

HERBICIDE TOLERANCE OF AND WEED CONTROL IN THREE MEDICINAL HERBS

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SUMMARY

Three medicinal herbs, feverfew (*Tanacetum parthenium*), valerian (*Valeriana officinalis*) and coneflower (*Echinacea purpurea*) were tested for their tolerance to a range of herbicides applied both pre-transplanting and over established plants. Feverfew showed good tolerance to pendimethalin, oryzalin and oxadiazon at planting and to terbacil when established. Valerian tolerated pendimethalin, oryzalin and trifluralin at planting and terbacil and diuron when established. Coneflower tolerated pendimethalin, oryzalin and a combination of oryzalin and chlorpropham at planting and terbacil, diuron and chlorpropham when established. Pendimethalin, oryzalin + chlorpropham and terbacil gave best weed control.

Keywords: feverfew, valerian, coneflower, medicinal herbs, herbicide tolerance.

INTRODUCTION

Natural plant based medicines are currently attracting considerable attention as alternatives to synthetic drugs (Principe 1989). New Zealand has an opportunity to enter this market and produce medicinal herb products for worldwide consumption (Douglas 1991). Three such medicinal herbs are feverfew, valerian and coneflower.

Feverfew is a biennial to perennial composite from which the leaves and stems are used for the treatment of fever, arthritis, menstrual problems and migraines. Valerian is a perennial from which the roots and rhizomes are used for their sedative and anti-spasm action. Coneflower is also a perennial from which roots, rhizomes and leaves are used as a blood cleanser and to stimulate the immune system.

Before these crops go into commercial production, problems of weed control need to be addressed. Though non-chemical weed control may ultimately be desirable, herbicide treatments may initially be necessary. Little information is available on the herbicide tolerance of these herbs so work was started in 1991 in Hawke's Bay testing their tolerance to a range of herbicides and their response to weed control, under field conditions.

METHOD

In 1991 the trial site was cultivated in early spring and sprayed with paraquat+diquat in November. Pre-plant herbicides (see Table 1) were applied on 28/11/91 by precision boom sprayer in 200 litres/ha at 210 kPa. Trifluralin treatments were incorporated into the soil by rotary hoeing immediately after herbicide application. Post-plant herbicides were applied on 24/12/91. Five well developed seedlings of each herb were transplanted, 20 cm apart, in a row across each 1.2 x 2 m plot. Feverfew was planted on 3/12/91 and valerian and coneflower on 11/12/91. There were three replicates in a randomised block design. Weeds were counted on whole plots and removed on 17/1/92 by cutting at ground level, except from untreated plots. Plots were kept weed-free thereafter, by hoeing, to allow measurement of herbicide tolerance. Herbs were cut to 10 cm above ground level (for dates see Table 1) and the fresh weight (FW) of herbage recorded. Plant survival was also recorded. After harvest weeds were allowed to grow and the area was grazed by sheep.

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During the winter a second trial was superimposed on the same site to test the tolerance of the herbs to winter application of herbicides that could be used for clean-up treatments. All plots with at least four survivors of all herbs were re-randomised, regardless of initial treatment, into four replicates of the treatments shown in Table 3. Prior to treatment on 21/8/92, feverfew (which sheep didn't eat) was cut to 15-20 cm. Valerian had been affected by the frost and chewed to ground level by the sheep and the coneflower was dormant with little foliage visible. Weeds had established in all plots and were mostly grazed by sheep. Weeds were assessed visually in September and October and herb fresh weight harvested in November.

In spring 1992, the treatments that gave best herb tolerance and weed control in the first trial, were re-evaluated. A new four replicate split-plot trial was laid down with main treatments of "stale seed bed" versus cultivation before transplanting. The area was cultivated in early September and the stale seed bed sprayed with paraquat+diquat a week before planting while the cultivation treatment was rotary hoed. Herbicide sub-treatments (see Table 2) were applied on 13/11/92 (as before) and herb seedlings transplanted on 17/11/92. Main plot size was 2 x 10 m and sub-plots 1.2 x 2 m. Weeds were counted on 11/12/92 and removed from "hand weeded" plots which were kept weed free thereafter. Weeds on the other plots were not removed in December but were counted again and removed on 4/3/93. Feverfew was harvested on 29/1/93 and again on 7/4/93. Valerian and coneflower were harvested on 7/4/93.

Unless at least 25 mm of rain fell within a week of herbicide application, overhead irrigation was applied. All data were analysed by standard analysis of variance techniques (ANOVA).

TABLE 1: Response of feverfew, valerian and coneflower transplants to herbicides applied pre-planting on 28/11/91 or post-planting on 24/12/91. Five plants per plot.

Treatment (kg ai/ha)	Weeds No./m ²	Feverfew 5/2/92		Valerian 11/2/92		Coneflower 11/3/92	
		No.	FW/plot (kg)	No.	FW/plot (kg)	No.	FW/plot (kg)
untreated	11.5 b ¹	4.7	2.1	5.0	0.7	5.0	1.5
hand weeded ³	7.9 bcd	5.0	2.1	5.0	1.1	5.0	1.5
Pre-planting							
trifluralin 1.0	30 ² a	4.0	1.3	5.0	1.2	5.0	1.2
chlorpropham 3.5	10.2 bc	5.0	2.0	5.0	1.0	5.0	1.4
diuron 1.5	4.3 bcde	4.7	1.9	4.0	0.5	4.3	1.5
pendimethalin 1.5	3.7 cde	5.0	2.3	5.0	1.0	4.7	1.9
propyzamide 1.5	10.2 bc	3.7	1.4	5.0	0.8	4.7	1.0
simazine 3.0	4.0 de	1.3	0.1	2.7	0.4	2.0	0.6
terbacil 1.0	1.9 e	3.3	0.5	4.0	0.9	0	0
Post-planting							
simazine 3.0	2.3 e	4.3	1.1	3.7	0.4	1.0	0.2
oryzalin 3.0	2.7 de	5.0	1.9	5.0	1.1	5.0	1.5
LSD 5%		1.6	0.83	1.5	0.57	1.4	0.46

¹ Numbers with no letter in common are significantly different (P<0.05) on ANOVA analysis of square root transformed data.

² If black nightshade excluded, trifluralin weed No. = 4/m².

³ Weeds removed after counting 17/1/92.

RESULTS

The first trial (spring 1991) showed pendimethalin, chlorpropham and oryzalin well tolerated by all three herbs though chlorpropham gave poor weed control (Table 1). Diuron was tolerated by feverfew and coneflower, but not by valerian. Best weed control was given by terbacil and simazine but the newly planted feverfew and coneflower were severely affected by these herbicides. Propyzamide failed to give satisfactory weed control and trifluralin plots were heavily infested by black nightshade (*Solanum nigrum*) stimulated to germinate by the incorporation cultivation.

The second spring trial (1992) was heavily infested with scrambling speedwell (*Veronica persica*) which was not controlled by diuron (Table 2). In oxadiazon treatments, scrambling speedwell contributed over 95% of the weeds. Pendimethalin and oryzalin+chlorpropham controlled most of the scrambling speedwell and consequently gave best weed control.

TABLE 2: Response of feverfew, valerian and coneflower transplants to herbicides applied pre-planting on 13/11/92. Six plants per plot.

Treatment main effects	No. weeds/m ²		Crop fresh weight kg/plot		
	11/12/92	4/3/93	Feverfew 29/1/93	Valerian 7/4/93	Coneflower 7/4/93
Main treatment					
cultivated	401 a ¹	42 a	3.0	1.5	1.0
stale seed bed	199 b	38 a	3.2	1.7	1.0
Herbicide treatment (kg ai/ha)					
hand weeded ²	749 a	-	3.0	1.6	0.9
diuron 1.6	673 a	90 a	2.7	0.7	0.3
pendimethalin 1.5	21 bc	7 c	3.5	2.5	1.5
oryzalin+chlorpropham 2.0 + 2.0	4 c	7 c	2.5	1.2	1.4
oxadiazon 1.6	54 b	55 b	3.8	1.9	1.0
LSD 5%			0.5	0.88	0.49

¹ Numbers with no letter in common are significantly different (P<0.05) on ANOVA analysis of square root transformed data.

² Weeds removed after counting on 11/12/92.

TABLE 3: Response of weeds and established herbs to winter herbicide treatments applied 21/8/92. Herbs harvested in November 1992.

Treatment (kg ai/ha)	Weed score ¹ visual 0-10	Feverfew FW (kg)	Valerian FW (kg)	Coneflower FW (kg)
untreated	6.5	7.0	7.5	1.3
chlorpropham 6.0	2.0	7.2	6.7	2.2
diuron 2.0	0.7	6.5	8.2	1.2
oryzalin 4.0	5.3	7.4	7.0	1.3
paraquat 0.5	3.5	6.2	8.2	1.8
pendimethalin 2.0	4.5	7.4	8.6	1.5
simazine 4.0	1.1	5.1	6.0	0.3
terbacil 1.0	0.3	7.7	8.2	1.1
LSD 5%	1.9	1.6	2.7	1.1

¹ Mean of three assessments during September and November, 0 = no weeds, 10 = complete cover.

All herbs produced high yields following pendimethalin treatment. Feverfew and valerian also yielded well following oxadiazon treatment while coneflower yielded well following the oryzalin+chlorpropham combination (Table 2). Diuron resulted in reduced yields. The second cut of feverfew showed no difference between treatments.

The "stale seed bed" technique halved the initial weed number taken over all sub-treatments, but had no effect later in the season (Table 2). It had no effect on herb yield.

All three herbs showed a high tolerance to the winter applied herbicides except feverfew and coneflower to simazine (Table 3). Best weed control was given by terbacil, diuron and simazine. As there was no correlation between weed score and crop yield either the herbs were unaffected by weed competition or they were partially inhibited by the effective herbicides.

DISCUSSION

Feverfew is a strong growing plant with a dense spread of basal leaves. As such it is fairly capable of competing with weeds as shown by its high production in the absence of weed control. However, as the foliage is required for medicinal purposes weed contamination would be undesirable for product quality. The best treatments were pendimethalin applied before transplanting or oryzalin which can be applied after transplanting. However, oryzalin required adequate rainfall or irrigation to give effective weed control. Oxadiazon also showed good potential providing scrambling speedwell is not a major weed. Established plants showed high tolerance to most herbicides tested with terbacil giving best weed control and very good plant yield.

Valerian has a similar plant form to feverfew and can also compete well with weeds when established. Again pendimethalin and oryzalin gave best results at the transplant stage. Trifluralin was also well tolerated giving good plant growth in spite of poor black nightshade control. It could be a useful herbicide if black nightshade were not a major weed or for autumn plantings, when black nightshade would not survive. Established plants showed high tolerance to all herbicides tested with best growth and best weed control following terbacil and diuron treatments. Green leaves were not present at treatment because they had been grazed by sheep. However, since valerian is frost sensitive it is unlikely there would have been much live leaf present had it not been grazed. Grazing could be a useful technique to "clean up" a valerian paddock over winter prior to herbicide treatment, providing it did not harm the sheep.

Coneflower is a less basally dense plant than feverfew and valerian but it is a vigorous plant able to compete well with weeds. For transplants, pendimethalin, oryzalin and the oryzalin+chlorpropham combination were the best herbicides. Transplants showed no tolerance to terbacil and simazine. In the winter on established plants, however, terbacil and diuron gave best weed control with reasonable plant growth while chlorpropham gave best plant growth with reasonable weed control.

In the second spring trial the better herbicide treatments increased herb yield relative to hand weeded. As weeds were very small when removed the yield loss in the hand weeded treatment was probably due to root disturbance during weed removal and subsequent hoeing to keep plots weed free.

Providing herbicide residues do not present problems with these herbs, there is a reasonable range of herbicides that can be used at transplanting and for winter "clean up" treatments. With valerian and coneflower, where the main product is root and rhizome it still has to be determined whether it is best treated as an annual or biennial crop in New Zealand. This could influence the weed control strategies. With feverfew where the product is foliage it will be essential to maintain a clean stand and there appears to be several herbicides that can do this.

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REFERENCES

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APPENDIX OF HERBICIDES USED

Chlorpropham (Yates Chloro-IPC), diuron (Karmex), paraquat+diquat (Pree glone), pendimethalin (Stomp 330E), propyzamide (Kerb 50 W), oryzalin (Surflan), oxadiazon (Farsite), simazine (Gesatop 500 FW), terbacil (Sinbar), trifluralin (Triflur 40).