Proceeding of the New Zealand Grassland Association 51: 119-122 (1990)

Tiller population and tissue turnover in a perennial ryegrass pasture under hard and lax spring and summer grazing

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ABSTRACT Plots of perennial ryegrass were grazed by sheep at 3 to 4-week intervals under hard (post-grazing herbage mass 1000 kg DM/ha) and lax (2000 kg DM/ha) management from October 1986 to August 1988. In early December 1987 treatments on half the plots were switched, giving 4 combinations of hard and lax grazing with 4 replicates. Tiller populations were consistently higher under hard than lax grazing. Net pasture and leaf production rates were also generally higher under hard grazing, because higher senescence losses compensated for higher rates of pasture growth under lax grazing. The switch from hard to lax grazing in late spring gave a transient increase in net pasture production, but the switch from lax to hard grazing at the same time resulted in a high tiller appearance and enhanced net leaf production over the summer. Management strategies to take advantage of this latter effect in pasture systems are discussed briefly.

Keywords Tiller population, tissue turnover, grazing management, perennial ryegrass

INTRODUCTION

Recent studies in the UK (Bircham & Hodgson 1983; Grant *et al.* 1983, 1988; Parsons *et al.* 1983; Parsons & Penning 1988) have shown that the rate of net herbage production (growth of new plant tissue minus senescence of mature tissue) in grazed ryegrass or ryegrass/white clover pastures is relatively constant across a range of pasture conditions and grazing managements. Similar principles appear to apply under New Zealand conditions (Bircham & Korte 1984), though long-term effects may be masked by seasonal changes in management (e.g. Korte *et al.* 1984; Sheath & Boom 1985).

The experiment described was carried out to study the influence of management and season on rates of tissue turnover in perennial ryegrass swards, and also provided the opportunity to investigate further the influence of spring management on subsequent pasture production. Evidence on the influence of tiller populations on pasture production is increasing (Sheath & Boom 1985). Korte *et al.* (1984) and Matthew *et al.* (1989) have recently provided evidence for the effect of pasture management during the reproductive phase on subsequent tillering activity and production potential.

METHODS

The experiment was carried out between October 1986 and August 1988 on a sward of perennial ryegrass (cv. Ellett) from which the clover had been removed by the use of picloram and 2,4-D. Individual plots 10 m x 10 m were grazed by sheep at 3-to 4-week intervals throughout under hard (H, post-grazing herbage mass 1000 kg DM/ha) and lax (L, post-grazing herbage mass 2000 kg DM/ha) managements. Grazing was normally completed within 2 days. On 9 December 1987 treatments on half the plots were switched, giving 4 combinations of hard and lax grazing with 4 replicates. Urea was applied at 15 kg N/ha every 3 weeks throughout the trial. Water was applied by sprinkler irrigation between November 1987 and January 1988 in limited quantities to maintain tiller viability. Over the 3 months rainfall was 159 mm, pan evaporation 469 mm, and water applied 100 mm.

Herbage mass was measured before and after each grazing from ground-level quadrat samples, and tiller population density at approximately monthly intervals throughout the trial from 30 cores per plot. Tissue turnover was measured at intervals from September 1987 to August 1988 (see Table 2), encompassing periods of spring, summer and winter growth on all pastures. Tissue turnover was estimated by the procedure of Bircham & Hodgson (1983) with 12 marked tillers per plot in 2 transects of 6, and tillers marked at 30 cm intervals. Results are based on randomised complete block analyses of variance on plot means.

RESULTS AND DISCUSSION

Effects of sustained hard and lax grazing

Tiller population densities were substantially higher under hard than lax grazing except during the final phase of the trial (HH vs LL, Table 1). Hard grazing usually resulted in higher rates of net pasture production than lax grazing, and particularly of net leaf production, because lower rates of growth were more than balanced by substantially lower senescence losses (Table 2). This result confirms the evidence from other, usually shorter-term studies under both rotational grazing and continuous stocking and from both ryegrass and ryegrass/white clover pastures (Bircham & Hodgson 1983; Grant *et al.* 1983; Parsons et *al.* *1983;* Korte *et al. 1984;* L'Huillier 1987 a, b), and demonstrates the importance of losses to senescence and decomposition in the pasture economy. The lax grazing management involved higher levels of pasture cover before and after grazing than would often occur in sheep systems, but was nevertheless within the limits of comparable studies (Korte *et al. 1984;* Sheath & Boom, 1985). In the studies of Tainton (1974) differences in severity of grazing resulted in similar rates of green pasture accumulation in spring, but not in summer. However, grazing intervals were very long in Tainton's studies, except in the spring (Tainton 1974).

Table I Effect of grazing management on perennial ryegrass tiller population density (tillers/m*).

	Treatment				
	HH	HL	LH	LL	SE of mean
9 Dec 1987	8090	8940	5880	4520	410
18 Jan 1988	11180	7990	7980	6630	620
23 May 1988	8940	6160	8390	5090	260
4 Aug 1988	5130	4910	4670	3840	410

Senescence losses were consistently 20-25% of tissue growth rates in treatment HH, but declined from 65% to 45% of growth in treatment LL(Table 2). Bircham & Hodgson (1983) found that senescence losses did not fall below 20% of tissue growth rates, even in circumstances where grazing pressures were high enough to substantially depress pasture growth rates. Over the period of study from spring through winter the net rate of leaf production varied by a factor of only two. However, high rates of stem production in the spring, even on the hard grazed treatments, contributed to a substantially greater seasonal variation in net pasture production.

Effects of management changes in late spring

The switch from hard to lax grazing in late spring temporarily increased net herbage production (HL vs HH, Table 2). This effect reflected primarily enhanced production of stem and seed head (J.X. Xia, unpublished data), and was soon offset by increasing senescence losses and a fall in tiller density (Tables 1 and 2). The advantage in net leaf production was particularly short-lived, though tiller population densities on the switched treatments took almost 6 months to converge with those on the equivalent continued treatments (Table 1). This result is consistent with the observations of Bircham & Hodgson, Grant *et al.* (1988) and Sheath & Boom (1984).

The switch from lax to hard grazing in December (LH vs. LL) increased tiller population density (Table 1) by encouraging new tiller development from the stubs of grazed reproductive tillers (Korte *et al.* 1984; 1985). The effect was to increase both net pasture production and net leaf production in comparison with treatments HH and LL (Table 2), and these effects were sustained for a substantially longer time on treatment LH than on treatment HL (Table 2).

Table 2 Rates of pasture growth, senescence and net production, and of net leaf production (g DM/m^2/day)

	Treatment				
	HH	HL	LH	LL	SE of mean
8 September 6 December 1987			5.7		
Pasture growth §	4.6	5.1	3.5	7.5	0.42
Pasture senescence §	1.4	1.2		4.1	0.40
Pasture net production §	3.1	3.9	2.3	3.3	0.45
Leaf net production	2.3	2.5	1.5	1.1	0.15
9-27 December 1987					
Pasture growth	8.0	12.9	13.7	9.4	1.10
Pasture senescence	1.8	3.4	3.5	5.6	0.98
Pasture net production	6.2	9.6	10.2	3.8	1.32
Leaf net production	2.5	3.0	3.1	1.8	0.40
30 December 1987 - 14 January 1988					
Pasture growth	1.5	11.0	11.5	3.6	0.66
Pasture senescence	3.6	5.8	9.3	2.7	0.40
Pasture net production		5.2	4.6		0.69
Leaf net production	3:o	2.5		3.2	0.44
23 May - 5 July 1988					
Pasture growth	2.9	2.7	3.3	2.8	0.30
Pasture senescence	1.1	1.5	1.4	1.7	0.25
Pasture net production	1.8	1.2	1.9	I.1	0.23
Leaf net production	1.8	1.3	1.9	1.2	0.21

§ Failure to sum due to rounding errors

Management implications

Several studies demonstrate the influence of hard spring grazing in enhancing tiller population density and summer pasture production (L'Huillier 1987 a,b; Sheath & Boom 1985). However, the results of this study confirm the evidence of Korte ef al. (1984) and Matthew et al. (1989) that summer and early autumn production can be further increased if reproductive tillers are allowed to develop to about anthesis by lax spring grazing, and are then removed by a switch to hard grazing to encourage the rapid development of new vegetative tillers.

This management is the opposite of that normally observed in grazing systems, where grazing can become increasingly lax through spring and early summer. It can be achieved most easily in systems involving early conservation, or in mixed grazing and conservation systems, and some topping managements may achieve the same result (Korte *et al.* 1984).

The stimulation of new tiller development in late spring may increase the risk of drought damage, a risk masked in this study by the limited use of irrigation, and confirmatory studies are required. However, in drought conditions there would be little direct benefit from the retention of a population of aged reproductive tillers. Moreover, there is evidence (C. Matthew, unpublished data) that, provided daughter tillers are formed before drought stress occurs, they may simply delay development of secondary and tertiary tillers until condtions become more favourable for growth.

CONCLUSIONS

Rates of net pasture and leaf production were usually greater under hard than under lax grazing, because greater pasture production under lax grazing was more than offset by higher rates of loss to senescence. However, in general terms these results provide further evidence that rates of net pasture production are relatively insensitive to sustained differences in grazing management.

There were advantages to summer pasture production from a management which allowed seedhead development to anthesis under lax grazing in spring, followed by hard grazing to enhance the subsequent development of new vegetative tillers. This pattern of lax followed by hard grazing is unusual in grazing systems, but can be achieved by judicious timing of conservation or pasture topping.

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