INFLUENCE OF GRAZING AND PHENOXY HERBICIDES ON NODDING THISTLE

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SUMMARY

The effectiveness of different grazing regimes in combination with three herbicides applied in autumn or winter was investigated for control of nodding thistle (*Carduus nutans*) in a sheep pasture. Mob stocking in June or August delayed the flowering of plants, but because of subsequent seedling invasion this did not reduce the total thistle population. In general, herbicides were more effective when applied in May than in July. MCPB/clopyralid gave effective control in both May and July, and was more effective on bigger plants than either MCPA or MCPB. Overall, light rotational grazing combined with MCPA or MCPB/clopyralid resulted in the lowest infestation of thistles in early summer, when most plants present were seedlings or small rosettes.

INTRODUCTION

Control of nodding thistle by any one method has proved to be very difficult and often highly variable. Recommendations for controlling this weed stress the importance of pasture competition to reduce the emergence and survival of seedlings (Popay and Thompson 1980; Phung and Popay 1981; Popay and Kelly 1986). Grazing management systems which produce dense pasture swards needed for competitive suppression of thistle seedlings have been promoted (Smith 1982). However, in a grazing management study by Martin and Rahman (1988) effective control of established rosettes was not achieved solely by manipulating pasture cover and stocking rates.

Control of nodding thistle with phenoxy herbicides has often been poor due to time of application, growth stage of the thistles or the lack of suitable grazing management. Hurrell *et al* (1983) demonstrated that in Canterbury spraying in autumn/early winter or in spring was more effective than winter and summer applications in reducing thistle populations. In the Hawkes Bay a late autumn/early winter application was more reliable than spring treatment (Popay *et al* 1982). Where thistle germination is not confined to the autumn, the level of control from autumn herbicide applications is reduced. For example, in the Waikato, Thompson (1979) observed significant nodding thistle germination in the spring and concluded that an annual winter herbicide treatment was unlikely to reduce the infestation in the long term.

Because of the poor success of any single control method, the development of integrated control practices such as spraying, grazing management and fertiliser application may be desirable. This work investigated the interaction between the effect of hormone herbicides applied in autumn or winter and different grazing management practices on the level of nodding thistle control in the Waikato.

MATERIALS AND METHODS

The site for this study was an established sheep pasture near Hinuera on a Tirau sandy loam soil. The eight grazing paddocks of 1050 m² used for the trial had large numbers of nodding thistles present following two main flushes of germination in November 1988 and March 1989. Thus the thistle population at the start of the trial consisted of older rosettes of 200-600 mm diameter and younger rosettes of under 100 mm diameter. The thistle ground cover at the site varied from 20% to 60%.

The herbicides used were MCPA (IWD MCPA) at 1.5 kg/ha, MCPB (IWD MCPB) at 2.5 kg/ha and MCPB/clopyralid (Lontrel Pasture) at 1 kg/28 g/ha. These

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were applied either in late autumn (31.5.89) or mid winter (21.7.89) to plots of 120 m² with a precision sprayer delivering 225 litres/ha at 210 kPa.

The grazing management included three different strategies. Two of these were winter mob stocking with ewes at 1000-3000 SU/ha for a period of 4 days, starting either on 23 June or 11 August. The pasture cover was allowed to build up to 2000-3500 kg DM/ha before the mob stocking and was reduced to under 500 kg DM/ha by the treatment. The third regime was a light rotation sheep grazing with 10-40 SU/ha to maintain a moderate pasture cover of 30-80 mm height. The trial was of a split-plot design with three replicates of the two mob stocking treatments and two replicates of the light rotational grazing treatments. The seven spraying treatments (three herbicides x 2 times of application + no herbicide (untreated)) were applied as sub-plots in each grazing treatment.

Nodding thistle plants were counted in six 1 m² quadrats within each plot at the start of the trial (31.5.89) and on 27 July, 19 September and 30 November. The point-quadrat method was used at the same times to determine the nodding thistle ground cover by assessing 100 points/plot. Visual assessments of ground cover of thistles were made in November and December 1989. The number of thistle plants flowering within each plot and plant height were recorded in November 1989. Final visual assessments of the population size structure were made on 14.12.89, as the site had to be evacuated.

RESULTS AND DISCUSSION

The numbers of nodding thistle plants declined naturally from May to November in the untreated plots. Under the light rotational grazing system the decline was 36% by July and 77% by November in the herbicide-free plots (Table 1). Significant changes in the population structure resulted from grazing and herbicide treatments, so that some plots had no flowering plants and others an almost total ground cover of large flowering plants by December (Table 2).

TABLE 1: Effect of grazing and timing of herbicide treatments on nodding thistle numbers (mean of all herbicides).

Time of treatment	No. of thistle plants/10 m ²			
	May	July	September	November
Rotational grazing				
Untreated	303	193	82	69
May application	325	14*	4*	18*
July application	318	245	21*	28*
June mob stocking				
Untreated	185	116	72	131
May application	199	8*	63	260
July application	157	90	23*	186
August mob stocking				
Untreated	162	156	105	77
May application	143	27*	22*	57
July application	188	169	27*	92

* Significantly different within group of three means ($P < 0.01$).

Effects of herbicides and application times

The effects of herbicide treatments were most obvious in the first few weeks after application. Spraying in May reduced the thistle numbers on average by 88%, 95% and 96% following treatment with MCPB, MCPA and MCPB/clopyralid respectively by 8 weeks after treatment (WAT). The July application was slightly less effective, with reductions in plant numbers 8 WAT of 82%, 89% and 93% respectively. Despite these large reductions, by the end of November there were no significant differences between the treated and untreated plots under the mob stocking regimes (Table 1) due to the invasion of seedlings after the mob stocking. However, the proportion of small rosettes

in the population was much greater in sprayed than in untreated plots except for MCPB under rotational grazing (Table 2). There were significant differences also between the effects of the three herbicides (Table 2).

Treatments affected the proportion of plants flowering by December. All herbicide treatments reduced the proportion of flowering plants with May applications more effectively than July treatments in this respect except under late mob stocking. Plots treated with MCPB/clopyralid had between 0 and 4% plants flowering in December. MCPA was as effective as MCPB/clopyralid in the June mob stocking, but slightly inferior in the other two grazing regimes (Table 2). MCPB was less effective than other herbicides against the more mature thistles with between 19 and 61% of the population flowering in December.

Treatments affected total ground cover of thistles in the way as they had affected the proportion of flowering plants (Table 2). MCPB/clopyralid plots had the least thistle ground cover in the light rotational grazing, where seedlings had not established, and in August mob stocking, where seedlings were still very young and small.

Effects of grazing

In the absence of herbicides, there were no significant differences in the total number of thistle plants present in the three grazing systems at the end of November. However, there were nearly twice as many flowering plants in the plots grazed rotationally as in those mob stocked (Table 2), partly because the mob stocking set back the growth of thistles and delayed their flowering. Mob stocking also bared the ground

TABLE 2: Effect of grazing and herbicide treatments on population structure and ground cover of nodding thistle plants in December 1989.

Grazing treatment	Herbicide and time	Population structure			Flowering plants (No./plot)	Thistle ground cover (%)
		Small rosettes (%)	Large rosettes (%)	Flowering plants (%)		
Rotational grazing	untreated	3	7	91	300	93
	May	55	23	22*	7*	4*
	July	36	21	43	67	22
	MCPB	8†	32	61	82	28
	MCPA	31*	33	37*	33*	10
	MCPB/clopyralid	99	1*	0†	1†	1*
June mob stocking	untreated	26	28	46	141	61
	May	66	32	3*	6*	25
	July	54	29	16	52	28
	MCPB	53	28	19	40	32
	MCPA	59	35	5*	28*	24
	MCPB/clopyralid	68	28	4*	20*	25
August mob stocking	untreated	11	35	54	150	56
	May	59	24	17	24	11
	July	58	31	11	9	9
	MCPB	27†	39	35	45	23
	MCPA	63*	30	7*	5*	5*
	MCPB/clopyralid	87	13*	0†	1†	2*

* Significantly different from those without asterisk and those marked with † (P<0.05) within a group. Untreated means not included in the analysis.

allowing more seedlings to establish which resulted in these plots having a larger proportion of seedlings and rosettes than rotationally grazed plots.

An interaction between grazing and herbicides was evident in December (Table 3) when MCPB/clopyralid and MCPA treatments had a larger proportion of small rosettes in two of the three grazing regimes (Table 2). The percentage of large rosettes was significantly lower only in MCPB/clopyralid treatment. Spraying with MCPB/clopyralid combined with either rotational grazing or August mob stocking resulted in the lowest thistle ground cover of all the treatment combinations in December (Table 2).

There was also a significant grazing by spraying time interaction (Table 3) whereby spraying in either May or June followed by mob stocking 3 weeks later effectively reduced the proportion of flowering plants.

TABLE 3: Levels of significant differences in main effects and interactions by Rank Analysis Method.†

	No. of nodding thistle plants			Thistle height (30.11.89)
	Large thistles (19.9.89)	Flowering thistles (30.11.89)		
Application time (AT)	***	***		**
Herbicides	***	***		***
Grazing/AT	***	***		**
Grazing/herbicide	*	*		***
	Thistle population structure (14.12.89)			
	Small rosettes (%)	Large rosettes (%)	Flowering plants (%)	Ground cover (%)
Application time (AT)	ns	ns	**	ns
Herbicides	***	*	***	***
Grazing/AT	ns	ns	***	ns
Grazing/herbicide	**	ns	***	**

† Untreated controls were excluded from all analyses. Results significant at 5% (*), 1% (**) or 0.1% (***).

In this trial under the rotational grazing system most nodding thistle plants were able to flower by December, if no herbicide was used. Mob stocking during the winter months delayed flowering, but allowed survival of many well established plants and establishment of a heavy infestation of seedling thistles while the pasture was recovering. This has also been observed by other workers (Phung and Popay 1981; Thompson *et al* 1987).

Herbicide spraying in late autumn (May) was more effective than in mid winter (July). Spraying with MCPB/clopyralid at either time gave effective control, reducing the proportion of flowering plants and thistle ground cover in two of the three grazing regimes. This herbicide mixture was also more effective on larger nodding thistle plants. Overall, the light rotational grazing combined with application of MCPA in the autumn, or MCPB/clopyralid in autumn or winter resulted in the lowest infestation of thistles, most of which were present as seedlings or small rosettes. This stresses the importance of continuous pasture cover to complement the effectiveness of herbicide treatments for control of nodding thistle.

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