6	15	75	173	57	43
terbacil 1.0	8 c	3	31	38	116	96	111
trifluralin 1.0	55 a	25	29	100	158	64	75
Post-planting							
simazine 3.0	1 d	1	14	63	172	52	86
oryzalin 3.0	1 d	3	8	18	88	74	17
Post-em weeds							
bentazone 1.5	NC	43	21	0	121	30	30
chloroxuron 4.0	11 c	3	3	33	129	50	55
MCPB 1.5	NC	55	8	15	38	8	8
LSD 5%		30	13	35	65	37	39

¹ NC - not counted as number high, (in excess of 100).

² Numbers in this column with no letter in common are significantly different (P<0.05) on ANOVA analysis of square root transformed data.

RESULTS

1991 trial

Weed numbers were very high on untreated, diuron (Karmex), linuron (Linuron 50), bentazone (Basagran) and MCPB (Rural MCPB) plots so these were not counted. Total weed numbers on treatments giving an obvious reduction are shown in Table 1. Best weed control was given by simazine and oryzalin (Surflan) post-planting followed by chloroxuron (Tenoran 50 WP), pendimethalin (Stomp 330 E), simazine (Gesatop 500 FW) pre-planting and terbacil (Sinbar).

Peppermint yield was highest on terbacil, trifluralin, hand weeded and pendimethalin plots. Lemon balm was depressed by all treatments except metribuzin (Sencor DF), pendimethalin and trifluralin but some depression might have been due to early weed competition. At the second cut, after weeds were removed in January, only oryzalin and MCPB reduced yield below hand weeded with diuron yielding highest. Oregano was only significantly depressed on bentazone and MCPB plots with yield highest after terbacil treatment. Thyme also yielded highest after terbacil treatment. Yield was depressed on metribuzin, propyzamide (Kerb 50 W), simazine, oryzalin, bentazone and MCPB plots.

Winter trial 1992

Terbacil and simazine gave greatest reduction in weed vigour (Table 2). The three remaining herbs, lemon balm, oregano and thyme, were most vigorous following terbacil, paraquat/diquat and simazine treatments.

TABLE 2: Response of weeds and established lemon balm, oregano and thyme to herbicides applied in the winter (21.8.92).

Treatment (kg ai/ha)	Weed score ¹ October 92	Herb vigour ² October 92		
		Lemon Balm	Oregano	Thyme
hand weeded/untreated	2.6	7.6	8.6	8.6
diuron 2.0	5.8	6.6	7.4	1.6
oryzalin 4.0	8.4	3.6	3.3	1.4
paraquat/diquat 0.33/0.17	6.6	7.7	8.0	8.6
pendimethalin 2.0	5.9	3.9	3.1	3.9
simazine 3.0	3.8	7.1	7.3	7.5
terbacil 1.0	2.7	9.0	9.6	9.6
LSD 5%	3.0	1.8	1.7	1.8

¹ Weed score, 0 = no weeds, 10 = dense stand of weeds

² Herb vigour, 0 = dead, 10 = best growth present

³ Hand weeded once in September then untreated

Spring trials 1992

As there were no significant interactions between main and sub-treatments in 1992 only the main effects are shown in Table 3.

Mints: Both mints gave highest yield following trifluralin main treatment at the first cut. With peppermint this trend continued and remained significant for the total yield over three cuts. The more vigorous spearmint showed no significant difference totalled over three cuts. Both mints were initially suppressed by sawdust but over three cuts peppermint was not significantly affected by any sub-treatment while spearmint yielded best following terbacil or through sawdust.

Lemon balm: Lemon balm was not significantly affected at either cut by any main or sub-treatments. Highest yield was recorded on trifluralin + simazine plots.

Oregano: A satisfactory fresh weight harvest could not be taken off the oregano because of genetic variability. Some plants grew upright and produced flower heads which would have given high weights while other plants grew prostrate and created

a vigorous ground cover difficult to harvest. Assessment has, therefore, been made on two vigour assessments in December and February. These showed no effect of main treatment but severe depression by oryzalin. Pendimethalin and terbacil resulted in healthy looking plants.

Thyme: Thyme was depressed, though not significantly, by trifluralin and pendimethalin. It was unaffected by terbacil.

Sage: Sage was unaffected by trifluralin but was depressed by diuron and bentazone at the first cut. However, some of this depression may have been due to poor weed control (Table 3).

Weed Control: On this site, in this atypical year, the main weed was scrambling speedwell (*Veronica persica*) with moderate numbers of *Malva* sp. and prostrate amaranth (*A. deflexus*). The stale seed bed technique reduced weed numbers in December by 45% (Table 3) but had no effect on *Amaranthus* sp. and little on *Malva* sp.. Trifluralin reduced weeds by 70% in December and maintained some control of scrambling speedwell in February. Best weed control was given by metribuzin, oryzalin, simazine, sawdust, terbacil and oxadiazon (Foresite). Most treatments gave useful control of *Amaranthus* sp. with oxadiazon being best. Only sawdust, oxadiazon and terbacil gave much control of *Malva* sp. and diuron and prometryn failed on scrambling speedwell.

TABLE 3: Weed density and herb total fresh weight yield (kg/plot - 6 plants) of peppermint, spearmint, lemon balm, oregano, thyme and sage transplants in response to soil management and herbicides applied pre-planting in 1992.

Treatments (kg ai/ha)	No. weeds /m ² Dec	Peppermint 3 cuts Dec-Mar	Spearmint 3 cuts Dec-Mar	Lemon balm 2 cuts Feb-mar	Oregano mean vigour Dec-Feb	Thyme 1 cut 19.4.93	Sage 2 cuts Feb-Apr
Main Treatment							
cultivation	296	1.3	2.5	1.5	5.1	0.39	1.2
stale seed bed	168	1.2	2.4	1.6	4.7	0.31	0.9
trifluralin 1.0	89	1.5	2.7	1.6	4.8	0.29	1.2
LSD 5%		NS	NS	NS	NS	NS	NS
Sub-treatment							
hand weeded	330	1.4	2.5	1.6	5.4	0.37	1.7
diuron 1.6	82	-	-	-	-	-	0.6
metribuzin 0.75	0	-	-	1.4	-	-	-
oryzalin 4.0	0	-	-	-	1.8	-	-
oxadiazon 1.6	12	-	-	-	-	0.31	-
pendimethalin 1.5	60	1.3	2.1	1.6	6.1	0.29	-
prometryn 1.0	210	-	-	-	-	-	W
simazine 2.0	0	-	-	1.7	-	-	-
terbacil 1.0	12	1.4	2.7	-	6.0	0.36	-
bentazone ¹ 2.0	43	-	-	-	-	-	1.0
sawdust	4	1.3	2.7	-	-	-	-
LSD 5%		NS	0.5	NS	0.7	NS	0.47

¹ Applied after planting post-emergence on weeds, weed No. in February

- Treatment not applied. W Too weedy to harvest

DISCUSSION

Both mints responded well to trifluralin and terbacil and these herbicides should give good establishment weed control. Sawdust caused an initial check to the mint but it was only temporary and might have been offset had nitrogen been supplied. Sawdust gave good initial weed control and created a good media for stolons to spread. However, sawdust may make subsequent weed control more difficult if it absorbs any herbicides applied. More work is required on winter treatments for mature mint.

After an initial check by many herbicides lemon balm showed good tolerance to a wide range of herbicides. Once established it proved very persistent and responded well to terbacil and even paraquat/diquat in the winter. Its ability to recover from weeds and mulching indicates there should be little difficulty in salvaging plots if weeds become a problem.

Oregano also showed a high tolerance to many herbicides including terbacil. As with lemon balm its tolerance of mulching, paraquat/diquat and terbacil in the winter gives good scope for maintaining a clean stand.

Thyme has a similar tolerance spectra to lemon balm and oregano. It could be planted following terbacil, pendimethalin or oxadiazon and could be cleaned up with paraquat/diquat or terbacil.

Unfortunately no sage plants were available for use in the 1991 screening trial. The use of diuron, prometryn and bentazone in 1992 was based on indicative results from a seedling trial in 1991. None of these proved satisfactory in this trial and more work is needed on sage. James *et al.* (1991) suggested linuron for weed control in sage and Fryer and Makepeace (1978) recommended simazine. However, neither of these performed well in the 1991 seedling trial. In a seedling trial conducted on an adjacent site in 1992, oxadiazon was the best treatment for plant yield but it reduced plant numbers significantly.

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