WHITE CLOVER CONTROL IN 'GRASSLANDS MAKU' LOTUS (*LOTUS PEDUNCULATUS*) SEED CROPS

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SUMMARY

Paraquat, oxyfluorfen, chlorimuron, AC 222,293 and ethofumesate were evaluated for white clover (*Trifolium repens*) control in 'Grasslands Maku' lotus (*Lotus pedunculatus*) seed crops. Chlorimuron, AC 222,293 and ethofumesate were particularly damaging to white clover, and lotus seed purities from plots receiving these herbicides were within basic seed certification standards. Chlorimuron severely checked lotus growth, but by late spring the lotus had recovered and subsequently seed yields were double that where no herbicides were used. AC 222,293 and ethofumesate checked lotus growth only slightly. Paraquat and oxyfluorfen were not effective in controlling white clover, but paraquat was effective in controlling annual poa. Chlorimuron, because its cost is much lower than ethofumesate, has potential for white clover control in lotus seed crops. AC 222,293 is not commercially available in New Zealand.

INTRODUCTION

White clover is still one of the major problem weeds for 'Grasslands Maku' lotus seed growers (Lancashire *et al* 1980; Neal 1983). White clover seed is almost the same size as lotus seed, and while a lot of it can be separated out during seed cleaning, large seed losses of lotus occur.

Ethofumesate has proved very effective in controlling white clover in Maku lotus seed crops (Brock and Henderson 1976, 1980). However, more cost effective alternatives are now available and required investigation. Chlorimuron is registered for use in lucerne (*Medicago sativa*) crops to control red, white and subterranean clovers plus dandelions (*Taraxacum officinale*), beaked hawkbeard (*Crepis capillaris*), and shepherd's purse (*Capsella bursa-pastoris*), but at the time of these trials had not been evaluated on lotus seed crops. The herbicide Sceptor belonging to the chemical family imidazolinone has been very effective in controlling white clover in *Lotus corniculatus* seed crops in Argentina (Amadeo 1988). Sceptor was not available in New Zealand, but a related product AC 222,293 was available for testing.

Earlier weed control trials on Maku lotus are also reported. In these trials paraquat, simazine and oxyfluorfen were evaluated for control of annual poa and white clover.

METHOD

Trial 1

The evaluation was carried out in the Manawatu on a 1 year old Maku lotus stand from which one seed crop had been taken. The stand was on a Holocene quartzofeldspathic interlayered silt alluvium and peat soil (Opiki humic silt loam). Herbicides used (Table 1) included paraquat (Gramoxone), simazine (Simazole 5A) and oxyfluorfen (Goal) plus an untreated control. These treatments were replicated three times in a fully randomised design. The herbicides were applied by a small pressure sprayer in 300 litres/ha water at 300 kPa on 4 August 1980. Individual plot size was 3 m x 5 m.

Herbicide effects were estimated by visual assessment of weeds (% injury to weeds, and white clover) 25 days after treatment, and Maku lotus (% injury) 25 and 65 days after treatment. Seed was harvested in February 1981 from 1 m² quadrats from each plot. Seed yield was corrected to 12% moisture.

Proc. 43rd N.Z. Weed and Pest Control Conf. 1990: 130-133

TABLE 1: The effect of herbicides on annual poa and Maku lotus (Trial 1).

Treatment	Rate (kg ai/ha)	Annual poa	Maku lotus		Seed yield kg/ha
		% injury (kg ai/ha) 25 DAT*	% injury 25 DAT	% injury 65 DAT	
untreated		0	0	0	130
paraquat	0.4	93	5	3	190
paraquat	0.8	99	5	3	200
oxyfluorfen	0.4	5	93	43	140
oxyfluorfen	0.8	5	92	57	170
paraquat	0.4	100	5	30	180
+ simazine	1.5				
paraquat	0.4	100	93	23	180
+ oxyfluorfen	0.4				
paraquat	0.4	100	88	43	200
+ oxyfluorfen	0.4				
+ simazine	1.5				
LSD (P<0.05)					55

*DAT = days after treatment.

Trials 2 and 3

These evaluations were carried out at the DSIR Grasslands Aorangi farm in the Manawatu using 2 year old Maku lotus stands from which two seed crops had been taken. Two separate stands were used in the two trials. Both stands were on a Holocene quartzo-feldspathic silty alluvium soil (Kairanga silt loam).

In Trial 2 AC 222,293 (Assert) (Table 2) was evaluated together with an unsprayed control in an unreplicated screening trial. The herbicide was applied on 25 May 1988 by a small gas pressure sprayer in 250 litres/ha water at 200 kPa. Individual plot size was 3 m x 5 m. Herbicide effects were estimated by visual assessments (% injury) of Maku lotus (69 and 131 days after treatment) and white clover (35, 69 and 131 days after treatment). No seed yield was taken.

TABLE 2: Effect of AC 222,293 on lotus and white clover herbage (Trial 2).

Herbicide	% Damage			
	Lotus	White clover		
25 May 1988 (kg ai/ha)	131 DAT*	35 DAT	69 DAT	131 DAT
untreated	0	0	0	0
0.30	0	20	50	30
0.60	0	80	65	30
0.90	0	99	95	95
1.50	0	99	90	90

*DAT = days after treatment

In Trial 3 the herbicides used were chlorimuron (Classic), AC 222,293 and ethofumesate (Tramat) (Table 3). These herbicides plus an untreated control were replicated three times in a fully randomised design. The herbicides were applied by a small pressure sprayer in 250 litres/ha water at 200 kPa on 13 May 1989. Individual plot size was 3 m x 5 m.

Botanical analysis to measure the percentage dry matter of Maku lotus, white clover and other species were taken from 0.25 m² samples cut from each plot on 13 May 1989 (beginning of trial) and 31 October 1989. Herbicide effects were also estimated by making visual assessments (% injury) of Maku lotus and white clover content in all plots on 65, 88 and 115 days after treatment. From each plot one 0.25 m² cut was taken

TABLE 3: Effect of herbicides on Maku lotus and white clover herbage (Trial 3).

Herbicide	Rate (ai/ha)	% Damage			
		65 DAT*		115 DAT	
		Maku lotus	White clover	Maku lotus	White clover
untreated		0	0	0	0
chlorimuron	(15 g)	83	83	43	87
chlorimuron	(30 g)	77	87	47	92
chlorimuron	(60 g)	90	93	75	96
AC 222,293	(0.75 kg)	30	90	7	96
AC 222,293	(1.2 kg)	50	87	8	95
ethofumesate	(1.4 kg)	50	80	5	94
LSD (P<0.05)		17	10	16	7

*DAT = days after treatment

for dry matter analysis on 27 October 1989 and two 0.25 m² cuts were taken for seed yield on 16 February 1990. The seed was threshed, cleaned, weighed and a purity analysis taken from each sample. Seed yield was corrected to 12% moisture.

RESULTS AND DISCUSSION

Trial 1

Paraquat was the most effective herbicide controlling annual poa and gave the highest seed yield (Table 1). Oxyfluorfen was not effective on annual poa and was also particularly damaging to Maku lotus soon after application, although the lotus recovered and produced seed. None of the herbicides had any effect on white clover. The herbicide combinations were no more effective than paraquat alone.

Trial 2

AC 222,293 had no injurious effect on Maku lotus (Table 2). At 0.90 and 1.55 kg/ha it was particularly damaging to white clover. White clover was showing slight signs of recovery by late spring but this would not have affected Maku lotus seed yields. This initial screening trial indicated that AC 222,293 was a promising herbicide for white clover control in Maku lotus seed crops.

Trial 3

Chlorimuron had caused significant ($P<0.001$) damage to both Maku lotus and white clover by 9 weeks after application (Table 3). AC 222,293 and ethofumesate were less damaging than chlorimuron to Maku lotus and were equally injurious to white clover. By 115 days after treatment, all the herbicides were equally damaging to white clover. Maku lotus at this time was starting to recover from the desiccating effect of chlorimuron and was showing no adverse effects from AC 222,293 and ethofumesate.

By late spring (27 October) Maku lotus had completely recovered from the effects of chlorimuron (Table 4). White clover was also starting to recover in the chlorimuron

TABLE 4: Effect of herbicides on total herbage dry matter, and botanical analysis of that dry matter, taken on 27 October 1989, in Trial 3.

Herbicide	Rate (ai/ha)	Dry matter (g/m ²)	Botanical analysis % by dry weight		
			Maku lotus	White clover	Other species
untreated		523	61.5	5.3	33.2
chlorimuron	(15 g)	442	92.6	6.1	1.3
chlorimuron	(30 g)	484	93.8	5.9	0.3
chlorimuron	(60 g)	360	93.4	4.8	1.8
AC 222,293	(0.75 kg)	530	91.3	0.1	8.6
AC 222,293	(1.2 kg)	570	89.3	0.2	10.5
ethofumesate	(1.4 kg)	553	80.4	0.7	18.9
LSD (P<0.05)		169	14.5	NS	10.7

TABLE 5: Effect of herbicides on Maku lotus seed yields and seed purities (Trial 3).

Herbicide	Rate (ai/ha)	Seed yield (kg/ha)	Seed purity		
			% Maku lotus	% White clover	% Inert
untreated		138	95.7	3.9	0.4
chlorimuron	(15 g)	287	99.5	0.3	0.2
chlorimuron	(30 g)	259	99.7	0.2	0.1
chlorimuron	(60 g)	245	99.7	0.2	0.1
AC 222,293	(0.75 kg)	274	99.6	0.1	0.3
AC 222,293	(1.2 kg)	259	99.7	0.1	0.2
ethofumesate	(1.4 kg)	261	99.8	0.1	0.1
LSD (P<0.05)		137	2.9	2.7	NS

plots, but not in the AC 222,293 and ethofumesate plots. This may be because the AC 222,293 and ethofumesate plots always maintained a good vegetative cover of lotus which would have prevented clover from growing again. In the chlorimuron plots the open canopy would have allowed clover to recover in the late spring. Chlorimuron was also very damaging to other weed species, particularly hawkesbeard, dandelion and some *Rumex* spp., and these plots had fewer weeds when compared to ethofumesate, AC 222,293 and the untreated plots.

At seed harvest there were no differences in seed yields and seed purity between the herbicide plots (Table 5), and the seed purities of these plots reached basic seed standards (MAF Qual, 1989). The untreated plots produced lower seed yields and the amount of white clover would have made the seed uncertified.

AC 222,293 and ethofumesate only mildly checked lotus growth, while chlorimuron severely desiccated and checked lotus growth for some weeks after application. This severe effect of chlorimuron may be advantageous by reducing plant and stem populations in aging stands and allowing vigorous high seed-yielding crown stems to develop (Hare 1987). AC 222,293 will not be available in New Zealand and therefore cannot now be considered by growers for white clover control in lotus seed crops. To control white clover effectively ethofumesate must be applied at 4-7 litres/ha. Chlorimuron, however, is considerably cheaper and applying the recommended product rate of 120 g/ha costs only \$50/ha. It was very effective in controlling other weeds as well. Chlorimuron is therefore a very economic alternative to ethofumesate in controlling white clover in lotus seed crops.

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