

## WEED CONTROL IN DIRECT-DRILLED LUPINS USING SIMAZINE AND POST-EMERGENCE HERBICIDES

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*Summary.* Lupins (*Lupinus angustifolius*) were successfully established by the direct-drilling method using paraquat/diquat<sup>1</sup> plus simazine to kill stubble weeds prior to sowing. Simazine at 1.8 to 2.4 kg ha<sup>-1</sup> controlled annual ryegrass (*Lolium rigidum*), silver grass (*Vulpia bromoides*), wild oats (*Avena fatua*), dandelion (*Taraxacum officinale*), and capeweed (*Arctotheca calendula*), and ensured significant increases in grain yield. A new post-emergence herbicide, PP009, at 0.25 to 0.75 kg ha<sup>-1</sup> gave good control of annual ryegrass and wild oats, but like diclofop-methyl at 0.375 kg ha<sup>-1</sup> it failed to control silver grass. Both PP009 and diclofop-methyl were safe to the lupins.

### INTRODUCTION

Ellington and Reeves (1978) have shown that lupins can be successfully cropped using the direct-drilling method. As lupins are very susceptible to competition from weeds, it is essential that weeds are effectively controlled from the start of the season. The Victorian Department of Agriculture recommends that simazine at 2.0 kg ha<sup>-1</sup> be applied after sowing in high rainfall areas, and pre-sowing (incorporated with the combine) in dry conditions. If annual ryegrass and wild oats are specific problems, tank mixing simazine with trifluralin at 0.4 kg ha<sup>-1</sup> and diallate at 0.56 kg ha<sup>-1</sup> respectively are recommended. Both trifluralin and diallate need soil incorporation for effective weed control. However, the direct-drilling system does not allow for the use of herbicides which need soil incorporation. A series of trials were established in 1979 and 1980 to evaluate the use of simazine applied in mixture with paraquat/diquat prior to sowing lupins using the direct-drilling method. The new herbicides, oxyfluorfen<sup>2</sup>, PP009 and a mixture of oryzalin and trifluralin, were included in the 1980 trials to evaluate their efficacy on annual ryegrass and wild oats.

### MATERIALS AND METHODS

In 1979, simazine (wetable powder formulation) was applied either in tank-mixture with paraquat/diquat before sowing or by itself at equivalent rates immediately after direct-drilling lupins. The lupins were sown 5 to 7 days after spraying using a 12 row combine drill fitted with 10 cm sowing and cultivating tynes. Diclofop-methyl was applied post-emergence as a standard treatment.

<sup>1</sup> Trade name Spray Seed.

<sup>2</sup> Trade name Goal.

In 1980, simazine, oryzalin/trifluralin and oxyfluorfen were applied in tank-mixtures with paraquat/diquat. The post-emergence treatments, applied 4 to 6 weeks after sowing, were PP009 and diclofop-methyl. Herbicides in both years were applied using a pressurised sprayer fitted with a 2.5 m boom at a volume of 100 L ha<sup>-1</sup>. A nonionic wetter at 0.1% was added to the spray solutions of PP009 and diclofop-methyl. The plots measured 2.5 by 30 or 50 m and each trial was replicated 3 or 4 times. In both seasons narrow-leaved lupin (*Lupinus angustifolius*) was sown. In both years, the trials were conducted in southern New South Wales and Victoria on sandy loam soils. Good growing conditions prevailed in both years.

Treatments were assessed by counting weeds in four 0.25 m<sup>2</sup> quadrats per plot, or by percentage scores of weed cover where 0 = no weeds and 100 = complete ground cover. Yields were measured by harvesting a 1.4 by 30 or 50 m strip in each plot. In one trial where no machine was available to harvest the crop, counts of numbers of pods m<sup>-1</sup> of row and number of seeds/pods were made.

## RESULTS

The results of the 1979 trials are shown in Table 1. At all three rates of 1.2, 1.8 and 2.4 kg ha<sup>-1</sup>, simazine applied in tank-mixture with paraquat/diquat before sowing was as effective as the post-sowing pre-emergence application. Simazine gave broad-spectrum weed control. Diclofop-methyl gave good control of annual ryegrass, but poor control of silver grass. As expected diclofop-methyl did not control broadleaved species such as dandelion and cape-weed. In the Victorian trial, all simazine treatments gave significantly higher yields than the paraquat/diquat only treatment. The low yields obtained in the New South Wales trial were due to severe thinning of the crop by hares.

The weed control efficacy of the treatments in the 1980 trials are presented in Table 2. Simazine at 2.0 kg ha<sup>-1</sup> provided better control of annual ryegrass and silver grass than oryzalin/trifluralin mixture and oxyfluorfen. Oxyfluorfen at 0.72 kg ha<sup>-1</sup> and simazine gave good control of capeweed. PP009 at all rates and diclofop-methyl gave good control of annual ryegrass, but were ineffective against silver grass. Good control of wild oats was obtained by both chemicals in the New south Wales trial. None of the treatments affected lupin crop emergence. Grain yields responded to effective weed control as shown in Table 3. Increases in yield were due to both increases in number of pods/plant as well as number of seeds/pod.

## DISCUSSION

Lupins can be successfully established using the direct-drilling method. For broad-spectrum weed control, simazine can be applied in mixture with paraquat/diquat prior to sowing or by itself soon after sowing. The pre-sowing treatment saves time and cost as it involves a one-pass operation. This treatment also ensures better activity from simazine, particularly under dry conditions, as some incorporation of the chemical is effected during the sowing process. The optimum rate for simazine appears to be between 1.8 and 2.4 kg ha<sup>-1</sup>. However, simazine rates must be adjusted for different soils, and rates lower than 1.8 kg ha<sup>-1</sup> may be appropriate on light sandy soils. The above work was carried out on medium loam to clay loam soils and results are not transferable to lighter soils.

PP009 at 0.375 kg ha<sup>-1</sup> applied post-emergence, 4 to 6 weeks after sowing, can effectively control a number of grass weeds should they appear with the crop. This compound is not only as effective as diclofop-methyl on annual

Table 1. The effect of pre-sowing and post-sowing applications of simazine in direct-drilled lupins in 1979.

Treatments:	Trial locations							
	New South Wales				Victoria			
	Application timing	Rate (kg ha <sup>-1</sup> )	Ryegrass (plants m <sup>-2</sup> ) (Aug 22)	Weed cover (%) (Oct 3)	Yield (kg ha <sup>-1</sup> )	Silvergrass	Weed cover (%) (Sept 14)	
Alone	Pre-sow	-	10.7 a <sup>1</sup>	86 a	308 a	35 a	32 a	880 d
Simazine	Pre-sow	1.2	3.2 b	50 bc	343 a	6 c	10 b	1430 a
		1.8	1.2 b	20 de	324 a	2 c	5 c	1570 a
		2.4	1.0 b	10 e	291 ab	1 c	3 c	1420 a
Simazine	Post-sow	1.2	0.8 b	38 cd	209 c	7 c	10 b	1340 ab
		1.8	2.7 b	27 de	227 bc	7 c	9 b	1140 bc
Diclofop-methyl	Post-emergence	2.4	1.8 b	15 e	208 c	4 c	7 bc	1340 ab
		0.38	4.8 b	58 b	297 ab	28 b	28 a	950 cd
C.V. (%)			92	40	21	43	29	14

<sup>1</sup> Values with the same letters are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

Table 2. Effect of herbicide treatments in direct-drilled lupins on percent cover of weeds in 1980.

Treatments:	Paraquat/diquat (0.25/0.15 kg ha <sup>-1</sup> ) plus	Application timing	Rate (kg ha <sup>-1</sup> )	Weed cover (%)							
				Ryegrass		Silvergrass		Wild oats	Brome grass	Cape- weed	
				Site 1	Site 2	Site 3	Site 1				Site 2
Alone		Pre-sow	-	96 a <sup>1</sup>	76 a	99 a	0 b	19 a	100 a	60 a	73 a
Simazine		Pre-sow	2.0	23 d	1 d	20 c	0 b	0 b	15 c	3 d	9 c
Oryzalin/ trifluralin		Pre-sow	0.29/0.29	74 ab	55 ab	85 b	0 b	20 a	90 b	46 ab	81 a
Oxyfluorfen		Pre-sow	0.36	95 bc	35 bc	93 a	0 b	14 a	98 a	50 ab	44 b
			0.72	94 cd	25 cd	83 b	0 b	18 a	88 b	34 bc	16 c
PP009		Post-emergence	0.25	9 d	5 d	11 d	17 a	14 a	5 d	35 bc	83 a
			0.375	2 d	0 d	5 ef	20 a	18 a	1 d	14 d	83 a
			0.75	1 d	3 d	2 f	20 a	13 a	1 d	18 cd	69 a
Diclofop-methyl		Post-emergence	0.375	3 d	18 cd	11 de	15 ab	13 a	18 c	43 ab	89 a
C.V. (%)				31	73	9	122	49	9	18	36

<sup>1</sup> Values with the same letters are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

Table 3. Effect of herbicides treatments on grain yield of direct-drilled lupins in 1980.

Treatments:	Paraquat/diquat (0.25/0.15 kg ha <sup>-1</sup> ) plus	Application timing	Rate (kg ha <sup>-1</sup> )	Grain yield (kg ha <sup>-1</sup> )			Pods (No. m <sup>-1</sup> of row) Site 2	Seeds/pod (No.) Site 2
				Site 1				
				Site 1	Site 3	Site 4		
Alone		Pre-sow	-	729 cd <sup>1</sup>	662 c	300 b	9.3 g	2.2 c
Simazine		Pre-sow	2.0	1044 abc	1242 a	967 a	48.4 a	4.0 a
Oryzalin/ trifluralin		Pre-sow	0.29/0.29	1021 abc	904 b	182 b	15.4 f	2.9 b
Oxyfluorfen		Pre-sow	0.36	858 bcd	729 c	782 a	21.8 e	2.4 bc
		Pre-sow	0.72	619 d	850 b	960 a	11.1 g	2.8 bc
		Pre-sow	0.25	1137 ab	1175 a	330 b	39.7 c	3.7 a
PP009		Post-emergence	0.375	1220 a	1258 a	480 b	44.3 b	3.8 a
		Post-emergence	0.75	1063 ab	1242 a	400 b	37.6 c	3.8 a
Diclofop-methyl		Post-emergence	0.375	1033 abc	1175 a	292 b	24.9 d	3.7 a
C.V. (%)				21	8	40	8	13

<sup>1</sup> Values with the same letters are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

ryegrass and wild oats, but also has activity on brome grass (*Bromus* spp.). As it is essentially a grass-killer, it has no activity on broadleaved weeds, which can exert severe competition with the crop as seen at western Victoria, Site 4. In these situations, simazine is the best treatment. Although oxyflurofen controlled capeweed, its efficacy on grasses was unsatisfactory. Unfortunately, at present, there is no suitable post-emergence broadleaved herbicide for use in lupins.

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