PARAQUAT AT LOW WATER RATES FOR SWARD SUPPRESSION DURING OVERSOWING INTO UNIMPROVED PASTURES.

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SUMMARY

Aerial application of paraquat or paraquat:diquat was necessary to maximise establishment of white clover (*Trifolium repens*) oversown into unimproved existing pastures. Application of 200 g ai paraquat or paraquat:diquat (6:1)/ha in 200 litres water increased establishment 200-300% over not spraying. Lowering the water rate to 60 litres/ha maintained a high level of establishment on steep slopes and achieved 80% of potential on easy slopes. By reducing the water rate with paraquat or paraquat:diquat applications, significant cost savings, (typically 30-50% of development costs) can be achieved.

INTRODUCTION

Paraquat and other herbicides have been used in oversowing programmes in hill country pasture development to achieve complete or near complete kill of the existing sward (Blackmore, 1961, 1964; Williams, 1967; Cullen, 1971; Baars *et al* 1982). Such work used rates of paraquat between 245 and 1140 g ai/ha applied in up to 313 litres water/ha.

The role of low rates of paraquat as a growth suppressant during oversowing hill country during establishment was assessed by Sithamparanathan *et al* (in press). This work showed that where the aim was to check the growth of the resident sward, rather than kill it, this could be achieved using paraquat at 250 g ai/ha or less. Such a growth check, coupled with adequate post oversowing grazing management was capable of establishing grass and legume seeds oversown in easy hill country.

A series of trials was carried out on a paddock scale at Whatawhata Hill Country Research Station to assess the role of various oversowing strategies in the establishment of white clover into unimproved, steep, hill country pastures.

This paper reports on aspects of sward suppression achieved using high (200 litres/ha) and low (60 litres/ha) water rates to apply the same rate of paraquat and paraquat:diquat, for sward suppression, during the establishment of white clover by oversowing into unimproved hill country pastures. The possible advantage of using low water rates for the application of paraquat and paraquat:diquat as growth suppressants, to lower the costs of application, is discussed.

METHODS

Two trials were carried out on a paddock basis during 1983 and 1984. Two replicate paddocks, each 3.6 ha of predominantly north facing aspect with 65% of each area being greater than 30 degrees slope, were each divided into three main plots. Three spray treatments were randomly allocated to each replicate; nil spray; paraquat 200 g ai in 60 litres/ha; paraquat 200 g ai/ha in 200 litres/ha (1983) and; nil spray; paraquat:diquat 6:1 200 g ai/ha in 60 litres/ha; paraquat:diquat 6:1 200 g ai/ha in 200 litres/ha (1984). Sub-plots, 2 x 1 m, were selected on easy (15-25 degrees) and steep (32-35 degrees) slopes within main plots. Sub-plot allocation was based upon aspect, slope and resident vegetation.

Prior to grazing in late May, the existing vegetation consisted of late summer pasture surpluses, characterised by a large proportion of dead matter, predominantly

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seed head and stalk. On easy slope the resident vegetation was white clover, new seedlings of subterranean clover (*T. subterraneum*), browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), ratstail (*Sporobolus africanus*) and paspalum (*Paspalum dilatatum*) with little bare ground present. The steep slope contained mainly browntop, sweet vernal (*Anthoxanthum odoratum*), danthonia (*Notodanthonia* sp) and ratstail; with little white clover and many annual legume seedlings; subterranean clover, suckling clover (*T. dubium*), hairy birdsfoot trefoil (*Lotus suaveolens*) and 10% bare ground.

Each paddock was grazed with 200 sheep/ha for 5 days. During this time residual dry matter was reduced to 1200 kg DM/ha on easy slope and 900 kg DM/ha on steep slope. Sub-plots were then oversown with 4 kg/ha of 'Grasslands Huia' white clover (1983) and 'Feather marked white clover C4851' (1984) and with 250 kg 30% potassic molybdc superphosphate/ha. Grazing was allowed to continue for a further 2 days before sheep were removed. At removal paddock residuals were 500 kg DM/ha on easy slope and 700 kg DM/ha on steep slope.

Main-plot spray treatments were then applied by helicopter (Hiller 12UE (1983) and Bell 206B Jet Ranger (1984)) using hydraulic nozzles ('Spraying Systems D6-45' disk and core) operating at 280 kPa.

Five days after spraying an estimate of herbicide coverage was made using point analysis. Six hundred cover points were made per main plot. Numbers of spray affected and non spray affected hits on clover, grasses and weeds were recorded, hits on bare ground were ignored. At 4 week intervals pasture cuts were taken from within main-plots to assess pasture growth rates and percentage of sward alive and dead. Seedling establishment and stolon growing point densities were assessed at intervals after oversowing.

Fig. 1: Effects of paraquat applied at two water rates (litres/ha) on sward components showing chemical effect 5 days after spray application, for easy and steep slopes, in May 1983.

RESULTS AND DISCUSSION

Reducing the rate of water used from 200 litres/ha to 60 litres/ha did not have any significant effect upon the proportions of the sward initially covered by paraquat, on either slope (Fig. 1). A greater percentage of grasses were affected than legumes and weeds. Because of this, diquat was included in the spray mixture at a rate of 6:1 paraquat:diquat, in the second year, in order to get better control of flat weeds and subterranean clover. Overall a greater proportion of easy slopes showed effects of

paraquat application compared to steeper slopes. The reasons for the overall lower coverage of steep slopes cannot be determined, but it may be due to a total lower volume of application due to slope angle effectively increasing land area and/or less accurate spray application.

Herbage dissections 5 days after spraying, indicated that similar amounts of vegetation had been desiccated by paraquat application in both 60 litres and 200 litres water/ha treatments. These results are in close agreement with the percent cover point analysis data.

The effects of each spray treatment in suppressing the resident pasture following oversowing are shown in Figure 2. Herbage accumulation in each treatment is given relative to the residual dry matter present at time of spraying.

Fig. 2: Effects of paraquat applied at two water rates (litres/ha) on sward growth and the live:dead fractions after oversowing, for easy and steep slopes. Sward mass expressed relative to mass at time of spraying.

TABLE 1: Effects of paraquat (1983) and paraquat:diquat (1984) application at contrasting water rates on white clover seedling establishment and stolon densities.

	% seed established		Stolon growing
	10 weeks	12 weeks	points/m ²
	1983	1984	6 months 1984
Easy Slope			
Spray treatment			
Nil	11	33	520
60 litres	22	51	930
200 litres	32	65	1330
	**	**	**
Steep Slope			
Nil	7	33	465
60 litres	23	50	1000
200 litres	18	60	1010
	*	**	**

* ** significance at 5% and 1% respectively

Application of paraquat at either water rate succeeded in holding net herbage accumulation to a minimum for 8 weeks on easy slopes and at least 12 weeks on steep slopes. During this time pasture growth was only replacing material killed by earlier paraquat application. Ratios of live:dead pasture took 12 weeks to approach those of the untreated areas. On easy slopes the high water rate maintained a lower rate of recovery of the live pasture than the low water rate.

The effects of these rates of water application on seedling establishment and stolon densities can be seen in the numbers of seedlings established following oversowing and in the resultant stolon growing point densities (Table 1). Spraying with 60 litres water/ha achieved an establishment of almost twice no spray on easy and steep slopes. Increasing the water rate increased establishment a further 30% on easy slopes, with little or no increase on steep slopes. These effects were stable with time. While there was a cost to final plant density, by lowering the water rate at application on easy slopes, the benefit over not spraying at all was still considerable.

The use of paraquat or paraquat:diquat as an aid in establishment was not able to replace poor pre- and post-oversowing grazing management (unpublished data). It should be used in conjunction with strategic grazing to reduce the amount of competition for establishing seedlings.

The potential savings that could be made in a development programme's overall budget, by lowering the rate of water applied with a herbage suppressant are outlined in Table 2. These figures will vary with location but do give a guide to the levels of savings possible per hectare, if one accepts a moderate decrease in overall establishment on easy country. Such savings represent 30-40% of total development costs on a 10 ha area, and are therefore quite significant.

TABLE 2: Costs of application and savings gained by reducing applied water rate from 200 litres/ha to 60 litres/ha in hill country. Waikato May 1984 costings.

Fixed Wing (minimum charge \$200) 60 litres/ha		Helicopter (minimum charge \$400) 60 litres/ha	
	\$/ha		\$/ha
0-40 ha	12.60	0-20 ha	20.15
40 + ha	11.75	21 + ha	17.60
200 litres/ha		200 litres/ha	
	\$/ha		\$/ha
0-10	42.93	0-10	71.10
10 + ha	36.29	11 + ha	64.60

Costings and savings for various land areas based on above figures.

	Application costs		Savings \$/ha	Savings %
	60 litres/ha \$/ha	200 litres/ha \$/ha		
Fixed Wing				
5 ha	40.00	42.93	2.93	7
10 ha	20.00	42.93	22.93	51
15 ha	13.33	36.29	22.96	63
21 ha	12.60	36.29	23.69	65
41 ha	10.75	36.29	25.54	67
Helicopter				
5 ha	80.00	80.00	0.00	0
10 ha	40.00	71.10	31.10	44
15 ha	26.66	64.60	37.94	58
21 ha	17.60	64.60	47.00	72
41 ha	17.60	64.60	47.00	72

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