EFFECT OF PASTURE SPECIES AND GRAZING ON SURVIVAL OF SEEDLING GORSE

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Summary

The survival of gorse (*Ulex europaeus*) seedlings, sown with different pasture species and fertilizers, was measured under three systems of grazing by sheep. Survival over winter without grazing was lowest under Yorkshire fog (*Holcus lanatus*) and highest in the absence of grass; survival under subsequent grazing was lowest under browntop (*Agrostis tenuis*) and highest under perennial ryegrass (*Lolium perenne*). Survival was reduced by the addition of white clover (*Trifolium repens*) but increased by Italian ryegrass (*L. multiflorum*). Lime reduced survival over winter while nitrogen had little effect. Survival was lowest under a long grazing rotation and highest under set-stocking. Many seedlings were destroyed by trampling.

INTRODUCTION

One of the major problems in long term control of gorse is that of controlling seedlings. Gorse is a prolific seed producer (Ivens 1978) and has hard seeds that can persist in the ground for many years (Moss 1960). For this reason gorse seedlings are a continuing problem for many years after initial clearance of established gorse.

A trial was conducted to measure the survival of gorse sown in association with different pasture species under three grazing managements. The effects of nitrogen and lime were also tested.

METHOD

The trial was conducted on a raised river terrace near Palmerston North on Tokomaru silt loam that had been in barley the previous year. A flat, gorse-free site was chosen so that grazing could be controlled easily and accurate measurements made of gorse survival.

Combinations of pasture species and fertilizer (Table 1) were broadcast and lightly rolled on 3 x 3 m plots and gorse seed surface sown on the centre 1 m² of each plot. Ten plots, one replicate of each main treatment, were located in the centre of each of 12 small paddocks. Eight additional species plots (Table 1) were located on four of the paddocks. Before sowing the plot areas were sterilized with methyl bromide to control weeds, especially annual grasses, and the entire trial area topdressed with 375 kg/ha superphosphate. Each paddock was subjected to one of three grazing managements giving four replicates of each grazing/species combination.

Pasture species and fertilizer

Four grass species (including no grass), of contrasting growth habits, were sown in May 1978. They were sown in association with other species

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and fertilizer as shown in Table 1. The main combinations were tested under all grazing systems and the additional combination under short rotation only.

TABLE 1: Pasture species and fertilizer combinations tested in main trial 'xx' and supplementary trial 'x'.

Basic species	Rate kg/ha	Additional species or fertilizer			
		White clover*	White clover+ nitrogen†	Paroa*	No additional treatment
'Grasslands Ruanui' perennial ryegrass	20	xx	xx	x	x
Ruanui + 5000 kg/ha lime	20	xx	xx	-	-
Yorkshire fog	10	xx	xx	x	x
Browntop	3	xx	xx	x	x
No grass		xx	xx	x	x

* 'Grasslands Huia' white clover 3 kg/ha
'Grasslands Paroa' Italian ryegrass 10 kg/ha

† Nitrogen at 50 kg/ha

Gorse

One hundred gorse seeds were precision planted, by vacuum planter, at 10 cm spacing shortly after the grass was sown. Seed dormancy was broken by heating to 80° for 15 minutes which gave 89% germination. The seeds were inoculated with gorse rhizobia immediately before sowing.

Grazing

Paddocks were grazed by sheep as follows:

Set-stocked to keep ryegrass at 2-3 cm high.

Short-rotation, grazed when ryegrass 10 cm high reducing height to 2-3 cm after grazing.

Long-rotation, grazed when ryegrass 20 cm high reducing to 2-3 cm after grazing.

The replicate paddocks of the rotational treatments were grazed in sequence by a large mob (Table 4) for 1-2 days each round as required.

Recording

After the winter establishment period all surviving gorse seedlings were recorded on a grid plan. The seedlings were relocated after the first grazing (early November) and again after subsequent grazings in late January. At both post grazing counts seedling size and the effect of grazing on the seedlings were recorded.

The height of each pasture species was measured before and after each grazing.

Analysis of data

The percentage survival of seedlings was calculated for each plot for each recording period. Where survival was from sowing the initial count was taken as 100 so survival since sowing includes an element of germination.

Percentage survivals then underwent a split plot analysis to determine the significance of differences between grazing regimes (main

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plots) and between pasture species (sub-plots) and to test the grazing by species interactions.

Additional treatments, measured under one grazing only, were analysed as a randomised block and contrasts of interest extracted.

RESULTS

Pasture Species

The numbers of gorse seedlings surviving the winter and subsequent grazing periods are shown in Table 2 as means of the percentage survival on each plot.

TABLE 2: Mean percentage survival of gorse seedlings as affected by pasture species and grazing from May 1978 to January 1979.

	% gorse seedlings surviving from sowing			% gorse seedlings surviving grazing		
	Over winter	Over winter + 1st graze	Over winter + all grazing	1st graze	Nov.-Jan. grazing	Total grazing
Pasture species*						
Ryegrass	14.8	7.9	1.25	51.4	17.0	7.2
Yorkshire fog	11.9	5.2	0.44	42.1	9.6	4.7
Browntop	18.0	8.5	0.31	46.6	4.5	1.8
No grass	19.8	9.3	0.94	46.3	9.5	4.2
LSD 5%	2.7	2.1	0.62	8.7	8.9	3.8
LSD 1%	3.6	2.8	0.82	11.5	11.7	5.0
Grazing						
Set-stocked		6.1	1.45	35.0	16.2	7.2
Short-rotation		6.3	0.60	42.6	11.4	5.2
Long-rotation		7.9	0.25	54.5	6.5	2.5
LSD 5%		2.9	1.13	17.6	10.8	6.0
LSD 1%		4.1	1.62	25.3	15.6	8.6
Overall mean	15.3	7.4	0.85	47.6	11.2	5.6

* Main trial species, i.e. species + white clover ± nitrogen
No significant interactions

By September only 15.3% of the sown gorse seed had survived as seedlings. Assuming the field germination was comparable to laboratory germination (89%) seedling mortality must have been high. Survival was significantly higher under browntop or in the absence of grass than under ryegrass. Survival was significantly lower under Yorkshire fog than under ryegrass.

Overall a further 52% of the surviving seedlings were lost over the first grazing period, survival being significantly less under Yorkshire fog than under ryegrass. Subsequent grazings, from November to January, eliminated, overall, a further 89% of the gorse seedlings surviving the first grazing. Over this period browntop was the most effective competitor giving a significant reduction relative to ryegrass. However, because of the low numbers of seedlings surviving the first grazing, analysis of percentage survival over the second grazing period is of limited value.

The total effect of grazing was much the same as that shown for the second period with survival significantly less under browntop than under ryegrass. The survival of gorse seedlings over the winter and under grazing

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was significantly less under Yorkshire fog and browntop than it was under ryegrass or in the absence of grass.

The effects of white clover or the addition of Paroa to a pasture mixture are shown in Table 3. Over the winter, gorse seedling survival was significantly higher in the absence of any sown competition (no grass, no addition). Over the winter period Paroa significantly reduced gorse seedling survival but under grazing, gorse survival was lower where the pasture species were sown without Paroa (analysed on total number data). Final survival, winter plus grazing was significantly less overall in the presence of white clover than in its absence.

TABLE 3: Effect of white clover and Paroa ryegrass on survival of gorse seedlings over winter and under grazing.

Basic species	% surviving over winter			% surviving grazing		
	No addition	+ clover	+ Paroa	No addition	+ clover	+ Paroa
Ryegrass	17.8	17.8	16.0	3.2	9.9	12.0
Yorkshire fog	15.8	15.3	16.8	8.2	0	15.2
Browntop	25.8	22.5	17.0	8.7	2.3	6.3
No grass	28.5	16.3	14.3	13.8	2.7	22.4
LSD 5%		7.7			15.8	
LSD 1%		10.3			21.0	
Mean	22.0	18.0	16.0	8.5	3.7	14.0
Mean final survival (winter + grazing)				1.8	0.66	2.25

Fertilizer

The application of lime significantly affected survival of gorse seedlings over winter, reducing survival from 14.8% to 11.7%. However, there appeared to be a greater survival under grazing in the presence of lime so that the overall effect was nil.

Nitrogen appeared to have an effect on gorse seedlings survival but this just failed to reach significance at the 5% level. The apparent effect was strongest over winter but in all stages was in the same direction, lower survival in the presence of nitrogen.

Grazing

The mean pasture heights before and after grazing for each species under short and long rotation are shown in Table 4. Under set-stocking pasture heights were maintained at approximately 3 cm for ryegrass, 2 cm for Yorkshire fog, 1 cm for browntop and less than 1 cm for no grass.

Grazing treatments also had a significant effect on gorse survival (Table 2). Final survival, winter plus grazing, was significantly less under long rotation than under set-stocking. The survival under short rotation was intermediate.

Gorse seedling survival over the first grazing period was lowest under set stocking followed by short rotation. However, this was probably an artifact of weather conditions rather than grazing systems. The four set-stocked paddocks and two short rotation paddock were accidentally pugged following heavy rain when first grazed. Comparison of gorse seedling survival on the two short rotation paddocks grazed wet (28%)

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with that on the two paddocks grazed dry (60%) shows a highly significant effect of grazing under wet conditions.

The November to January period probably reflects more accurately the influence of grazing management on gorse seedling survival. The data in Table 2 show a strong trend but because of the small number (often none) of seedlings surviving on individual plots the data are not significant. However analysis on a paddock basis totalled across all species, showed a highly significant reduction in survival under long rotation relative to set-stocked. Short rotation also showed a significant reduction relative to set-stocked but survival was not significantly greater than on long rotation.

Seedling damage

Following the first grazing 1608 seedlings were still alive. Of these 832 (52%) were noticeably trampled, 518 (32%) were incomplete with tops either broken or bitten off and 259 (16%) were apparently undamaged. By the final count there were only 12 seedlings with no recorded damage but they had branched, indicating probable damage to the apex that had not been recorded. Sixty-eight percent of the final survivors had branched following damage while most of the remainder were "just alive".

TABLE 4: Grazing dates and mean pasture height (cm) of main species before and after grazing

Date during which replicates grazed	October		November				December				January			
	18-27†	31-4	4-8	23-27	8-13	13-24	3-16							
Treatment and species*	B	A	B	A	B	A	B	A	B	A	B	A	B	A
Short rotation														
Ryegrass	28	6			12	3	11	5	8	3			13	2.5
Yorkshire fog	25	4			15	2	5	2	3	1.5			9	1
Browntop	9	1.5			2.5	1	4	1.5	3	1			11	1
No grass	4	<1			1	<1	1	<1	1	<1			11	<1
Long rotation														
Ryegrass			42	8							22	9		
Yorkshire fog			25	3							22	2.5		
Browntop			15	2.5							22	7		
No grass			5	<1							16	1		
No. sheep/ha	1300		2200		1300		700		500		800		500	

† Stock off 5 days following heavy rain

* species + white clover ‡ nitrogen

B = before grazing A = after grazing

Long rotation treatment grazed again on 19-24 January but pasture not measured.

DISCUSSION

The survival of gorse seedlings in the face of pasture competition and grazing was very low. Grazing on a long rotation had the greatest effect though ground conditions at the time of grazing affected survival markedly. Pugging had a severe effect on gorse seedling survival but no effect on subsequent growth height of the pasture species. Gorse seedlings very frequently lost their top below the level to which the pasture

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(especially ryegrass) was grazed suggesting that sheep's feet were doing more damage than their teeth. This conclusion was also supported by an auxiliary trial measuring gorse seedling survival when grazed by sheep normally, grazed through a fence to excluded feet, or when trampled without grazing. Trampling, which meant walking the sheep round the block for half an hour, destroyed five times more seedling than grazing. There was no significant difference between grazing with or without feet but dry conditions prevailed at the time.

The relatively poor performance of ryegrass in association with grazing as an antagonist to gorse seedlings may result from sheep's apparent dislike of ryegrass. The ryegrass plots were never grazed below 2.5 cm and gorse seedlings must be decapitated below the cotyledons to prevent branch development (Rolston 1974). Had grazing commenced earlier in the spring the ryegrass might have been grazed shorter and results been different. The value of Yorkshire fog for gorse control may be in its dense growth habit particularly over winter and the ease by which it can be trampled by sheep. Browntop, though slow off the mark, formed a dense ground cover closely grazed by sheep, making it both competitive and non-protective to the gorse. The addition of Paroa ryegrass to increase the initial suppression effect of the pasture did not help because it suppressed the perennial pasture species (except browntop) relatively more than the gorse. The value of clover for gorse control has been shown before, under mowing (Thompson 1974).

The addition of lime suppressed gorse establishment even though the initial pH of the soil was 5.6. This was anticipated as gorse likes acid conditions (Grubb and Suter 1970) but the reversal effect under grazing cannot be explained. The addition of nitrogen appeared to reduce gorse survival and might have become significant had further application of nitrogen been given in the spring.

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