EFFECTS OF HERBICIDE TREATMENTS ON THREE LUPIN SPECIES

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Summary

In experiments on three lupin species *Lupinus albus* cv 'Ultra' was the most resistant to herbicides, *L. luteus* cv 'Weiko III' the most susceptible and *L. angustifolius* cv 'Unicrop' intermediate. Pre-emergence chemicals gave the best weed control, atrazine and simazine showing a good safety margin on 'Ultra' and 'Unicrop' while linuron was more damaging. Among pre-planting chemicals, which also gave reasonable control, dinitramine was the most effective but least safe, ethalfluralin, penoxalin and trifluralin were safe, with ethalfluralin more effective than trifluralin. Atrazine caused damage applied post-emergence but chloroxuron gave reasonable control with little crop damage.

INTRODUCTION

New varieties of lupin (*Lupinus* spp) show promise as high protein seed or forage crops for New Zealand conditions but effective weed control is considered essential for the success of the crop. Previous herbicide work has been largely confined to *L. angustifolius* and several materials appear promising as pre-planting or pre-emergence treatments (Betts 1975; Mitchell *et al* 1975; Rhodes 1975). Little information, however, is available on the susceptibility of *L. albus* and *L. luteus*, which are also of potential value. The present trials were undertaken to obtain information on the effectiveness and relative safety of a range of promising herbicides on the above three species.

METHOD

Adjacent pre-planting, pre-emergence, and post-emergence experiments were established on Manawatu silt loam soil. *L. angustifolius* cv 'Unicrop', *L. albus* cv 'Ultra' and *L. luteus* cv 'Weiko III' were sown on 15-16 October 1975 in 20cm rows at a spacing of 5 cm with a Stanhay precision drill. Each experiment was laid out in a split plot randomised block design with four replicates and the 4 x 2m main plots split for crop species. Sub-plots contained three crop rows.

The pre-planting treatments, detailed in Table 1, were incorporated to a depth of approximately 7.5 cm by rotavator within 1.5 hours of spraying and the plots sown immediately afterwards. Pre-emergence treatments (Table 2) were applied the day after sowing and post-emergence treatments (Table 3) on 12 November when the lupins were 7.5-10 cm high with 4.5-6 leaves. Each experiment included hand-hoed and unweeded controls.

Weeds were assessed by counting ten 0.1m² quadrats per plot, the principal species being fathen (*Chenopodium album* agg), twincress (*Coronopus didymus*), shepherd's purse (*Capsella bursa-pastoris*), wild turnip (*Brassica campestris*), black nightshade (*Solanum nigrum*), and redroot (*Amaranthus powellii*), together with numerous clovers (*Trifolium* spp). Effects on the crop were assessed visually by scoring 4 weeks after spraying (2 weeks after the post-emergence spraying) and by sampling a 1 m length of row for dry matter determination 8 weeks after sowing. Seed yields were recorded later but were too variable to show valid effects, statistical analysis of weed reductions were performed on transformed data.

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Crop Weeds

RESULTS

Pre-planting treatments

As shown in Table 1 the two higher rates of all chemicals gave effective control of the major weeds (especially fathen). Most weeds which remained at counting consisted of very small clover and twincress seedlings unlikely to have interfered with the growth of the crop. Ethalfluralin gave slightly, but significantly, better control than trifluralin, while dinitramine was distinctly more effective than trifluralin, penoxalin or ethalfluralin. Dinitramine, however, was also the only pre-planting chemical to affect the crop significantly. At the 2 kg/ha rate the mean dry weight of the three species was reduced by 27% in comparison with hand-hoeing, and the effect was apparently greatest with *L. luteus*, though the treatment/species interaction was not significant in this experiment.

TABLE 1: EFFECTS OF PRE-PLANT INCORPORATED TREATMENTS ON WEEDS AND CROP GROWTH

Treatment (16/10/75)	Rate (kg/ha)	Weeds % Reduction from unweeded (27/11/75)	Crop* DM as % of unweeded (8/12/75)		
			ang.	alb.	lut.
trifluralin	0.5	52 d	107	101	102
trifluralin	1.0	5b d	101	103	82
trifluralin	2.0	71 c	101	103	91
penoxalin	0.5	46 d	114	107	99
penoxalin	1.0	71 c	118	111	94
penoxalin	2.0	80 bc	111	107	101
ethalfluralin	0.5	50 d	92	88	101
ethalfluralin	1.0	73 c	94	86	89
ethalfluralin	2.0	84 b	100	92	79
dinitramine	0.5	71 c	99	98	90
dinitramine	1.0	83 b	97	95	58
dinitramine	2.0	96 a	82	75	53
hand-hoed		53 d	107	93	89
		No./m ²	kg/ha		
unweeded		408	1990	1840	1680
sig. diff. (P = 0.05)		--	20	21	23
CV %		11		12	

* ang. = *L. angustifolius*; alb. = *L. albus*; lut. = *L. luteus*

Pre-emergence treatments.

Of the pre-emergence treatments listed in Table 2, atrazine, simazine, and linuron gave very high levels of weed control at rates down to 0.5 kg/ha. Methabenzthiazuron was effective at the highest rate tested, while ethalfluralin was ineffective as a surface treatment. Crop species varied considerably in reaction, *L. albus* showing no signs of injury, *L. luteus* being the most susceptible and *L. angustifolius* intermediate. Linuron was the most damaging chemical (87% reduction of *L. luteus* dry matter with 3 kg/ha). Atrazine caused moderate to severe chlorosis and dry matter was not significantly reduced. Slight chlorosis was recorded and dry matter was not significantly reduced. Slight chlorosis was recorded with the highest rate of simazine on *L. luteus* and a few seedlings were slightly affected by methabenzthiazuron at 3 kg/ha. The chlorotic plants subsequently grew normally, however, and although the dry matter figures suggest a small reduction with simazine, the reduction was not significant.

Crop Weeds

TABLE 2: EFFECTS OF PRE-EMERGENCE TREATMENTS ON WEEDS AND CROP GROWTH

Treatment (16/10/75)	Rate (kg/ha)	Weeds % Reduction from unweeded (26/11/75)	Crop* DM as % of unweeded† (7/12/75)		
			ang.	alb.	lut.
ethalfluralin	1.0	0 f	88	84	90
ethalfluralin	2.0	29 f	88	103	112
atrazine	0.5	99 ab	94	101	110
atrazine	1.0	99.7 a	113	97	96
atrazine	2.0	99.9 a	106	93	79
simazine	0.5	89 cd	108	117	128
simazine	1.0	93 c	109	111	113
simazine	2.0	99.9 a	111	95	73
linuron	0.75	96 bc	106	109	94
linuron	1.5	99 ab	109	122	48
linuron	3.0	99.6 ab	56	76	13
methabenzthiazuron	0.75	20 f	100	103	97
methabenzthiazuron	1.5	58 e	120	109	115
methabenzthiazuron	3.0	85 d	87	92	99
hand-hoed		81 d	110	77	98
		No./m ²	kg/ha		
unweeded		286	2415	1785	1515
sig. diff. within species (P = 0.05)			28	38	45
CV %		24		18	

* ang. = *L. angustifolius*; alb. = *L. albus*; lut. = *L. luteus*

† means of only 3 replicates, the 4th badly affected by root rot

Post-emergence treatments

The results given in Table 3 show that atrazine was almost as effective applied after emergence on weeds up to 3 cm high as pre-emergence but considerably more damaging to all species of lupin. Chloroxuron on the other hand, though killing fewer weeds, was much less damaging, only the highest rate significantly reducing dry weight of *L. luteus*.

TABLE 3: EFFECTS OF POST-EMERGENCE TREATMENTS ON WEEDS AND CROP GROWTH

Treatment (12/11/75)	Dose (kg/ha)	Weeds % Reduction from unweeded (27/11/75)	Crop* DM as % of unweeded (8/12/75)		
			ang.	alb.	lut.
atrazine	0.5	86 a	82	77	49
atrazine	1.0	97 a	31	53	33
atrazine	1.5	99 a	32	49	42
atrazine	2.0	100 b	10	34	32
chloroxuron	0.75	26 c	100	82	86
chloroxuron	1.5	33 c	94	92	82
chloroxuron	2.25	58 c	98	75	80
chloroxuron	3.0	70 d	87	86	48
hand-hoed		69 e	95	89	100
		No./m ²	kg/ha		
unweeded		308	1940	1790	1410
sig. diff. within species (P = 0.05)			20	22	28
CV %		16		19	

* ang. = *L. angustifolius*; alb. = *L. albus*; lut. = *L. luteus*

DISCUSSION

The experiments show clear differences in herbicide susceptibility between lupin species. *L. angustifolius*, the most commonly grown species, had a high level of resistance to the dinitroaniline chemicals, moderate resistance to atrazine, simazine, and linuron as pre-emergence treatments but marked susceptibility to atrazine applied after emergence. *L. luteus* was more susceptible to pre-planting (especially dinitramine) and pre-emergence sprays. *L. albus*, on the other hand, appeared considerably more resistant than the other species to all types of treatment, though post-emergence atrazine was still damaging.

The comparative effectiveness of the herbicides tested is in general agreement with previous reports. The superiority of atrazine over dinitroaniline materials was commented on by Mitchell *et al* (1975) and Rhodes (1975). In the present work, atrazine applied pre-emergence at 0.5 kg/ha killed practically all weeds and a four-fold increase in rate caused only slight, temporary chlorosis with *L. angustifolius*, suggesting an adequate safety margin with this species. Simazine appears to offer a safer, and only slightly less effective, alternative for the more susceptible species *L. luteus*, whereas linuron, though effective, was more damaging. Methabenzthiazuron, though safe, was less effective.

Of the various dinitroanilines, dinitramine was the most effective, in agreement with Betts (1975) but also had a lower safety margin (cf Mitchell *et al* 1975). Ethafluralin, however, while giving better control than trifluralin appeared equally safe. With the dinitroanilines generally, although the degree of control appeared to be appreciably lower than with the pre-emergence treatment, the surviving weeds were small and uncompetitive so that the 1 kg/ha rate of penoxalin or ethafluralin would probably be considered as satisfactorily effective. In situations where grass weeds form a larger proportion of the population these chemicals could have advantages over pre-emergence materials.

The results also confirm those of Betts (1975) in showing that atrazine is too damaging as a post-emergence treatment for lupins and that chloroxuron has possibilities at this stage, though relatively high rates are likely to be required for satisfactory control. Throughout the present trials there was no indication that the vegetative growth of the crop was increased by either hand hoeing or chemical treatment. Without more definite data on seed yield it cannot be assumed that control of weeds was unnecessary, but the results do suggest that the three types of lupin grown are all able to offer strong competition to weeds from an early stage of growth.

ACKNOWLEDGMENTS

We wish to acknowledge the financial support of the lupin project by Dalgety New Zealand Ltd. and the Pork Industry Council. Thanks are also due to the firms which provided herbicide samples and to T. Lynch, L. Frost and D. Fernandes who assisted in the experimental work.

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