The effect of pasture height on herbage intake and ewe production under continuous stocking management during the autumn

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ABSTRACT

A replicated trial design with ewes continuously stocked on mixed ryegrass/white clover pastures at three target sward surface heights (SSH) of 4, 6 and 8 cm, and 16 ewes per sward treatment (total 96 ewes), was carried out from February through to April 1993. Herbage intake was assessed indirectly from faecal output measured using chromium controlled release capsules and the *in vitro* digestibility of herbage samples obtained from oesophageal-fistulated sheep run with the ewes. Intake measurements were taken before and after the rams were joined with the ewes.

Pasture measurements for the 4,6 and 8 cm SSH treatments were: SSH, 4.12 vs. 6.18 vs. 7.97 cm (PSE 0.54 cm, $P<0.05$); mass, 3358 vs. 4291 vs. 5231 kg DM/ha (PSE 389 kg DM/ha, $P<0.1$); dead matter content, 38.9 vs. 26.7 vs. 40.4% (PSE 5.8%, NS); and organic matter digestibility, 68.0 vs. 71.9 vs. 63.8% (PSE 1.21%, $P<0.0001$). Organic Matter (OM) intakes for the 4, 6 and 8cm SSH treatments were 1.39 vs. 1.86 vs. 1.06 kg OM/ewe/day (PSE 0.08 kg OM/ewe/day, $P<0.05$) for the pre-mating intake and 1.26 vs. 1.34 vs. 1.09 kg OM/head /day (PSE 0.06 kg OM/ewe/day, NS) for the mating intake period.

Production responses of the ewes for the 4, 6 and 8 cm SSH treatments were: liveweight gain, 72 vs. 83 vs. 73 g/day (PSE 5 g/day, NS); and wool growth rate, 1.37 vs. 1.44 vs. 1.42 mg/cm^2/day (PSE 0.03 mg/cm^2/day, NS). These results suggest that, in the autumn, maximum herbage intake and ewe performance on ryegrass - white clover pastures can be obtained at a sward height of about 4cm, and that pasture digestibility and dead matter content in the pastures are the major limiting factors at this time of year.

Keywords: Herbage intake; sward height; autumn management; continuously stocked; ewe productivity.

INTRODUCTION

Grazing management guidelines based on pasture (sward) height are likely to be more easily understood by farmers (Hodgson, 1986) than those based on terms such as herbage mass (kg green DM/ha) which have historically been used in New Zealand to describe how sheep should be managed on pasture. Futhermore, describing herbage allowance in terms of sward height is particularly well suited to continuous stocking management which is practised on most sheep and beef cattle farms, especially during the lactation and mating periods

The effects of level of nutrition during the period immediately prior to mating, on ovulation rate, are well established (Allison, 1982). The positive benefits of flushing have encouraged farmers to prepare feed in advance of this period to enable them to feed their ewes as well as possible in a 3-6 week period prior to mating. Management guidelines on the quantity of pasture that should be made available to ewes under rotational grazing systems were provided by Rattray *et al.* (1987).

Parker and McCutcheon (1992) and Morris *et al.* (1993) have provided sward height recommendations for continuously stocked ewes over the periods of pregnancy and lactation, however, corresponding guidelines for continuous stocking of ewes during the autumn under New Zealand conditions are not available. This form of grazing management, commonly referred to as set stocking, may be preferred by farmers in situations where there is limited subdivision, high stock numbers per labour unit or disease restrictions on ewe movement. Some farmers also have a personal preference for this system of grazing. The purpose of this trial was therefore to obtain information about the relationship between sward height, herbage intake and ewe performance (liveweight change, wool growth and reproduction) from February through to April.

MATERIALS AND METHODS

Ninety six Border Leicester x Romney ewes, of mixed age (MA) were weighed, drenched with anthelmintic, had a midside wool patch clipped on the right side (Bigham, 1974) and were randomly assigned, within ewe liveweight and age, to 6 groups on 12 January (d0). The ewes were introduced to one of three sward surface height (SSH) treatments (4, 6 and 8 cm), replicated twice, on 23 February (d42). At this stage the midside patch was clipped, to provide a pre-treatment (covariate) estimate of wool growth (42 days), and the ewes weighed. The paddocks were approximately one hectare and pastures were 10 year old ryegrass (*L. perenne*)/ browntop (*A. venius*)/ white clover (*T. repens*) pastures which had been prepared to sward heights of 4, 6 and 8 cm over a period of 10 weeks prior to the trial with non-trial ewes.

The 16 ewes in each paddock were continuously stocked on their treatment from d42 (23 February) until d94 (15 April).

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Harnessed rams were introduced on d63 (15 March) and remained with the ewes until d94. The ewes were run together from ram removal to lambing under a rotational grazing management system which restricted herbage intake to a maintenance level.

Chromium controlled release capsules (CRC, Captec (NZ) Ltd.) were inserted on d48 and faecal samples were collected daily, over two 5-day periods immediately prior to and post ram introduction (d63), beginning d56 and d66 respectively. The faecal samples were oven-dried to a constant weight, pooled on an individual animal basis and the chromium concentration assessed using atomic absorption spectrophotometry (Parker *et al.*, 1989). The rate of chromic oxide release from the capsules was determined by measurement of plunger travel in CRC recovered, after slaughter, from two ewes grazed with the treatment ewes at each sward height.

Extrusa samples were collected for each paddock, and intake period, from four mixed age oesophageal fistulated wethers. Botanical composition was estimated from a sample of half of the extrusa using a 100 grid point counting method (Clark and Hodgson, 1986). The remainder of the sample was freeze-dried and subsequently bulked within paddock, and intake period, on an equal weight basis for *in vitro* digestibility analysis by the method of Roughan and Holland (1977).

Midside patches were clipped on d94. Ewes were weighed within 1 hour of coming off pasture on d0, d41, d63 (ram introduction) and d94. Sixteen hour fasted liveweights were taken on d42 and d95. Ewes were condition scored using the Jefferies (1961) 5-point scale on d0, d42 and d94. Lambing birth rank was collected at birth and lambs were identified to their dam.

Pasture height was measured weekly using the HFRO sward stick (Barthram, 1986). Herbage mass in each paddock was estimated by cutting 8 randomly selected 0.09m^2 quadrats to ground level on d50, d64 and d89. The pasture was washed and oven-dried to a constant weight to estimate herbage mass.

Data was analyzed using the Statistical Analysis System computer package (SAS, 1985). The SSH treatment x replicate mean square was used to test for the effects of SSH on ewe intake, liveweight change and midside wool growth. The proportion of ewes lambing relative to those mated, together with the proportion of ewes lambing singles versus multiples were analysed as binomial traits using the SAS procedure for categorical data modelling (logit transformation). Differences between group means were tested according to pre-planned comparisons using the Chi-Square statistic (SAS, 1985)

RESULTS AND DISCUSSION

Pasture data during the trial period is shown in Table 1. The paddocks were at sward heights of 4.0, 6.3 and 8.0 cm on d42 when the ewes were introduced. The 4 and 6 cm SSH treatments remained at this level until early April before increasing to 4.7 and 7.4 cm by d94. The 8 cm SSH treatment fluctuated between 7.1 and 9.3 cm throughout the trial, much of this variability was attributable to the presence of seed head in these pastures. The mean heights of the 4, 6 and 8 cm SSH treatments for the experimental period were 4.1, 6.2 and 8.0 cm (PSE 0.54, P<0.05), respectively. The pastures contained high proportions of dead material (38.9, 26.7 and 40.4% for the 4, 6 and 8 cm SSH treatments respectively) and some browntop which led to a low pasture digestibility. This reflected uncontrolled herbage accumulation during the early summer (i.e. prior to d0). The average herbage mass for the 4, 6 and 8 cm SSH treatments was 3358, 4291 and 5231 kg DM/ha (PSE 389, P<0.1) respectively.

TABLE 1: Means of sward height, herbage mass, botanical composition and organic matter digestibility of herbage, of the three Sward Surface Height (SSH) treatments from d42 to d94 (Means, Pooled SE and P Values).

	SSH Treatment				
	4	6	8	PSE	P
Sward height (cm)	4.12	6.18	7.97	0.54	0.03
Herbage mass (kg DM/ha)	3358	4291	5231	389	0.09
Herbage mass - green (kg DM/ha)	2052	3145	3118	232	0.07
Botanical composition (%)					
Grass	54.1	65.8	53.7	4.8	NS
Clover	4.1	7.1	5.9	1.9	NS
Dead	38.9	26.7	40.4	5.8	NS
Weed	1.4	0.5	0.0	0.8	NS
Organic Matter Digestibility (%) of oesophageal extrusa	68.0	71.9	63.8	1.2	0.0001

Ewe intake data obtained immediately prior to and after ram introduction are shown in Table 2. The rate of chromium release was 165.7 mg Cr/d (SD ±7.4). For the pre-mating period the organic matter and metabolizable energy intake (OMI and MEI) of the ewes was 1.39, 1.86 and 1.06 kg OM/ewe/d (PSE 0.08, P<0.05) and 15.2, 22.2 and 10.7 MJ ME/ewe/d (PSE 0.9, P<0.05) for the 4, 6 and 8cm SSH treatments, respectively. These intake values corresponded to the OMD values for each sward (Table 1), and even though the 6 and 8 cm pastures had very similar amounts of green herbage, voluntary feed intake by the ewes on the longer but lower digestibility herbage of the 8 cm sward was less than that measured for the 4 cm sward. These intake values were similar to the results reported by Walsh (1989) who found, for ewes grazing the same paddocks in autumn at a sward height of 3.5 cm (31% dead material and OMD 66.8%), DMI was 50.9 gOM /kg$^{0.75}$/d. This equates to 1.16 kg OM/ewe/d and a MEI of 10.91 MJ/ewe/d. Ewe DOMI ranged between 10.6 and 22.2 g DOM/kg LW/d which is similar to results of Hawkins *et al.* (1993) who found that hoggets fed *ad lib* on pastures, containing 40% dead material and with an OMD of 72.6%, consumed 18.9 g DOM/kg LW/d. In their study near maximum performance for hoggets was achieved on pastures containing as low as 10% dead material in the autumn.

During the mating period OMI on each of the pastures was approximately 1.2 kg OM/ewe/d and was not significantly different between SSH treatments (Table 2). The estimated MEI for this period of 13.8, 15.1 and 11.3 MJ ME/ewe/d (PSE 0.6) for the 4, 6 and 8 cm SSH treatments, is similar to the maintenance requirements of a 65kg ewe (approximately 13.0 MJ ME/ewe/d; Geenty and Rattray, 1987). This was substantiated by relatively stable ewe liveweights over the mating period.

Ewe performance during the trial in terms of liveweight, liveweight change, condition score, wool production and mean fibre diameter are shown in Table 3. The ewes had a

TABLE 2: Effect of sward surface height treatment on ewe intake prior to and after ram introduction (Means, Pooled SE and P Values).

	SSH Treatment				
	4.0	6.0	8.0	PSE	P
Prior to ram introduction[a]					
OMI[b] (kg/ewe/d)	1.39	1.86	1.06	0.08	0.03
DMI (kg/ewe/d)	1.59	2.10	1.17	0.09	0.03
DOMI (kg/ewe/d)	0.93	1.36	0.65	0.06	0.05
Energy (MJ ME/ewe/d)	15.2	22.2	10.7	0.92	0.05
Mating					
OMI (kg/ewe/d)	1.26	1.34	1.09	0.06	NS[c]
DMI (kg/ewe/d)	1.44	1.51	1.22	0.06	NS
DOMI (kg/ewe/d)	0.85	0.92	0.69	0.04	NS
Energy (MJ ME/ewe/d)	13.8	15.1	11.3	0.60	NS

[a] Day 63 (17 March 1993) = ram introduction
[b] OMI = organic matter intake, DMI = dry matter intake, DOMI = digestible organic matter intake, MJ ME = megajoules of metabolisable energy.
[c] NS = non significant (p>0.10)

TABLE 3: Effect of sward surface height treatment on ewe liveweight change, condition score, wool growth and mean fibre diameter (Means, Pooled SE and P Values).

	SSH Treatment				
	4.0	6.0	8.0	PSE	P
Prior to ram introduction[a]					
Ewe liveweights (kg)					
d0 (12 Jan)	58.2	58.3	58.4	1.10	NS
d42 (23 Feb)	61.1	61.2	61.2	1.15	NS
d63 (15 Mar)	63.9	66.3	64.9	1.14	NS
d94 (15 Apr)	64.6	65.3	65.3	1.15	NS
Liveweightgain (g/d)	72	83	73	5	NS
Condition score					
dO (12Jan)	2.93	3.12	3.00	0.12	0.1
d42 (23 Feb)	3.20	3.18	3.23	0.10	NS
d94 (15 Apr)	3.07	3.07	3.23	0.11	NS
Wool growth rate (mg/cm²/d)	1.37	1.44	1.42	0.03	NS
Mean fibre diameter (microns)	43.6	43.6	43.7	0.03	NS

mean liveweight of 58.3±0.1 kg on d0, and 61.2±0.1 kg on d42 (ewe introduction). By ram introduction (d63), ewe liveweight had increased over all treatments, but differences between treatments were not significant. During the mating period, liveweights remained static on each SSH treatment and this was consistent with the estimated daily intakes of energy. Changes in ewe condition score values corresponded to the changes in liveweight. Gunn *et al.* (1992) also found that sheep did not show significant differences in liveweight or condition score until pastures declined below 3.5 cm sward surface height, although no pasture digestibility results were given. Wool growth and mean fibre diameter was not significantly affected by SSH treatments.

Table 4 shows that out of 30 surviving ewes per treatment, 28 (93%), 26 (86%) and 27 (90%) lambed for the 4, 6 and 8 cm SSH treatments respectively, and of these 12 (43%), 14 (54%) and 9 (33%) had twins. Neither of these reproductive parameters was significantly affected by sward surface height. This contrasts with Rattray *et al.* (1987) who found that a higher pasture dry matter allowance (kg green DM/

TABLE 4: Effect of sward surface height treatment on the proportion of ewes lambing and having multiple births (Means±SEM).

	SSH Treatment		
	4.0	6.0	8.0
No. of ewes	30	30	30
- proportion lambing (%)	2.64±0.73[1](93)[2]	1.87±0.54 (86)	2.20±0.61(90)
- proportion of multiples (%)	-0.29±0.38 (43)	0.15±0.39 (54)	-0.69±0.40 (33)

[1] logit-transformed
[2] back-transformed (%)

ewe/d) was required to increase the ovulation rate of ewes on poorer quality pasture with a high dead material content. Rattray *et al.* (1987) also noted that the ovulation rate of heavy ewes in good condition, such as were used in the current experiment, was not as sensitive to pasture allowance as that of light thin ewes. Gunn *et al.* (1992) reported significant increases in the loss of ova and the incidence of barrenness in ewes grazing swards declining below 3.5 cm SSH in comparison to those grazing on swards longer than 5 cm.

The results from this study indicate that grazing swards maintained at about 4.0 cm in the autumn will not significantly reduce ewe reproductive performance even where feed is of relatively low digestibility. However, as Morris *et al.* (1993) suggested for lactating ewes, ewes must be in good condition by early autumn if this form of grazing management is to be adopted. The results also suggest that pasture digestibility and dead matter content, rather than sward height, will be the major limiting factor at this time of the year which is in agreement with Hawkins *et al.* (1993). Sheep farmers should therefore place a high priority on achieving feed supplies of good quality (i.e. OMD≥75% with a low dead material content) for the pre-mating and mating periods. Prior studies by Korte (1982) and Rattray and Clark (1984) have indicated that maintaining the development of plant reproductive material during the late spring - early summer is a critical prerequisite to realising this pasture digestibility objective.

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