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The effects of season and herbage mass on the nutritive value of prairie grass cv. Grasslands Matua and perennial ryegrass

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ABSTRACT

The nutritive value of perennial ryegrass (RG), low mass Matua prairie grass (LM) and high mass Matua prairie grass (HM) swards were measured during early spring, late spring, summer and autumn of 1987/88 and 1988/89. Pre-grazing herbage masses were approximately 3000, 4000 and 5500 kgDM/ha for RG, LM and HM swards, respectively. Lactating cows on a common herbage allowance (50 kg DM/cow daily), grazed the ryegrass and Matua swards at mean intervals of 25 and 35 d, respectively.

Values for the concentration of N (% OM) and DMD in whole plants, averaged across all seasons, were (%N) 2.6, 2.5 and 2.3, and (% DMD) 71.4, 71.1 and 69.4, respectively, for RG, LM and HM. The values for HM were significantly lower than those for the other two treatments. Values for the concentration of N and DMD in green grass leaf were (%N) 3.4, 3.5 and 3.5, and (% DMD) 72.4, 71.9 and 71.5, respectively, for RG, LM and HM. There were no significant differences in % N between the three treatments; the difference in % DMD between RG and HM was significant. During the autumn in both years, the LM treatment had a higher value for DMD % than the RG treatment (by 3 to 6% units).

These results indicate that even at high pre-grazing herbage masses (4-5 tDM/ha) Matua prairie grass plants maintained relatively high nutritive values in green leaf and stem.

Keywords Matua prairie grass, ryegrass, whole plant, plant components, nutritive value, season.

INTRODUCTION

Herbage produced by prairie grass (*Bromus willdenowii* Kunth cv. Matua) is reputed to be highly palatable and highly digestible (Rumball, 1974; Hume, 1990 a,b), and there is some data for its chemical composition (Rumball *et al.*, 1972; Rys *et al.*, 1978; Crush *et al.*, 1989; Hopkins *et al.*, 1989; Hume, 1990 a,b; Thom *et al.*, 1990). However there is little information about the composition of Matua Prairie grass grazed by dairy cattle.

The present report is based on a two year study involving perennial ryegrass swards maintained at a moderate herbage mass, and Matua prairie grass swards maintained at either low or high pre-grazing herbage masses. All the three sward types were grown in association with white clover. This paper presents results for the nutritive value, in terms of digestibility and nutrient concentrations (Ulyatt, 1981), of whole plants and plant components of Matua prairie grass as compared to perennial ryegrass under field conditions. Data for botanical and morphological compositions and feeding value for milk production were reported by Rugambwa *et al.* (1990).

MATERIALS AND METHODS

The Swards

The nutritive values of whole plants and plant components from two Matua prairie grass and one perennial ryegrass (*Lolium perenne* L.) swards were assessed at Massey University's Dairy Cattle Research Unit between October 1987 and April 1989. The three sward types, ryegrass (RG), low mass Matua (LM) and high mass Matua (HM), were grazed by lactating Friesian cows at pre-grazing herbage masses of approximately 3200, 4200 and 5500 kg DM/ha, respectively. Mean post-grazing herbage masses were RG 2100, LM 2200 and HM 3500 kg DM/ha. The swards were grazed at intervals of approximately 25 days for ryegrass and 35 days for Matua, during the periods of the experiments (spring to autumn). The cows were fed generously (daily herbage allowance 50 kg DM/cow) during each of the eight grazing trials, each lasting for 2 to 3 weeks, during early and late spring, summer and autumn over the two year period. Details of the establishment and management of the swards before and during the experimental period, herbage mass estimations, herbage sampling, and sample processing protocols were reported by Rugambwa *et al.* (1990).

Design and Statistical Analysis

The experimental design used and statistical methods employed to test the treatment differences were described by Rugambwa *et al.* (1990). The results are presented as least squares means (LSM) with corresponding standard errors ($S.E._{LSM}$), unless indicated otherwise.

Measurements

Fresh herbage sub-samples from RG, LM and HM sward types were dissected into either ryegrass or Matua plants (retaining senescent matter attached to the plant), or into plant components (green leaf laminae, green stem or pseudostem, inflorescence (above flag leaf) and dead matter). These sward components, except inflorescence (seedhead) and dead matter, were bulked within replications during each season after being washed, freeze-dried and ground; and were analysed for concentrations of total nitrogen (N), ash, acid detergent fibre (ADF), lignin, gross energy (GE), and for *in vitro* digestibility as was described previously (Rugambwa *et al.*, 1990). Results for ADF, lignin and gross energy concentrations, and for all analyses performed on seedheads and dead matter are simple means (± standard deviations) of sub-samples bulked within sward types during each season. The concentrations of metabolizable energy of the various pasture components were estimated from their respective values of digestible organic matter in the dry matter (DOMD) according to MAFF (1975), with slight modifications to suit New Zealand pasture herbage (Ulyatt *et al.*, 1984).

RESULTS

Chemical Composition of Whole Plants

Mean values for the chemical composition of perennial ryegrass (RG), low mass Matua (LM) and high mass Matua (HM) whole plants, averaged across all eight experimental periods, are presented in Table 1. The concentrations of total N in RG and LM plants were similar, while that of HM plants was significantly lower. RG plants had the lowest concentrations of ADF and lignin, LM values were intermediate, and HM plants had the highest values. Mean concentrations of lignin in Matua plants were higher than those of ryegrass values by about 1% unit.

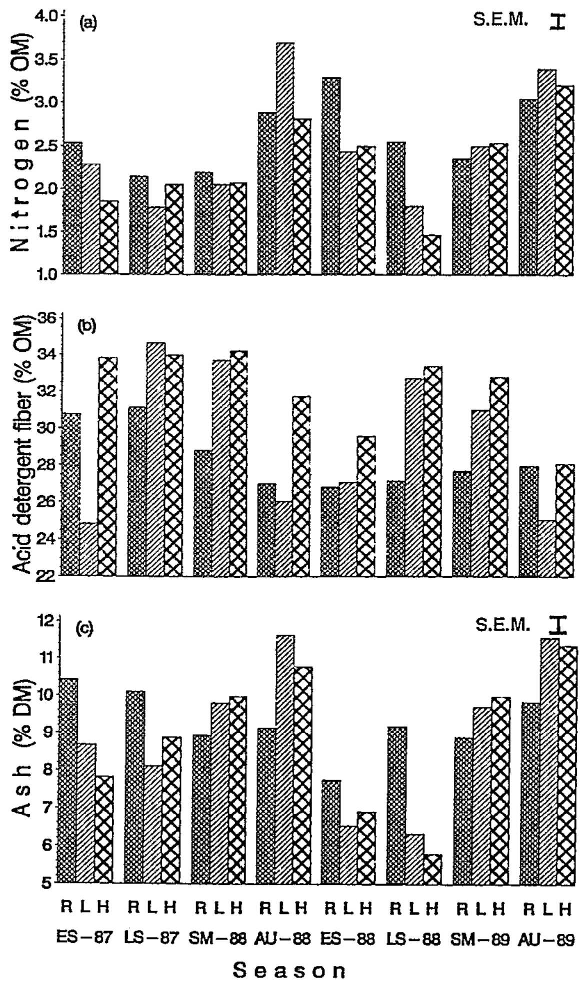

FIG 1 Influence of sward type and season on the concentration of (a) nitrogen, (b) acid detergent fibre and (c) ash of whole plants. (R = ryegrass, L = Low mass Matua, H = high mass Matua; ES = early spring, LS = late spring, SM = summer, AU = autumn 1987-1989; S.E.M.: highest standard error of means).

TABLE 1 Mean values for chemical composition of whole ryegrass and prairie grass plants and their components from the three sward types, averaged across eight seasons (unless stated otherwise, n=32).

Herbage parameter	Herbage component	Sward type RG	LM	HM	S.E.	P < 0.01
N (% OM)						
	Whole plant	2.6	2.5	2.3	0.05	**
	Green leaf	3.4	3.5	3.5	0.07	NS
	Green stem	1.7	1.8	1.7	0.05	NS
	Inflorescence[1]	2.1 ± 0.4	2.0 ± 0.3	2.0 ± 0.3	NA	NA
	Dead matter[2]	1.8 ± 0.3	1.8 ± 0.3	1.6 ± 0.2	NA	NA
ADF (% OM)[2]						
	Whole plant	28.6 ± 1.7	29.4 ± 3.9	32.2 ± 2.2	NA	NA
Lignin (% OM)[2]	Whole plant	2.7 ± 0.4	3.5 ± 0.7	3.8 ± 1.0	NA	NA
Ash (% DM)	Whole plant	9.3	9.1	9.0	0.24	NS
	Green leaf	9.8	10.2	10.1	0.14	NS
	Green stem	7.3	7.2	7.2	0.21	NS
	Inflorescence[1]	7.0 ± 1.5	5.3 ± 0.4	5.6 ± 0.5	NA	NA
	Dead matter[2]	11.1 ± 1.4	10.5 ± 1.5	9.3 ± 201.2	NA	NA

NA = Not analysed statistically.

[1] Values are means (± SD) of samples bulked within each sward type during each season with n=3 for RG and n=7 for LM and HM.

[2] Values are means (± SD) of samples bulked within each sward type during each season with n=8.

NS = Non significant (P>0.05).

The concentration of ash tended to be lower in Matua, relative to ryegrass, but the differences were not significant. There were, however, highly significant sward type x season interactions in the proportions of N and ash of plants from the three sward types (Fig. 1). Ryegrass had the highest proportion of total N in the organic matter during early and late spring (Fig. 1a), while plants from all three swards had similar values for % N during summer. The proportion of ADF in LM plants was either equal to or lower than that of ryegrass during early spring and autumn (Fig. 1b) whereas HM plants had the highest ADF values during most seasons. Compared to ryegrass, Matua plants had lower concentrations of ash during early and late spring (Fig. 1c), but higher values during summer and autumn.

Digestibility of Whole Plants

Mean values for *in vitro* digestibility and energy concentrations of whole plants in the three sward types are shown in Table 2. RG and LM plants had similar values for DMD and similar DOMD and ME concentrations, but values for HM plants were significantly lower. There were no differences in GE between the three treatments. Seasonal trends in the *in vitro* DMD for ryegrass and Matua plants are illustrated in Figure 2a. RG and LM plants had similar mean DMD values in Year One except during autumn when the digestibility of LM plants was significantly greater. In Year Two, however, the DMD of LM plants was consistently lower than that of RG, except again during autumn when the DMD of LM plants was significantly

TABLE 2 Mean values for in vitro digestibility and energy concentration of whole ryegrass and prairie grass plants and plant components, and of leaf:stem ratios from the three sward types, averaged across eight seasons (unless stated otherwise, n=32).

Herbage parameter	Herbage component	Sward type RG	LM	HM	S.E.	Sign.
DMD (%)	Whole plant	71.4	71.1	69.4	0.29	**
	Green leaf	72.4	71.9	71.5	0.28	+
	Green stem	70.8	69.7	68.4	0.39	**
	Inflorescence[1]	67.8 ± 10.4	64.1 ± 3.5	61.4 ± 4.5	NA	NA
	Dead matter[2]	50.3 ±1.9	47.9 ± 1.6	45.3 ± 2.1	NA	NA
DOMD (%)	Whole plant	67.4	66.9	65.5	0.33	**
	Green leaf	68.8	68.1	67.6	0.33	+
	Green stem	68.7	67.6	66.3	0.46	*
	Inflorescence[1]	66.0 ± 8.9	63.4 ± 2.9	60.7 ± 3.8	NA	NA
	Dead matter[2]	42.9 ± 2.8	40.5 ± 2.5	37.7 ± 2.3	NA	NA
GE[2] ($MJ\ kg\ DM^{-1}$)	Whole plant	18.5 ± 0.32	18.5 ±0.26	18.2 ± 0.25	NA	NA
ME ($MJ\ kg\ DM^{-1}$)	Whole plant	11.0	10.9	10.7	0.05	**
	Green leaf	11.2	11.1	11.0	0.05	+
	Green stem	11.2	11.0	10.8	0.06	*
	Inflorescence[1]	10.8 ± 1.5	10.3 ± 0.5	9.9 ± 0.6	NA	NA
	Dead matter[2]	7.0 ± 0.5	6.6 ± 0.4	6.1 ± 0.4	NA	NA
Leaf:stem ratio		2.3	1.4	1.1	0.04	***

* = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$
+ = $P < 0.1$

NA = Not analysed statistically.
[1] Values are means (± SD) of samples bulked within each sward type per season with n=3 for RG and n=7 for LM and HM.
[2] Values are means (± SD) of samples bulked within each sward type per season with n=8.

higher than that of RG plants.

Leaf and Stem

There were no significant differences between the swards in the mean concentrations of total N (Table 1) in either the green leaf or green stem. Similarly, the proportions of ash in either the green leaf or green stem did not differ between sward types. The concentrations of N and of ash were higher for green leaf than for green stem.

In vitro DMD of both green leaf and stem was significantly higher in RG than in HM plants, values for LM plants were intermediate and not significantly different from either RG or HM values (Table 2). The values were generally slightly higher for green leaf than for green stem.

Differences between the three swards in the *in vitro* DMD of leaf (Fig. 2b) were only apparent during autumn (Year One) and late spring (Year Two), when LM and RG green leaf had significantly higher values than HM green leaf. The DMD values in the green stem of RG and LM plants (Fig. 2c) were similar during most seasons, except during late spring and summer of Year Two when LM values were lower than those of RG. Stem from HM plants tended to have the lowest DMD values, particularly during late spring and summer.

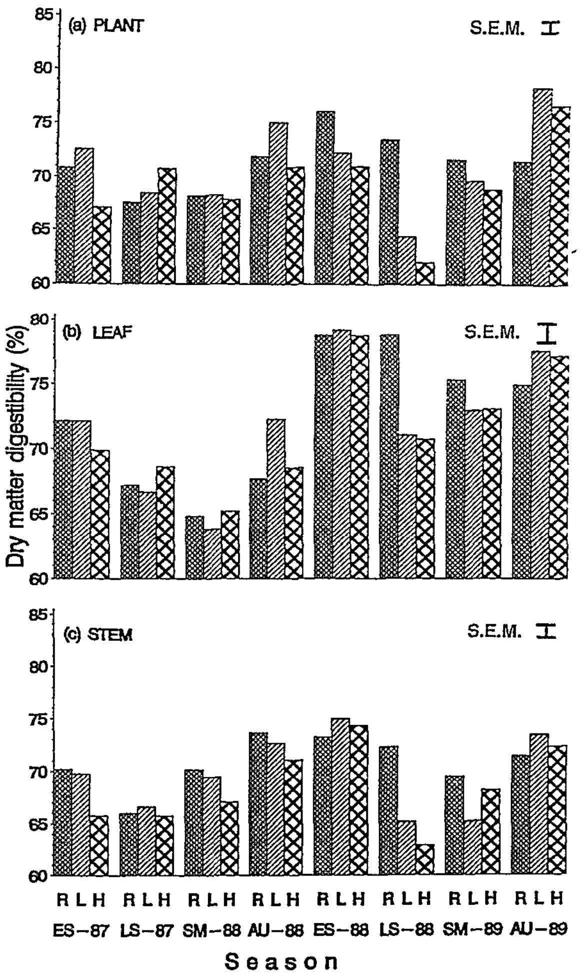

FIG 2 Influence of sward type and season on the *in vitro* dry matter digestibility of (a) whole plant, (b) green leaf and (c) green stem. (R = ryegrass, L = low mass Matua, H = high mass Matua; ES = early spring, LS = late spring, SM = summer, AU = autumn 1978-1989; S.E.M.: highest syandard error of means).

SeedHeads and Dead Matter

Seedheads from the three sward types had similar concentrations of N (Table 1). The concentration of ash in RG seedheads was considerably higher than that of LM and HM seedheads (Table 1). *In vitro* DMD and ME values of RG seedheads were higher than those of Matua, with HM swards showing the lowest values.

The concentration of N in the dead matter of the three sward types was similar to that of green stem (Table 1). The proportions of ash in the dead matter (Table 1) were higher than those of whole plants and plant components, regardless of sward type. Dead matter in all sward types had the lowest *in vitro* digestibilities and ME concentrations relative to other sward components.

The mean proportion of green leaf:stem in ryegrass plants (Table 2) was 40 and 50% greater than that of LM and HM plants, respectively, with minor seasonal variations.

DISCUSSION

The average values for digestibility and the changes in these values between seasons, are similar to those reported by previous authors (Rattray, 1978; Crush *et al.*, 1989). The values of DMD were similar for ryegrass and low mass Matua plants, but these were higher than the values for high mass Matua plants (by about 1.5% units). The exception to this general finding was that in autumn, digestibilities of plants from both Matua treatments were higher than ryegrass plants as has been reported by Crush *et al.* (1989).

In general, digestibility of plant material decreases with increases in maturity and mass (Osbourn, 1980) due to increases in stem:leaf ratio, cell wall carbohydrates and lignin concentrations (Ulyatt, 1981; Waghorn and Barry, 1987) and proportion of dead matter (Bircham and Hodgson, 1983). In the present experiment the Matua swards had much larger pre-grazing herbage masses than the ryegrass swards (by 1 to 2.5 t DM/ha), and had longer periods for regrowth between successive grazings. Therefore the similarity in DMD between LM and RG plants, the relatively small difference between RG and HM plants, and the absence of any difference in % N between the swards, are surprising. It is interesting to note that, at a similar stage of maturity, the digestibility of cell walls and the concentration of water soluble carbohydrates were greater for Matua plants than for Westerwolds annual ryegrass plants, despite higher concentrations of cell wall polysaccharides in Matua (Hume, 1990b).

The differences in DMD between RG and HM swards were, however, larger for inflorescence and dead material (about 5% units). These are likely to have contributed to the poorer feeding value of HM swards reported by Rugambwa *et al.* (1990).

CONCLUSION

Low mass Matua and perennial ryegrass whole plants had similar average nutritive values, which were higher than that of high mass Matua. Only small differences between sward types were observed for digestibility of green leaf or stem, despite large differences in herbage mass between swards. The digestibility and ME concentration of dead matter was lower in Matua than in ryegrass.

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