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Effect of continuous stocking of breeding ewes at different sward surface heights during the late summer-autumn on herbage intake and productivity

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ABSTRACT

At present, there are few guidelines available to New Zealand farmers that define the optimum sward conditions for continuous stocking management of ewes leading up to, and during, the mating period. Three different nominal sward surface heights (SSH) (2, 4, and 6 cm) replicated twice were used for a trial with 14 mixed age breeding ewes per treatment (n=84 ewes) continuously stocked from February to April 1994. The pastures consisted of predominantly 10-year old ryegrass (*L. perenne*), white clover (*T. repens*) and browntop (*A. capillaris*). Sward heights were measured weekly throughout the trial. Herbage intakes by the ewes were determined indirectly from faecal output using chromic oxide controlled release capsules and *in vitro* digestibility of digesta samples obtained from oesophageal-fistulated sheep run with the ewes. The average actual sward surface heights for the 2, 4, and 6 cm SSH treatments were 2.7 vs. 4.3 vs. 6.1 cm (±0.05 cm (SEM), P<0.001). Herbage mass, dead matter content and organic matter digestibility (OMD) for the 2, 4, and 6 cm SSH treatments were: 2723 vs. 3880 vs. 4337 (±204 kg DM/ha, P<0.05); 69.74 vs. 64.62 vs. 51.37 (±2.78%, P<0.05); 66.52±0.85 vs. 60.29±0.90 vs. 69.56±0.84% (P<0.01). The corresponding daily liveweight gain, condition score, wool growth rate and mean fibre diameter were: 103 vs. 122 vs. 195 (± 15 g/d, P<0.05); 2.89 vs. 3.05 vs. 3.23 (±0.06 condition score units, P<0.1); 1.30 vs. 1.26 vs. 1.41 (±0.03 mg/cm²/day, P<0.1); 43.01 vs. 44.07 vs. 44.38 (±0.35 microns, P>0.1). Swards maintained at a height of at least 6 cm appeared to be required to support adequate liveweight and condition score gain in breeding ewes in the period prior to and during mating.

Keywords: Continuous stocking; late summer-autumn; sward height; breeding ewes.

INTRODUCTION

Many farmers, particularly those in summer-dry areas, prefer continuous stocking management during the late summer-autumn because of the difficulty of maintaining a grazing rotation. In the UK, sward surface height (SSH) is commonly used to manage sward and animal performance under continuous stocking systems (Maxwell, 1985). While the advantages of SSH over herbage mass as an indicator of herbage production and animal intake are well established (Webby and Pengelly, 1986; Hodgson, 1990), guidelines for pregnant and lactating ewes under continuously stocked systems in New Zealand have only recently been developed (Parker and McCutcheon, 1992; Morris *et al.*, 1993). Corresponding New Zealand data for the period prior to and during mating are limited (Burnham *et al.*, 1994), but British research suggests that swards maintained at 4 to 6 cm at this time will achieve optimum pasture production and sward structure, as well as good performance by breeding ewes (Hodgson, 1986; Orr *et al.*, 1990).

The purpose of this paper is to further report on the relationship between SSH of ryegrass-clover pastures and herbage intake and subsequent production of breeding ewes during the late summer-autumn period.

MATERIALS AND METHODS

Six paddocks (1.0 - 1.9 ha) were randomly assigned to three different SSH treatments, nominally 2, 4 and 6 cm, replicated twice. The pastures, predominantly 10-year old ryegrass (*L. perenne*), white clover (*T. repens*) and browntop (*A. capillaris*) swards were prepared to the required SSH using non-trial ewes over a period of 10 weeks prior to the trial.

Eighty-four mixed age (4-8 years old) Border Leicester x Romney ewes were weighed and had a midside patch cleared of wool on the right hand side on 26 January 1994. The patch was re-clipped on 22 February (d 0), to provide a pre-treatment (covariate) estimate of wool growth rates, and then again on 13 April (d50). Mean fibre diameter (MFD) of scoured samples was measured using the airflow technique for samples weighing more than 2.5 g and the projection microscope for samples weighing less than 2.5 g. Ewes were randomly allocated to SSH treatments on d 0 and remained continuously stocked (14 ewes/ha) until d 50. Unfasted liveweights were recorded on d 0, 13, 24, and 50. Ewe condition was scored using the 5 point scale of Jefferies (1961) on d 0 and d 50.

Mating commenced on 14 March (d 20) with one harnessed Coopworth ram assigned to each of the six paddocks. After ram removal the ewes were run together until lambing under a rotational stocking system which restricted herbage intake to a maintenance level (approximately 1 kg DM/ewe/d). Lamb birth rank and birth weight were recorded and lambs were identified to their dam.

Pasture height was measured weekly during the trial using a sward stick as described by Burnham *et al.* (1994). Herbage mass and botanical composition were estimated from four randomly selected 0.18 m² quadrats cut to ground level in each paddock on d 16, 29, and 51.

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On 28 February (d 6), 8 ewes in each treatment replicate were dosed with a single chromic oxide (Cr_2O_3) controlled release capsule (CRC; Captec (NZ) Ltd., Auckland) and then faecal sampled as described by Burnham *et al.* (1994). Cr concentrations in the ashed faecal samples were assessed using atomic absorption spectrophotometry (Parker *et al.*, 1989). The rate of Cr_2O_3 release from the CRC was 134-136 mg Cr/day as determined by measurement of plunger travel in capsules recovered, after slaughter, from four ewes grazed with the treatment ewes on the 2 and 4 cm swards.

Four mixed-age oesophageal fistulated (OF) wethers, rotated around the paddocks, were used to obtain extrusa samples to estimate botanical composition (Clark and Hodgson, 1986) and *in vitro* digestibility (Roughan and Holland, 1977) of the diet consumed by the ewes.

STATISTICAL ANALYSIS

Data were analysed using the Statistical Analysis System computer package (SAS, 1985). The SSH treatment x replicate mean square was used as the denominator to test for the effect of SSH treatment on ewes' intake, daily liveweight gain, midside wool growth and lamb birth weight. The proportion of ewes lambing relative to those mated (proportion lambing) and the proportion of ewes lambing singles versus multiples (proportion of multiples) were analysed as binomial traits using the SAS procedure for categorical data modelling (logit transformation). Data were expressed in terms of means (± S.E.M). Differences between group means were tested using the Least Significant Differences Test (SAS, 1985).

RESULTS AND DISCUSSION

Sward surface heights were maintained close to the target levels during the trial period (Table 1). The proportion of grass was greater and that of dead material was lower in the 6.0 cm than in the other swards (Table 1). Extrusa samples showed little difference in composition except for the low proportion of weed on the 6.0 cm SSH treatment ($P<0.05$). The pasture dry matter and organic matter digestibilities (DMD and OMD) of the 4.0 cm SSH treatment were lower ($P<0.05$), while digestible organic matter in the dry matter (DOMD) of the 6.0 cm SSH treatment was higher ($P<0.05$), than those of the other treatments.

The predicted M/D values were significantly different ($P<0.05$) across SSH treatments with the 4.0 cm SSH treatment being the lowest. The low values (8.39-9.68 MJ ME/kg DM) can be attributed to the high proportion of dead material and were below those (10-12 MJ ME/kgDM) recommended for flushing ewes (Rattray and Jagusch, 1978). However, they coincide with those reported by Ulyatt *et al.* (1980) who found that mature swards had M/D values ranging from 8-10 MJ ME/kg DM.

Ewe liveweights were generally greater on the 6.0 cm SSH treatment reflecting the greater ($P<0.05$) daily liveweight gain of those ewes compared to ewes on the 2.0 and 4.0 SSH treatments. Ewes were in good condition (body condition score 3) at the start of the trial and this was maintained throughout the trial period. In contrast, Gunn *et al.* (1992) found that ewe liveweight and body condition decreased as sward height declined below 3.5 cm.

TABLE 1: Sward height, herbage mass, green herbage mass, botanical composition and *in vitro* digestibility of the three sward surface height (SSH) treatments (Mean ± SEM).

	Sward surface height (SSH)		
	2cm	4cm	6cm
Sward surface height (cm)	2.7 ± 0.05^a	4.3 ±0.05^b	6.1 ± 0.05^c
Herbage mass (kg DM/ha)			
total	2,723 ± 204^a	3,880 ± 204^b	4,337 ± 204^b
green[1]	832 ± 111^a	1,373 ± 111^b	2,104 ± 111^c
Botanical composition (%)			
Cut herbage			
grass	26.34 ± 3.29^a	29.02 ± 3.29^a	45.41 ± 3.29^b
clover	3.89 ± 1.46	6.36 ± 1.46	2.96 ± 1.46
weed	0.04 ± 0.15	0.00 ± 0.15	0.26 ± 0.15
dead matter	69.74 ± 2.78^b	64.62 ± 2.78^a	51.37 ± 2.78^a
Extrusa samples			
grass	50.49 ± 2.59	52.12 ± 2.22	60.40 ± 1.43
clover	1.06 ± 1.30	1.93 ± 1.14	4.18 ± 0.74
weed	24.20 ± 2.08^b	19.62 ± 1.83^{a,b}	13.36 ± 1.18^a
dead matter	24.24 ± 2.54	26.33 ± 2.23	22.06 ± 1.44
Extrusa analysis			
Nitrogen (%)	2.84 ± 0.08^b	2.38 ± 0.09^a	2.93 ± 0.08^b
DMD[2] (%)	66.18 ± 0.78^b	59.99 ± 0.83^a	68.85 ± 0.78^b
DOMD (%)	55.85 ± 0.77^a	52.44 ± 0.81^a	60.53 ± 0.76^b
OMD (%)	66.52 ± 0.85	60.29 ± 0.90^a	69.56 ± 0.84^b
M/D value (MJ ME/kg DM)	8.94 ± 0.12^a	8.39 ± 0.13^a	9.68 ± 0.12^b

[a,b,c] Mean values on the same row with different superscript letters differ significantly ($P<0.05$).

[1] green herbage mass = herbage mass (100% - % dead material).

[2] DMD = dry matter digestibility, DOMD = organic matter digestibility of dry matter, OMD = organic matter digestibility, MJ ME = megajoules of metabolisable energy.

TABLE 2: Effects of sward surface height (SSH) on ewe liveweight, daily liveweight gain and condition score, wool growth rate and mean fibre diameter (Mean ± SEM).

	Sward surface height (SSH)		
	2cm	4cm	6cm
Ewe liveweight			
d 0[1]	60.23 ± 0.53	61.23 ± 0.53	61.34 ± 0.53
d 13	63.98 ± 0.68	63.86 ± 0.68	67.05 ± 0.68
d 24	63.95 ± 0.76	64.95 ± 0.76	66.80 ± 0.76
d 50	65.38 ± 0.78^a	67.34 ± 0.78^a	71.11 ± 0.78^b
Daily liveweight gain (g/d)	103 ± 15^a	122 ± 15^a	195 ± 15^b
Ewe condition score			
d 0	3.07 ± 0.03		3.07 ± 0.03
d 50	2.89 ± 0.06		3.05 ± 0.06
Wool growth rate (mg/cm^2/d)	1.30 ± 0.03	1.26 ± 0.03	1.41 ± 0.03
Mean fibre diameter (microns)	43.01 ± 0.35	44.07 ± 0.35	44.48 ± 0.35

[a,b] Mean values on the same row with different superscript letters differ significantly ($P<0.05$).

[1] d 0 = 22 February 1994.

The dry matter intakes (DMI) of ewes across all treatments were similar but the organic matter intakes (OMI) of ewes on the 6.0 cm SSH treatment were higher ($P<0.05$) than those of ewes grazing the 4.0 cm SSH treatment, while OMI of ewes on the 2.0 cm treatment were intermediate. The high proportion of weed and dead material, and therefore restricted accessibility to green herbage, in the 2.0 and 4.0 cm swards, is likely to have restricted ewe intake in these groups (Burnham *et al.*, 1994).

TABLE 3: Effects of sward surface height (SSH) on DMI (Dry Matter Intake), OMI (Organic Matter Intake), DOMI (Digestible Organic Matter Intake) and MEI (Metabolizable Energy Intake) (Mean ± SEM).

	Sward surface height (SSH)		
	2cm	4cm	6cm
DMI (kg/ewe/d)	1.25 ± 0.08	1.09 ± 0.07	1.49 ± 0.07
OMI (kg/ewe/d)	$1.03 \pm 0.07^{a,b}$	0.91 ± 0.06^{a}	1.30 ± 0.06^{b}
DOMI (kg/ewe/d)	0.68 ± 0.05^{a}	0.55 ± 0.04^{a}	0.91 ± 0.04^{b}
MEI (MJ ME/ewe/d)	10.93 ± 0.78^{a}	8.84 ± 0.70^{a}	14.51 ± 0.68^{b}

[a,b] Mean values on the same row with different superscript letters differ significantly ($P<0.05$).

The derived daily metabolizable energy intakes (MEI) of ewes grazing the 2.0 and 4.0 cm swards were lower than the recommended maintenance requirement for a 65 kg ewe (13.0 MJ ME/ewe/day, Geenty and Rattray, 1987). In fact, these ewes gained liveweight. The favourable climatic conditions during the trial and reduced exercise under continuous stocking are both likely to have reduced the energy required for grazing activity relative to the average values assumed in the ARC recommendations (ARC, 1980). Ewes grazing the 6.0 cm sward achieved a MEI above the recommended maintenance requirement and gained 195 g/day over the trial period. The SSH treatments did not significantly affect wool production (wool growth rate and mean fibre diameter), a result consistent with that of Burnham *et al.* (1994).

TABLE 4: Effects of sward surface height (SSH) on lamb birth weight, proportion lambing and proportion of multiples.

	Sward surface height (SSH)		
	2cm	4cm	6cm
No. ewes	28	28	28
Proportion lambing (%)	2.56 ± 0.73[1] (93)[2]	2.56 ± 0.73 (93)	2.56 ± 0.73 (93)
Proportion of multiples (%)	$-2.32\text{E-}17 \pm 0.39$ (50)	-0.15 ± 0.39 (46)	$-2.32\text{E-}17 \pm 0.39$ (50)
Lamb birth weight (kg)	5.9 ± 0.2	6.2 ± 0.2	5.5 ± 0.2

[1] Logit-transformed.
[2] Back-transformed.

There were no significant effects of SSH treatment on ewe reproductive performance (Table 4). Burnham *et al.* (1994) reported a similar finding, possibly because ewes with liveweights over 60 kg and body condition scores of at least 3.0 are unresponsive to pasture allowance over the flushing period (Rattray *et al.*, 1983).

CONCLUSIONS

Summer-autumn swards of low-medium quality pasture should be maintained at a height of at least 6.0 cm to support breeding ewe performance in the period prior to and during mating. Lower sward heights (4.0 cm) will achieve the same result where pastures are of high quality and have an associated high proportion of green material (Burnham *et al.*, 1994). These levels are lower than the 6.0-8.0 cm swards that Treacher (1990) recommended for late summer in order to build up reserves of good quality herbage and maintain ewe intake prior to and during mating. Grazing management should aim to minimize the accumulation of weed and dead material in the swards by controlling pasture growth throughout the spring-summer period to maintain pasture quality into the autumn.

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