FACTORS AFFECTING HERBICIDE CONTROL OF BARLEY GRASS — POT TRIALS

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Summary

Various factors affecting herbicide (mainly ethofumesate) control of barley grass (*Hordeum* spp.) were examined. Soil type, soil moisture and age and size of plant all affected efficiency. Root and foliage uptake appeared necessary for maximum effect from ethofumesate. The five more common species of New Zealand barley grass were not equally susceptible to ethofumesate.

INTRODUCTION

Most work with herbicides for control of barley grass (*Hordeum* spp.) in New Zealand has been done on field plots. Under such conditions it is often difficult to determine the effect varying environmental factors have on the efficiency of the herbicide. Specific information on the effect of some environmental factors may be obtained from pot trials. The trends so indicated could influence field performance.

METHOD

Initially pots and seed boxes were used but 15 cm diameter pots holding 1 kg dry soil were the most convenient. Five pot replicates were used for each treatment with ten plants per pot grown from seed. Unless specified otherwise all herbicide treatments were applied as an overall spray by Oxford precision sprayer when the plants were about four weeks old (3 to 4 tillers). Leaf only treatments were applied by spraying the leaves after the soil was covered with strips of blotting paper or dry pumice. These coverings were removed after treatment. Soil only applications were applied by spraying the soil while the plant leaves were protected inside inverted test tubes or by pipetting a measured quantity of herbicide onto the soil below the plant leaves. Herbicide rates were low to detect differences in plant sensitivity.

All plots were given phosphate and nutrient solutions and watered from above to maintain maximum growth except for those in the water regime trial (see Table 3). Horotiu sandy loam was used throughout except where specified.

Plants were trimmed periodically after treatment to limit size and help identify treatment effects which were easier to detect on regrowth, or lack of it, than on old leaves.

RESULTS

Site of uptake of ethofumesate:

For three to four weeks after herbicide application a similar effect was given by the overall treatment and the leaf only treatments while soil only treatments appeared to increase the vigour of the plants.

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However, after four weeks plants treated overall continued to decline and most plant deaths had occurred by nine weeks, whereas nearly all plants treated leaf only recovered. By nine weeks some of the plants treated soil only died and deaths continued up to 14 weeks (Table 1). In the boxes, soil treatment was inferior to overall treatment, but in the pots final results were comparable for soil and overall treatments.

TABLE 1: EFFECT OF HERBICIDE PLACEMENT ON PERCENTAGE OF PLANTS (*H. murinum*) KILLED BY ETHOFUMESATE (1.0 kg/ha)

	Boxes		*Pots*	
	Days post treatment			
Treatment placement	60	100	60	100
Control	0 dC	2	0 bB	0
Overall spray	97 aA	97	52 aA	60
Leaf only (paper)	0 dC	—	5 bB	—
Leaf only (pumice)	4 cC	—		
Soil only (pipette)	21 bB	47	34 aA	56
Soil only (spray)			49 aA	62

Dash, not recorded; blank, no experiment.

Effect of soil types (three herbicides, overall spray)

The results show that the performance of the three herbicides examined varied considerably on different soil types (Table 2). Ethofumesate and TCA/2,2-DPA both gave good results on Horotiu sandy loam but were ineffective on Ahuriri clay loam. Propyzamide was more effective on Atiamuri sand than on Horotiu sandy loam, while TCA/2,2-DPA was more effective on Horotiu sandy loam than Atiamuri sand. Comparison *between* herbicides should not be made because of the suboptimal doses used.

TABLE 2: EFFECT OF SOIL TYPE ON PERCENTAGE OF PLANTS (*H. murinum*) KILLED BY HERBICIDES (65 days)

Treatment	*Rate kg/ha*	*Horotiu sandy loam*	*Atiamuri sand*	*Ahuriri clay loam*
Control		0	0	10
ethofumesate	1.0	100 aA	100 aA	30 bB
TCA/2,2-DPA	3.4/0.6	100 aA	73 bB	3 cC
propyzamide	0.3	41 bB	71 aA	

Duncan's multiple range test letters compare soil types; comparison should not be made between herbicides.

Effect of soil moisture (ethofumesate, overall spray)

Ethofumesate was most effective at high moisture levels. Although ultimate control at the medium moisture level was comparable to that at the high moisture level the action was significantly slower (Table 3). At the low moisture level ethofumesate was ineffective.

Where the water regime was changed after herbicide application the results were intermediate except for the plants treated at high moisture levels and then kept at a medium level where control was significantly lower than for plants maintained at either high or medium moisture levels.

TABLE 3: EFFECT OF SOIL MOISTURE ON PERCENTAGE OF PLANTS (*H. murinum*) KILLED BY ETHOFUMESATE (0.75 kg/ha)

*Moisture level**		*Days post treatment*	
Pre-treatment	*Post-treatment*	*30*	*40*
High	high	94 aA	96 aA
Medium	medium	40 bBC	90 aAB
Low	low	4 deDE	4 dCD
Medium	high	76 aAB	84 abA
Medium	low	10 cdCDE	22 cdCD
High	medium	22 bcdCDE	54 bcBC
Low	medium	32 bcCD	50 bcBC
Untreated controls‡		0 eE	0 dD

* Moisture levels; high = 500 g water/kg dry soil;
medium = 300 g water/kg dry soil;
low = 100 g water/kg dry soil.

‡ Pooled data for control pots maintained at high, medium and low moisture levels.

Effect of age and size of plants (ethofumesate, overall spray)

Sensitivity of barley grass plants to ethofumesate declined with increased age of plants (Table 4). Where the plants were trimmed weekly to control their size effects of age were reduced but the small plants of all ages were more sensitive than the larger plants of the same ages.

TABLE 4: EFFECT OF AGE AND SIZE OF PLANTS (*H. murinum*) ON PERCENTAGE KILLED BY ETHOFUMESATE (0.75 kg/ha) AT 65 DAYS

Age at treatment	*full size*	*small**
4 weeks	16 ef	44 cde
3 weeks	30 de	72 bc
2 weeks	52 bcd	80 ab
1 week	52 bcd	
sown 2½ weeks post treatment	98 a	
untreated control	4 f	

* trimmed weekly to keep plants small.

Species sensitivity to ethofumesate, (overall spray)

The five more common species of barley grass differed in their sensitivity to ethofumesate. *Hordeum glaucum* was most sensitive while *H. hystrix* and *H. marinum* showed most tolerance. *H. murinum* and *H. leporinum* were intermediate (Table 5).

TABLE 5: DIFFERENTIAL TOLERANCE OF BARLEY GRASS SPECIES TO ETHOFUMESATE (1.0 kg/ha)

(Plants 6 weeks old when treated)

	% killed at	
Species	*34 days*	*50 days*
H. leporinum	12 bB	30 bAB
H. murinum	10 bB	20 bAB
H. glaucum	48 aA	64 aA
H. hystrix	4 bcB	5 cBC
H. marinum	2 bcB	5 cBC
untreated (all species)	0 cB	0 cC

Note: *H. hystrix* is now called *H. geniculatum*.

DISCUSSION

This work should be regarded as a preliminary investigation only but it indicates the influence environmental factors may have on herbicide effectiveness.

Soil type is known to affect the efficiency of soil acting herbicides and this trial demonstrates the need to consider soil type when applying barley grass herbicides where these depend on some root absorption.

The heavy dependence of root uptake for ethofumesate action was unexpected in light of initial development work which indicated that ethofumesate entered plants via the emerging shoots (Pfeiffer 1969). Similar findings have subsequently been confirmed for barley grass by Fisons Ltd (Pfeiffer personal communication).

The rapid decline in plant sensitivity to ethofumesate with increasing age indicates the advantages of early post- or pre-emergence application. However the greater sensitivity shown by small plants indicates that continuous hard grazing pre-treatment could help maintain the older plants in a more susceptible condition.

The lack of activity from ethofumesate in dry soil conditions is consistent with its activity being in aqueous solution rather than in the vapour phase (Pfeiffer 1969). The low moisture regime used in this trial (Table 3) was lower than that most likely to be found in New Zealand at the time of application of ethofumesate for barley grass control, however this work suggests that best results may be expected under conditions of high soil moisture. Field trials have shown ethofumesate to be more effective in Canterbury and coastal Otago than in Waikato (Allen *et al.* 1974) with the implication that higher rates are needed in wetter areas. This may be so but not as a direct consequence of soil moisture content.

The more common species of barley grass, *H. murinum* and *H. leporinum* are equally susceptible to ethofumesate but the higher tolerance shown by *H. hystrix* is unfortunate in view of the damage this species does to stock (Hartley and Bimler 1975).

More work is required to determine the effect of various environmental factors on herbicide action but this paper may draw attention to some of the differences that can occur.

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NEW CROPS

CHAIRMAN'S SUMMARY

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The first three papers in this session investigated herbicides for weed control in lupin seed crops. Rhodes showed significant seed yield responses to trifluralin in two trials and to the pre-emergence application of atrazine in one. Betts screening eighteen candidate herbicides showed dinitramine at 0.5 kg/ha and 1.0 kg/ha pre-plant incorporated to provide significant yield responses, being superior to the other dinitroanalines tested on wild turnip. The comparison of the pre-emergence materials was inconclusive due to the problem of hares grazing the plots during the course of the trial. Of the post-emergence treatments only chloroxuron 0.75 kg/ha produced significantly higher lupin seed yields, although all gave good weed control. The author suggested further work was necessary with both pre-emergence and post-emergence materials. Mitchell *et al.* showed that lupins were tolerant to all of the pre-plant incorporated dinitroanalines apart from dinitramine which significantly reduced lupin vigour. The rates of dinitramine used however i.e. 1.0 to 1.5 kg/ha were higher than those used in the work reported by Betts and higher than would be considered necessary from previously published work. Although lupin vigour was reduced by these rates of dinitramine this was the only pre-plant incorporated treatment to cause a significant increase in lupin seed yield. Of the pre-emergence treatments tested penoxolin 1.0 and 1.5 kg/ha, atrazine 1.0 and 1.5 kg/ha, and cyanazine 1.0 and 1.5 kg/ha provided a significant yield response with atrazine in particular providing a high level of volunteer brassica weed control. All of the post-emergence treatments including methabenzthiazuron, metribuzin, bentazone and MCPB caused severe crop damage.

Dr Iven's presented results from trials screening materials for weed control in 'Grassland's Maku' lotus and demonstrated that of the materials tested dinoseb-acetate pre-emergence and 2,4-DB post-emergence were the best although he suggested that further work was necessary before recommendations could be made for field scale use. Trifluralin, benfluralin, methabenzthiazuron, and propyzamide might also be worth further testing in situations where grass weeds predominate. Discussions following the presentation of this paper raised the problem of establishing 'Grassland's Maku' lotus on hill country and the suggestion was made that research work in this area could be worthwhile possibly evaluating the role of herbicides to reduce competition.

Meeklah *et al.* reported results from three trials testing a range of herbicides for use in oil seed rape. The first two trials were tolerance trials and showed Oro variety oil seed rape to be tolerant to trifluralin, nitralin, dinitramine, penoxalin, fluchloralin, napropamide, and propachlor. Desmetryn caused a small but significant yield depression at the 0.38 kg/ha rate as did picloram/nitrofen at 1.8 kg/ha. It was pointed out during discussion that chlornitrofen was used, and not nitrofen as quoted in the paper. In the third trial picloram/nitrofen at 1.2 and 1.8 kg/ha caused significant yield reductions. Dicamba also caused yield reductions in these trials at rates above 0.14 kg/ha although these reductions were not significant. There was however definite evidence of phytotoxicity, plants treated at higher rates having shorter stems and fewer pods.

Betts screened herbicides for use in *Solanum laciniatum* in the final paper of the session. Of the post-plant materials tested *Solanum laciniatum*

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