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Milk production by cows grazing on Matua prairie grass (*Bromus willdenowii* Kunth) pastures maintained under different managements

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ABSTRACT

Perennial ryegrass (RG) and Matua prairie grass swards of low (LMPG) and high (HMPG) pre-grazing herbage masses were compared in 8 grazing trials (2-3 weeks) during early spring, late spring, summer and autumn (1987/88 and 1988/89) to assess their feeding values. Pre-grazing masses were approximately 3000, 4000 and 5500 kg DM/ha for RG, LMPG and HMPG treatments, respectively. Friesian cows (8 per treatment) were allowed 50 kg DM/cow/d. Mean concentrations of N (% in OM) and OMD (%) for RG, LMPG and HMPG herbage were 2.7, 2.6, 2.3 (s.e.lsm 0.04, $P < 0.001$); and 74.7, 73.1 and 70.7 (s.e. 0.18, $P < 0.001$), respectively, HMPG values were lowest during all seasons and were influenced by high compositions of dead material, low leaf:stem ratios and low compositions of clover in the swards.

Daily yields of milk and protein on RG swards were 3% higher ($P < 0.05$) than LMPG yields, and 11 and 13% higher ($P < 0.001$), respectively than those of HMPG swards. Milkfat yields were similar on RG and LMPG swards, but were 11% lower ($P < 0.001$) on the HMPG treatment. *The results indicate that leafy prairie grass and leafy ryegrass swards have similar feeding and productive values.* Further research is needed on Matua's persistence under grazing.

Keywords Matua prairie grass; ryegrass; herbage mass; season; sward composition; milk production.

INTRODUCTION

'Grasslands Matua' prairie grass (*Bromus willdenowii* Kunth) was released in New Zealand as a high yielding, cool and summer season active, high nutritive value pasture cultivar most suited to lax-infrequent grazing (Rumball, 1974). More recent work with sheep (Frazer, 1985; Alexander, 1985), dairy cows (Brookes and Holmes, 1986) and with bull beef (Cosgrove and Brougham, 1988) has raised questions on Matua's feeding value, and on levels of pasture utilization when grazed laxly to ensure persistence. The current practice has been to graze more intensively with long rest periods (Alexander, 1985; Matthews, 1986) or to graze intensively only after replacement tillers have emerged at the base of the sward (Black and Chu, 1989).

There is very little information on the effects of grazing regime on Matua's persistence, herbage composition, and production per cow or per hectare in dairying situations. The limited data available show that production of milk and milk solids from cows fully fed on Matua/clover pasture is either equal to (Wilson and Grace, 1978) or lower than that of cows equally fed on perennial ryegrass/clover pastures (Brookes and Holmes, 1986; Sellars, 1988). This paper is a preliminary report of results from a two year comparative study of the composition of Matua prairie grass/white clover swards maintained under two grazing managements and of perennial ryegrass/clover pasture; and of milk production by cows grazed generously on the three sward types.

MATERIALS AND METHODS

Swards and Treatments

Eight short term grazing trials were conducted at Massey University's Dairy Cattle Research Unit between October 1987 and April 1989 with spring calving Friesian cows. The experimental swards comprised of well established perennial ryegrass (*Lolium perenne L.*) swards grown with white clover (*Trifolium repens L.*), and one year old Matua prairie grass/white clover pasture on a well drained Tokomaru silt loam soil. Each of four Matua paddocks (0.8 ha each) were divided into two parts in late August 1987. Differential grazing was imposed in early September in order to create and maintain either low mass, LMPG (1.5-2.5 t DM/ha residual herbage mass (RHM)) or high mass, HMPG (2.5-3.5 t RHM) Matua prairie grass sward types. Four similar size ryegrass paddocks, previously subjected to conventional management and adjacent to the Matua swards, constituted the control treatment, RG (1.0-2.0 t/ha RHM). Target pre-grazing herbage masses for RG, LMPG and HMPG were 2.0-3.5, 3.0-4.5 and 4.5-6.0 t/ha, respectively. When deemed necessary, LMPG paddocks were either regrazed, topped or both to approximately 1.5 t/ha RHM (5 cm height) within 24 h after experimental grazing. One dressing of 15% potassic superphosphate (375 kg/ha) and two of urea (25 kg N/ha each) were applied in autumn and during autumn and early spring (1987 and 1988), respectively.

During each of two years the three sward types prepared as described above were grazed by three groups of lactating cows (8 per treatment), for 2-3 weeks in early spring (September/October), late spring (October/November), summer (December/February) and autumn (March/May). The cows were selected before each trial and grazed as a group on ryegrass/clover pasture for a two week covariate period, and thereafter randomly allocated to the treatments. A common herbage allowance of 50 kg DM/cow/d was given in daily breaks during the experimental periods.

Measurements

Herbage mass was estimated every two days within 36 h before and after grazing by cutting (to ground level) eight 0.247 m^2 quadrats along a transect using a motor powered shearing handpiece. Cut herbage was immediately washed, dried at 80°C for 36-48 h and weighed. Snip samples of pre- and post-grazing herbage adjacent to each quadrat were cut to ground level, sub-sampled and washed for determination of chemical composition and morphological components. Chemical analyses and *in vitro* DMD and OMD determinations (Roughan and Holland, 1977) were performed on freeze dried samples ground through a 1 mm sieve and bulked within replications. Total N and ash were measured by the Kjeldahl technique and by incineration in a muffle furnace at 500°C for 16-18 h, respectively. Acid detergent fibre (ADF) and lignin were estimated according to Robertson and Van Soest (1981).

Milk yields for each animal were measured twice daily on 2 and 3 consecutive days per week during the two week covariate and the experimental periods, respectively, using a proportioning Milk Meter (TruTest Co., N.Z.). Milk composition was assessed by infra-red absorption (Milk-O-Scan, A.S N Foss, Denmark). Cows were weighed and condition scored on two consecutive days at the start and end of each experimental period. Apparent herbage intakes were estimated from the difference between pre- and post-grazing herbage masses.

Statistical analysis

Data for sward measurements, herbage intake and individual animal performance were examined by analysis of variance or covariance (liveweight and condition score change with initial measurements as covariates). Milk yield and milk constituent data were analysed on seasonal basis by repeated measures analysis with covariance and on pooled basis by analysis of covariance. Unless otherwise stated, data are presented as least squares means.

RESULTS

Sward characteristics

Mean pre- and post-grazing herbage masses for each treatment are presented in Table 1. Herbage allowance was similar ($P > 0.05$) at 50.7, 50.0 and 49.9 (s.e.lsm 0.4) kg DM/cow/day for ryegrass, low mass and high mass prairie grass treatments, respectively.

The mean botanical composition and morphological components of the swards are also shown in Table 1. There were significant ($P < 0.001$) treatment x season effects on the proportion of green leaf relative to stem of the herbage on offer. The ryegrass swards had the largest ($P < 0.01$) proportion of leaf (23 and 36% higher *vs* LMPG and HMPG, respectively) during all seasons except in late spring when low mass Matua had a similar (Year One) or a higher $P < 0.001$, Year Two leaf:stem ratio compared to ryegrass swards. The leaf:stem ratio was lower in high mass than low mass Matua treatments, and was lowest in the LMPG treatment during summer. The proportion of dead material in the swards was greatest ($P < 0.05$) in the HMPG treatment irrespective of season; that of RG swards but lowest in most seasons but was similar to the LMPG treatment ($P > 0.05$) during late spring.

Chemical composition

The mean chemical composition of herbage on offer is presented in Table 2, with data on the pattern of OM digestibility in Figure 1. The OM digestibility of ryegrass and low mass Matua swards was similar ($P > 0.05$) during spring (Year One) and during autumn (Year Two); otherwise it was greater ($P < 0.05$) on the RG treatment during the other seasons, the mean difference, however, was small (Table 2). The HMPG treatment had the lowest values for OM digestibility ($P < 0.01$) during all seasons, while that of Matua swards dropped markedly during summer in comparison to ryegrass pastures. The nitrogen concentration of the herbage in RG and LMPG treatments was similar ($P > 0.05$) during five of the eight seasons, and the difference between means was small ($P = 0.04$) in favour of RG swards (Table 2). The high mass Matua treatment had the lowest ($P < 0.01$) concentration of N throughout the experiment.

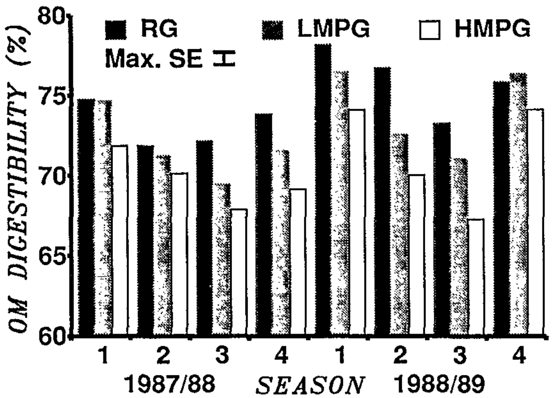

FIG 1 Influence of sward type and season on the OM digestibility of herbage on offer (1, early spring; 2, late spring; 3, summer; 4, autumn).

Animal performance

The effects of sward type on milk production are given in Table 3. The seasonal milkfat yields are shown in Figure 2. Yields of milk, milkfat, protein and lactose were, respectively, 11, 12, 13 and 11% less ($P < 0.001$) on the high mass Matua treatment, and were, except milkfat, (3% not 9% and $P < 0.05$ not 0.01) on low mass Matua compared to the ryegrass treatment. Milkfat yields on the RG and LMPG swards were similar ($P > 0.05$) during all seasons except during late spring when LMPG yields were higher in Year One ($P < 0.05$). The 3% decline in mean yields of milk, milk protein and lactose on the low mass Matua treatment relative to the ryegrass yields was generally insignificant except during summer. Repeated measures analysis of milk production data failed to detect any time effects or consistent time x treatment interactions on the response of cows to the treatments during each season.

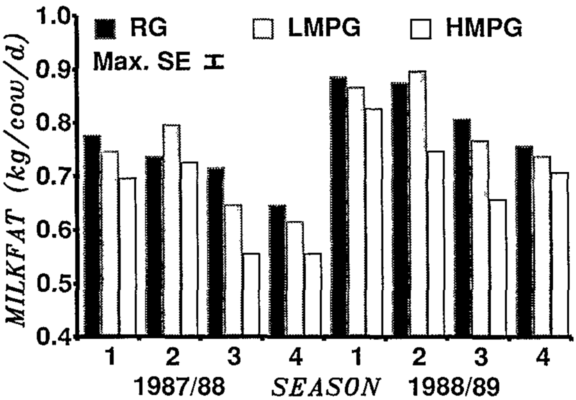

FIG 2 Influence of sward type and season on the yield of milkfat (1, early spring; 2, late spring; 3, summer; 4, autumn).

There were no treatment effects on milk composition (Table 3) except milk protein which was lowest ($P < 0.05$) on the high mass Matua pastures. Similarly, the change in liveweight of the cows was not influenced

TABLE 2 Mean chemical composition of herbage on offer

	Sward type RG	LMPG	HMPG	SEM
DM digestibility (%)	69.4	67.3	64.3	0.17***
OM digestibility (%)	74.7	73.1	70.7	0.18***
Nitrogen (% of OM)	2.7	2.6	2.3	0.04***
Ash (% of DM)	10.0	9.7	9.0	0.25NS
ADF (% of DM)	29.2	32.0	34.6	0.92**
Lignin (% of DM)	3.5	4.3	4.5	0.24*
ME (MJ/kg DM)[1]	10.7	10.4	10.0	0.03***

[1] ME = %DOMD x 0.163 (MAFF, 1984)

TABLE 3 Mean animal production data

	Sward type			
	RG	LMPG	HMPG	SEM
Milk yield (l/cow/d)	17.7	17.2	15.7	0.12***
Milk constituent yields				
Fat (kg/cow/d)	0.78	0.76	0.69	0.012***
Protein (kg/cow/d)	0,63	0.61	0.55	0.004***
Lactose (kg/cow/d)	0.84	0.82	0.75	0.006***
Milk composition				
Fat (%)	4.46	4.48	4.43	0.03NS
Protein (%)	3.63	3.60	3.55	0.02**
Lactose (%)	4.71	4.73	0.74	0.01NS
Liveweight change (kg/cow)	+1.4	+0.2	+0.2	1.04NS
Condition score change	+0.1	0.0	-0.1	0.04*
Feed intake (kg DM/cow/d)	16.6	18.8	17.6	0.75NS

TABLE 1 Mean botanical composition and morphological components of pasture on offer (% of DM), and sward herbage masses (t DM/ha (± SD)).

	Sward type			
	RG	LMPG	HMPG	SEM
Botanical composition				
Grass	65.3	61.0	71.9	1.90**
White clover	16.9	16.5	12.2	0.94*
Other species[1]	17.9	22.6	15.9	1.86*
Morphological components				
Live leaf	50.5	38.7	32.5	1.13***
Live stem	26.6	33.4	32.1	0.48***
Leaf:stem	2.3:1	1.5:1	1.2:1	0.03***
Dead material	23.2	28.0	36.7	1.19***
Herbage mass				
Pre-grazing	3.2(0.7)	4.2(1.1)	5.7(1.1)	
Post-grazing	2.1(0.5)	2.2(0.8)	3.6(0.8)	

[1] Other grasses and weeds

by the sward types. The condition of cows on the HMPG treatment, however, decreased slightly ($P < 0.05$) in comparison to the RG group (Table 3). The initial liveweights and condition score of the cows on the three treatments were similar $P > 0.05$, (mean 459 ± 51 kg/cow and 4.6 ± 0.7, respectively). Apparent feed intakes did not differ significantly ($P > 0.05$) probably because of the high C.V. (19%), but tended to be greater on the Matua swards.

DISCUSSION

The differences in component composition, in particular leaf:stem ratio and dead material, were reflected in the lower N concentration and OMD of herbage on offer from the HMPG and LMPG treatments in comparison to the RG swards. The absolute differences between the RG and LMPG swards, especially during late spring and autumn, were small. Similar trends in Matua's nutritive value have been reported by Hume (1990) under a cutting management. The nutritive value of Matua swards was lowest during summer and was much lower than RG swards. Cosgrove and Brougham (1988) have reported poor performance of bull calves grazing Matua based pastures during summer, in the North Island, while Fraser (1985) working with sheep observed good summer growth in the South Island. The summer period coincided with peak concentrations of dead material, stem and other species in the Matua swards, which may explain the marked decline in herbage quality.

The daily herbage allowance (50 kg DM/cow) was generous and was planned to minimise restrictions on the cows' DMI. Dry matter intakes were slightly, but not significantly, higher on the Matua swards. Prairie grass has a greater proportion of leaf in the upper sward horizons (L'Huillier *et al.*, 1986) and has a shorter rumen retention time (Cruickshank *et al.*, 1985) than perennial ryegrass which may have contributed to the slightly higher intakes off the Matua swards.

Cows on the HMPG swards produced lower yields of milk, fat, protein and lactose in both years, which may have been caused by differences in the nutritive value of herbage consumed since DMI did not differ significantly between the treatments. The feeding value of low mass Matua pastures, measured in terms of yields of milk, fat and protein was practically similar to that of perennial ryegrass pasture, particularly during late spring.

CONCLUSION

Grazing Matua prairie grass at pre-grazing herbage masses above 4 t DM/ha resulted in swards with the highest concentrations of stem and dead material; and the lowest levels of white clover and pasture quality. Milk yields were depressed on these swards. At low pre-grazing masses, however, Matua swards were comparable to perennial ryegrass swards in herbage quality and milk production. It appears that the feeding value of Matua pastures declines more slowly with reproductive growth and increasing herbage mass in relation to ryegrass swards. This suggests that prairie grass may be a suitable grass species under silage, hay or 'cut and carry' feeding systems in both cool and warm environments. Thus Matua would be suitable as a special purpose pasture. Further work on the management of Matua pasture is required. Again, grazing studies under different environments are still needed to exploit Matua's high feeding and growth qualities.

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