Spring grazing management and tiller dynamics in a ryegrass/white clover pasture

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Abstract

The objective of this trial was to study the effect of variation in the timing and duration of lax spring grazing on tiller dynamics in perennial ryegrass. Tiller population density, tiller appearance, and tiller death were measured in a sward of perennial ryegrass (cv. Grasslands Nui) and white clover (cv. Grasslands Tahora) grazed by sheep every 14 days to 4 cm (hard) and every 21 days to 7 cm (lax) residues. The experiment comprised 2 lax spring grazing treatments [lax grazing October 26-December 8 (H-H-L-H) and September 16- December 8 (H-L-L-H)], plus a hard grazed control (H-H-H-H). Ryegrass tiller density was greater in H-L-L-H than H-H-L-H and H-H-H-H from mid summer until the end of the trial in autumn, mainly because of the difference in tillering activity late in December. Tiller appearance rate increased in all the treatments from September to the end of January, and was particularly high late in December in the second regrowth after grazing of the apices of the main group of reproductive tillers. The lax grazing management strategy increased tiller appearance rate during late December and January. Higher tiller losses in lax grazing treatments over the same period were not offset enough to affect this advantage. The response in tiller population density was greater following the extended period of lax spring grazing.

Keywords: grazing management, *Lolium perenne*, reproductive growth, tiller population density, tiller demography, *Trifolium repens*

Introduction

Recent studies of tiller dynamics in ryegrass have revealed consistent seasonal patterns of tiller appearance and death, and also have demonstrated the potential advantages to tiller population and herbage production in late summer and autumn from a spring management which allows early seedhead development (Matthew *et al.* 1989, 1991; Matthew 1990; Da Silva *et al.* 1993). Matthew *et al.* (1989) suggested that a timely hard grazing of reproductive tillers may increase summer-autumn pasture growth rate by re-allocation of energy reserves to daughter tillers.

This experiment was carried out to study the effect of variation in the timing and duration of lax spring grazing on tiller dynamics and summer pasture production in perennial ryegrass. Only the results of observations on tiller activity and tiller demography are reported here.

Material and methods

The trial was conducted at Massey University between September 1992 and March 1993 on a perennial ryegrass (*Lolium perenne*, cv. Grasslands Nui) and white clover (*Trifolium repens*, cv. Grasslands Tahora) sward, which was rotationally grazed by sheep. The experiment comprised 2 lax spring grazing treatments [lax grazing 26 October-8 December (H-H-L-H) and 16 September-8 December (H-L-L-H)], and a hard grazing control (H-H-H-H). Individual plots 9.3 m x 9.3 m were grazed every 14 days to 4 cm (hard), or every 21 days to 7 cm (lax), and allocated in a complete randomised block design with 3 replicates. From 8 December on, all the treatments were grazed every 2 weeks to 4 cm (hard).

Tiller demography was measured at fortnightly intervals throughout the trial. Two 6.5 cm diameter plastic frames per plot were permanently fixed at ground level. All live ryegrass tillers within each frame were tagged on 18 September 1992 with short lengths of coloured split plastic tubing (2-5 mm diam. and 3-5 mm long). New tillers were tagged at 2-week intervals, using a new colour each time. Rings were removed from dead tillers and counted. Estimation of tiller weight was made before and after each grazing from 3 ground-level quadrat (20 cm x 50 cm) samples per plot. Tiller population density was determined from 30 cores (each 5.3 cm diameter) per plot throughout the experimental period.

Results and discussion

Tiller population density

Details of changes in ryegrass tiller population density are shown in Table 1 and Figure 1. The initial tiller population estimated over all treatments was 3500 tillers/m^2. Tillering was most rapid between November and January. A similar period of rapid tillering has been observed in New Zealand in swards under grazing (Chapman et *al.* 1983; Korte 1986; L'Huillier 1987; Matthew *et al.* 1989; da Silva et al. 1993) or cutting (Korte 1986).

Tiller densities were higher in fixed quadrats than in surrounding swards (Table 1 and Figure 1). This effect has been noted in previous studies (Davies 1981; Matthew *et al.* 1989), and appears to be associated with the sward disturbance involved in tiller counting. To minimise the biases involved, subsequent data on tiller appearance and loss (Table 3) are expressed on a tiller per tiller basis.

Table 1 Tiller density of ryegrass-white clover sward under contrasting spring grazing management (tillers/m^2 from tiller cores).

Treatment	20 Oct	1 Dec	1 Jan	25Jan	23 Mar
H-H-H-H	4690	3630	6990	7760	5050
H-L-H-H	4530	3260	5640	6620	8050
H-L-L-H	4770	3740	7070	12740	7756
SE	306	466	1115	1636	1248

From late December the tiller population density was higher in H-L-L-H than in H-H-L-H and H-H-H-H, and these differences persisted throughout the trial (Figure 1 and Table 1). Variability in estimates of tiller population density was high. However, within marked populations, tiller population density in H-L-L-H was 17% and 51% higher than H-H-H-H and H-H-L-H in late December, and 27% and 30% higher in late January (Figure 1). In tiller cores, tiller density in H-L-L-H was 64% (P = 0.06) and 44% (P = 0.12) higher than in H-H-H-H and H-H-L-H respectively in late January and 59% (P = 0.15) higher than H-H-H-H at the end of March.

Table 2 Effect of grazing treatment on mean tiller dry weight (mg) and relative proportion of vegetative and reproductive ryegrass tillers in early December.

	H-H-H-H	H-H-L-H	H-L-L-H	SEM
Mean tiller weight	16	36	29	3.03'
% of vegetative and reproductive tillers				
Vegetative	64	67	67	
Total Repr.	16	33	33	
(a) No flag leaf	14	17	23	
(b) Flag leaf expanded	2	7	3	
(c) Seedhead	0	9	7	

Before the switch to common grazing management in early December the proportion of ryegrass tillers which were reproductive was twice as great in treatments H-H-L-H and H-L-L-H as in H-H-H-H (Table 2), and no tillers on treatment H-H-H-H carried emerged seedhead at that time. Individual tiller weight was also twice as great on the two lax grazed treatments as on the control (Table 2). Hard grazing increased the proportion of other grasses and weeds and reduced the proportions of ryegrass and white clover in the pastures in early December (52, 66 and 67% for ryegrass and 8, 12 and 11% for clover in treatments H-H-H-H, H-H-L-H and H-L-L-H, respectively).

Tiller appearance and loss

Tiller appearance and loss occurred throughout the experiment, but were particularly high in late spring and summer (Figure 1 and Table 3). Figure 1 shows continuing increase in tiller density in all treatments from September to the end of January, with particularly rapid tillering activity late in December.

Stem elongation started late October in all the treatments. During this period tiller appearance was not significantly different between treatments ($P > 0.05$), but lax spring grazing resulted in the peak of tiller appearance being later and greater than that under continued hard grazing. Thus, tiller appearance rate (tiller per tiller per 14 days) was 100% and 50% higher in H-H-H-H than H-H-L-H and H-L-L-H, respectively in late November ($P < 0.05$), but the difference was reversed ($P < 0.05$) in late December. No other treatment effects were significant. The burst of tillering activity in December represented increases of 35%, 48% and 60% over the late November tiller population density in treatments H-H-H-H, H-H-L-H and H-L-L-H respectively.

Table 3 Tiller appearance and mortality under contrasting spring grazing management (tillers/tiller/14 days).

Treatment	31 Nov		15 Dec		31 Dec	
	App	Loss	App	Loss	App	Loss
H-H-H-H	0.46	0.35	0.26	0.12	0.52	0.10
H-L-H-H	0.35	0.19	0.26	0.26	0.75	0.25
H-L-L-H	0.20	0.21	0.13	0.22	1.10	0.25
SE	0.09'	0.06	0.07'	0.03'	0.20'	0.04'

The high rate of tiller appearance found particularly in treatment H-L-L-H supports the result of Matthew et al. (1989) and the conclusion (Matthew *et al.* 1991) that the early growth of young summer tillers can be stimulated by the transfer of assimilates from decapitated flowering tillers.

The highest rate of tiller appearance in H-L-L-H and H-H-L-H was recorded in the second regrowth after defoliation of the apices of the main group of reproductive tillers. After the main period of activity late in November and December, differences in tiller appearance were not significant. Korte (1986) recorded highest tiller appearance rate in November, in the regrowth immediately after defoliation of the main group of reproductive tillers. The differences between our results and those of Korte could have been due to differences in the frequency of defoliation; a 2-week interval was used in our trial, and a 3-week interval in that of Korte (1986).

L'Hullier (1987) found that during summer and autumn high stocking rate resulted in higher tiller densities and content of white clover than low stocking rate. Other studies have concluded that tillering was not influenced by grazing intensity or cutting frequency (Tallowin 1981; Chapman *et al.*, 1983; Korte, 1986). However, our results indicate that relatively lax grazing management prior to and during the reproductive phase increased both tiller appearance and tiller population in summer (Figure 1 and Table 3).

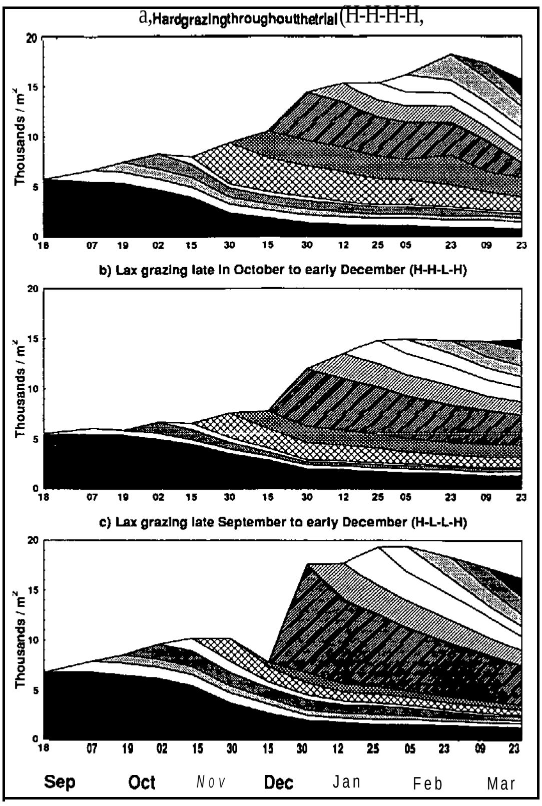
Tiller losses were highest in November and December, similar to the seasonal patterns observed by L'Hullier (1987) in dairy pastures. Of the original population of overwintering tillers, 77% were lost from treatment H-H-H-H by late December and a further 7% by the end of the trial. Losses on treatments H-H-L-H and H-L-L-H were 65% and 70% to late December, and 20% of the original tillers on these treatments survived to the end of March (Figure 1).

Tiller mortality expressed as tillers per tiller per 14 days in H-H-H-H was 84% and 66% higher than in H-H-L-H and H-L-L-H in November ($P < 0.05$, Table 3). During December the reverse was the case, losses being 132% and 114% higher in H-H-L-H and in H-L-L-H than in H-H-H-H ($P < 0.05$). Death of reproductive tillers contributed to losses in the two previously lax grazed treatments over this period. From the populations of tillers tagged in the peak of tillering activity in December, 64%, 48% and 51% had disappeared by late March from treatments H-L-L-H, H-H-L-H and H-H-H-H, respectively.

Conclusions

The results of this study confirm the hypothesis (Matthew *et al.* 1989, 1991) that enhanced levels of summer pasture production after a period of relatively lax spring grazing management and subsequent removal of early seedheads are a consequence of increased tillering activity after the control grazing. They show that although this enhancement of tillering activity is short lived and is followed by increases in rates of tiller loss, the net advantage in tiller population density can persist for some time. The evidence also indicates for the first time that this effect is likely to be greater after an extended period of relatively lax spring grazing.

Figure 1 Changes in tiller population and tiller age profiles for ryegrass clover sward under contrasting spring grazing managements. Shaded sectors indicate time trends in the population of tillers present at the start of the experiment, and those appearing in successive two-week recording intervals.



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