WEED CONTROL IN LUPINS

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Summary

Lupins (*Lupinus angustifolius*) show good tolerance to pre-emergence weedkillers in contrast to high sensitivity towards all post-emergence weedkillers tested. In the presence of vigorous weeds the use of effective weedkillers has led to increased green weight of lupins. In crops likely to suffer from weeds, chlorpropham, amiben, simazine or atrazine are recommended at the lowest rates likely to control moderately sensitive weeds.

POST-EMERGENCE WEEDKILLERS

THE FOLLOWING chemicals have been found far too damaging for selective weed control in lupins: 2,4,5-T, 2,4-D, 2,4-DB, MCPA, MCPB, mecoprop, TBA, fenac, SMCA, 2,2-DPA, amitrole, diquat, dinoseb, PCP, and white spirit. The least damaging among these are 2,4-DB and MCPB, but recovery from spraying with these is poor.

PRE-EMERGENCE WEEDKILLERS

In early trials lupins showed good tolerance to pre-em. weedkillers. Rather than attempt to evaluate numerous chemicals on a basis of crop tolerance, the writer has eliminated many on account of poor weed control. Monuron and diuron were not used because they exhibit greater damage than triazines towards legumes generally. Recent trials have been based largely on chlorpropham, amiben, simazine and atrazine.

It is usual to express yields of fodder crops on a dry matter basis, and this has been done in the Invermay trials. Reduction to dry matter, however, will bias yields in favour of the stalk, which on a dry weight basis has less nitrogen than the leaves, and less value therefore as fodder or green manure.

An important proportion of the central stalk is not eaten by sheep, especially in the more mature crops. Some allowance is desirable for the inedible stalk and roots as they are useful for soil improvement. The best estimate of the crop is perhaps the green weight of the whole plant with the dirt shaken off the roots. This is the weight used in these trials. The crops were harvested at a stage at which they might be fed off or turned under, before they started to dry off.

RESULTS OF SOME TRIALS

Pre-emergence trials by the writer are numbered serially. Trials done at Invermay are given the numbers used by the Department of Agriculture. Results of the Invermay trials and of No. 17 have been analysed by the Department of Agriculture biometricians. Quantities of chemicals used are expressed in terms of active ingredient per acre.

Trial 1 (Table 1), done on a heavy clay soil in the Nelson district, was the first to demonstrate a gain in lupin growth from weed suppression.

All treatments gave yields significantly greater ($p < 0.05$) than the untreated.

In contrast, results unfavourable to chlorpropham were obtained at Invermay on alluvial ground (Table 2).

TABLE 3: TRIALS WITH CHLORPROPHAM AT 8 lb

Trial No.	Sown	Harvested	No. Replicates	Rel. Green Wt. Lupins	CV	Rel. No. Plants (Control = 100)	CV
7	Dec. 8, 60	—	3	—	—	96	11%
8	Oct. 21, 60	Feb. 1, 61	6	102 (HW = 100)	22%	95	7%
11	Feb. 16, 61	July 15, 61	5	125* (Untr. = 100)	14%	119*	16%
18	Mar. 10, 61	Aug. 18, 61	4	103 (HW = 100)	14%	—	—
19	April 9, 61	Oct. 21, 61	3	94 (Untr. = 100)	25%	80*	11%
22	Mar. 25, 62	—	5	—	—	98	15%

* These figures differ significantly ($p < 0.05$) from the controls. Student's t used for significance test.

TABLE 1: TRIAL No. 1

Treatment (lb)	Lupin Yield — Green Weight (tons per acre)				
Chlorpropham 4	.....	.....	.....	.....	22.7
Chlorpropham 2	.....	.....	.....	.....	20.2
EPTC 2	.....	.....	.....	.....	21.6
Propham 4	.....	.....	.....	.....	18.2
HWC	.....	.....	.....	.....	18.3
Untreated control	.....	.....	.....	.....	12.3

Sown February 20, 1960; sprayed February 20, 1960; harvested September 23, 1960. Number of replicates, three; main weed — spurrey (*Spergula arvensis*).

TABLE 2: TRIAL 60/I 543

Treatment (lb)	Yield Dry Wt. (lb per Acre)						Rel. No. Plants
	Lupins			Weeds			
Chlorpropham 4	1210	b	B	620	b	BC	91 a A
Chlorpropham 8	460	c	C	190	c	CD	74 b B
2,4-DB 1½	460	c	C	230	c	BCD	—
MCPB 1½	360	c	C	620	b	B	—
Amine Salt of Dinoseb 2	350	c	C	300	c	BCD	—
Untreated con- trol	1540 a	A		1700 a	A		—
HWC	1570 a	A		8	c	D	100 a A

Sown November 14, 1960; sprayed chlorpropham November 19, 1960, others December 21, 1960; harvested January 30, 1961. Number of replicates, four; main weeds — wireweed (*Polygonum aviculare*), cornbind (*Polygonum convolvulus*).

Seed of Borre variety lupins left over from the above trial was taken to Nelson and used in several trials where it stood chlorpropham well.

A series of trials done with chlorpropham on the writer's ground are summarized in Table 3.

In these trials seed was planted by hand in rows and plots were a moderate size.

In Trial 16 (Table 4) Borre lupin seed was broadcast and harrowed, and chlorpropham applied with a 16 ft boom.

TABLE 4: TRIAL No. 16

<i>Treatment</i> (lb)	<i>Green Wt. (tons per acre)</i>			<i>Rel. No. Plants</i>
	<i>Lupins</i>	<i>Weeds</i>		
Chlorpropham 2	9.9	0.2	.....	119
Untreated control	6.7	4.3	.....	100

Sown March 12, 1961; sprayed March 13, 1961; harvested July 25, 1961. Number of replicates, five; main weeds — chickweed (*Stellaria media*), spurrey.

Increase in lupin weight was significant (p well below 0.05) but increase in number of plants was not.

Trial 17 (Table 5) was laid down on free-draining silt at Lower Moutere, near Motueka. Bitter blue lupins were cross-drilled.

Trial 20 (Table 6) was laid down on free-draining silt in Motueka. Seed was drilled into moist soil. Two inches of rain fell five days after planting, but afterwards the weather was abnormally dry.

TABLE 5: TRIAL No. 17

<i>Treatment</i> (lb)	<i>Lupin Yield</i> <i>Green Wt. (tons per acre)</i>		
Chlorpropham 2	.....	.....	25.2 a A
Atrazine ½	.....	.....	24.5 ab AB
Atrazine 1	.....	.....	22.2 bc AB
Amiben 1	.....	.....	23.8 abc AB
3Y9 2	.....	.....	23.7 abc AB
Trietazine 1	.....	.....	23.5 abc AB
Simazine 1	.....	.....	22.8 abc AB
Propazine 1	.....	.....	22.3 bc AB
Simeton 1	.....	.....	22.5 bc AB
Prometon 1	.....	.....	21.5 c B
Untreated control	.....	.....	22.0 bc AB
C.V.	.....	.....	6%

Sown March 12, 1961; sprayed March 16, 1961; harvested August 20, 1961. Number of replicates, three; main weeds — stagger weed (*Stachys arvensis*), speedwell (*Veronica persica*), docks (*Rumex obtusifolius*).

TABLE 6: TRIAL No. 20

<i>Treatment</i> (lb)	<i>Green Wt. (tons per acre)</i>		<i>Rel. No. Plants</i>
	<i>Lupins</i>	<i>Weeds</i>	
Simazine 1	.....	17.6	6
Atrazine ½	.....	21.3	5
Amiben 2	.....	20.9	4
HWC	.....	22.8	2
Untreated control	.....	12.1	16
C.V.	.....	16%	60%

Sown October 22, 1961; sprayed October 22, 1961; harvested January 7, 1962. Number of replicates, four; main weeds — fathen (*Chenopodium album*), 7 ft tall and vigorous; amaranthus (*Amaranthus hybridus*), not very vigorous; nightshade (*Solanum nigrum*), numerous but well smothered by the crop.

TABLE 7: TRIAL 61/I 593

<i>Treatment</i> (lb)	<i>Lupin Yield</i> <i>Dry Wt. (lb per acre)</i>		
Prometryne 1½	.....	.....	12,800 b A
Prometryne 2½	.....	.....	13,100 ab A
Atrazine 1½	.....	.....	12,600 b A
Atrazine 2½	.....	.....	13,300 ab A
Simetryne 1½	.....	.....	13,300 ab A
Simetryne 2½	.....	.....	14,400 a A
Ametryne 1½	.....	.....	13,800 ab A
Ametryne 2½	.....	.....	13,100 ab A
Amiben 4	.....	.....	13,200 ab A
Untreated control	.....	.....	14,100 a A
C.V.	.....	.....	6%

Sown December 7, 1961; sprayed December 11, 1961; harvested February 23, 1962. Number of replicates, three; main weeds — a light infestation of spurrey, fathen, and cornbind.

Treated plots, considered collectively, yielded 6% less than the untreated. This difference was significant ($p < 0.05$).

All treatments showed 5% significant decrease in yield.

A trial was run at Invermay using Borre lupins (Table 7). Lupins grew well and competition from weeds was slight.

DISCUSSION

It is evident that worthwhile increases in lupin yield are possible only with the fulfilment of three conditions:

- (1) Crop damage must be absent or only slight. At the low rates at which pre-emergence weedkillers must be used on a field scale, serious damage to lupins is unlikely, especially with triazines.
- (2) Weed control must be adequate. A trial at Rukuhia illustrated inadequate weed control from insufficient soil moisture.
- (3) Both the lupins and the weeds must be growing vigorously. A poorly growing lupin crop will not respond sufficiently from weed removal to pay for the weedkiller.

On the other hand, a vigorous lupin crop will smother a feebly growing weed infestation and may show only slight benefit from weed removal. In Trial 17 weed control was very good, but the gain in yield from removing many small feebly growing weeds was slight.

Where both the crop and the weeds are vigorous, the use of weedkiller is likely to have the greatest benefit. Trial 20 illustrates a big increase in yield from checking weeds, even though the weed control was not particularly good.

It may be worth treating lupins merely to prevent undesirable weeds from seeding, for instance to keep *Poa annua* off ground which will later be planted in onions or carrots. As little as 2 lb of chlorpropham has been found to diminish greatly the amount of barley grass (*Hordeum murinum*) coming up in autumn-sown crops of lupins.

Other points are discussed with regard to particular weedkillers.

CHLORPROPHAM

Damage to lupins in the Invermay trial was in disagreement with successful use of chlorpropham by the writer. Chlorpropham has been used in 16 further trials which have indicated the importance of soil type.

Six of these trials were designed to test chlorpropham on a safe soil under the unfavourable conditions of shallow planting, high rate and heavy watering of the soil. Crop damage occurred in one trial only — No. 19.

Chlorpropham appears to be more likely to depress lupins when they are growing poorly with weak nodulation — *e.g.*, when they are planted too late in the autumn or are suffering from deficiency of phosphate or molybdenum.

In Trial 17, chlorpropham-treated plots yielded rather higher than all others. Very heavy rain fell during the month following emergence and for one day the trial area was flooded.

In view of the successful use of chlorpropham in such trials, it would appear generally safe to use it at the lowest rate to control spurrey, chickweed and *Poa annua* — *i.e.*, at 1 to 2 lb. The use of higher rates to control more difficult weeds can be recommended only in soils proven to be safe with chlorpropham.

On all occasions when lupins were planted with broad beans or French beans, the lupins have shown much greater resistance. It is

clear that the tolerance of lupins to chlorpropham does not arise solely from "depth protection".

AMIBEN

Amiben has been included in seven trials because it offers good control of fathen, which is the most important weed in spring-sown lupins in New Zealand.

Like chlorpropham it controls a narrow range of weeds.

Amiben appears to have little margin for safety when used on lupins, and it should be used only at the minimum rate for control of fathen — *i.e.*, 2 to 3 lb.

TRIAZINE HERBICIDES

Triazines have been used in 12 trials and have shown generally good safety towards lupins. The use of heavy rates on shallow planted lupins has shown atrazine to be less selective than simazine, propazine or trietazine. Atrazine is, however, so much better in weed control that its lesser selectivity must be accepted for field use because the lowest rates possible must be used. Prometon and simeton are poor in weed control and are liable to give delayed crop damage through leaching. Such damage, though small, was visible in Trial 17.

Triazines are active against a broad range of weeds including members of the Compositae and Labiatae which are not controlled by chlorpropham or amiben. Unfortunately, the triazines appear to be even more demanding than other pre-emergence weedkillers in their requirements of soil moisture.