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The effect of sward surface height on ingestive behaviour and intake of once-bred and non-pregnant heifers under continuous stocking management in early winter

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ABSTRACT

Ingestive behaviour and herbage intake were measured in 36 twenty-month old pregnant and non-pregnant Hereford x Friesian heifers with an initial liveweight of 360 ± 21 kg (mean + SE). The heifers were grazed under continuous stocking management on ryegrass (*Lolium perenne*)/white clover (*Trifolium repens*) pastures maintained at a sward surface height of 7 cm or 11 cm. The groups of heifers (n = 6/group) were balanced for liveweight and pregnancy status and allocated to three replicates per sward height. There were no significant differences between the non-pregnant *vs* pregnant heifers in biting rate (55 *vs* 57 bites/minute), total grazing time (573 *vs* 612 minutes/day), ruminating time (319 *vs* 301 minutes/day) or idling time (546 *vs* 524 minutes/day). Nor did these parameters differ between sward heights. Estimates of organic matter (OM) intake per bite derived from ingestive behaviour parameters were not significantly different between the 11.0 cm and 7.0 cm pastures (0.23 *vs* 0.24 g OM/bite), but the heifers on the 11 cm sward had liveweight gains which were significantly (P<0.01) greater than those of heifers on the 7 cm sward (1.10 kg/d *vs* 0.80 kg/d). There were no significant differences in liveweight gain between pregnant and non-pregnant heifers. The results indicate that the target liveweight gains for once-bred heifers of 0.8 kg/day during mid-pregnancy can be achieved on ryegrass-white clover swards maintained at a sward height of 7.0 cm. Liveweight gains of 0.8 kg/day during mid-pregnancy will ensure once-bred heifers continue growing during pregnancy to reach a calving target liveweight of 420 kg.

Keywords Once-bred heifers, pregnancy, sward height, grazing behaviour, herbage intake, continuous stocking management.

INTRODUCTION

Many dairy farmers in New Zealand use a beef-breed bull over their dairy herds to complete mating after the main period of artificial breeding has finished. The resulting beef x dairy heifer calves can be mated at fifteen months to produce calves at two years of age in a once-bred heifer (OBH) beef production system (Morris *et al.*, 1991), rather than being sold as bobby calves or reared in a traditional heifer beef system. The progeny, sired by a terminal sire breed, can be sold as high value weaners or retained for beef production, while their dams are finished and sold as prime beef before thirty months of age.

Information on the feed requirements of beef x dairy heifers is required for feed planning and managing OBH systems to achieve production targets. Herbage intake of beef cattle can be estimated using chromic oxide (Cr_2O_3) controlled release capsules (CRC) (Adams *et al.*, 1991), while observations of grazing behaviour can be used to complement and explain indirect estimates of herbage intake and the production responses recorded (Jamieson, 1975; Hodgson, 1985). This paper reports the herbage intake, grazing behaviour and liveweight change of pregnant and non-pregnant heifers in a once-bred heifer system.

MATERIALS AND METHODS

The experiment was conducted at Massey University's Sheep and Beef Cattle Research Unit in May, 1990. Three replicates each of two fixed sward heights were prepared to the required heights over a six week period using non-trial cattle on plots of 1.11 ha to represent sward surface heights (SSH) of 11 cm (herbage allowance of *c* 2500 kg DM/ha) and 7 cm (*c* 1500 kg DM/ha). The sward surface heights were chosen to represent two extremes of autumn saved pasture. The characteristics of the swards are summarised in Table 1.

TABLE 1 Characteristics of the swards (± SEM) for each sward height treatment in May.

	Sward Height	
	7 cm	11 cm
Sward surface height (cm)	6.1 ± 0.7	10.5 ± 0.5 **
Compressed sward height (cm)	4.7 ± 0.4	8.6 ± 0.3 **
Herbage mass (kg DM/ha)	1650 ± 120	2670 ± 150 **
Botanical composition (%DM)		
Grass	57.2 ± 5.6	49.1 ± 5.6
Clover	6.3 ± 2.7	6.9 ± 2.7
Weeds	4.6 ± 1.7	2.4 ± 1.7
Dead	31.9 ± 3.6	41.6 ± 3.7
Ash (%)	13.7 ± 0.4	12.4 ± 0.4
In vitro digestibility (%)		
Dry Matter Digestibility	75.1 ± 1.0	75.3 ± 1.0
Organic Matter Digestibility	79.1 ± 0.8	79.1 ± 0.8
Digestible Organic Matter in Dry Matter	75.1 ± 0.9	69.3 ± 0.9

**P<0.01

Thirty-six 20-month old Hereford x Friesian (H x F) heifers of 360 ± 21 kg (mean ± SE) liveweight (LW) were randomly assigned within the replicates to one of the two sward surface heights. Six heifers, three pregnant and three non-pregnant, were assigned to each plot. Heifers were all treated for intestinal and external parasites with "Ivomec" on 9 May, 1990 (Day 0), and dosed with a single chromic oxide CRC (Nufarm Ltd, Auckland).

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The heifers were weighed before and after a 16 h fast on Day 0 and at the completion of the intake study on Day 22.

Herbage intake was calculated for each animal using the estimate of faecal output derived from the dilution of Cr_2O_3 in the faeces and the appropriate replicate *in vitro* herbage organic matter digestibility. Faecal sampling began on Day 8 and continued through to Day 17 in two five-day periods. At least three faecal samples were collected for each heifer in each period, dried, bulked on a dry weight basis across days and analysed by atomic absorption spectrophotometry for chromium content (Parker *et al.*, 1989). Intake estimates (per head per day) were expressed in terms of organic matter (OMI; kg/hd/d), dry matter (DMI; kg/hd/d) and megajoules of metabolisable energy (MJ ME /hd/d).

Handplucked samples of herbage, similar to that being grazed by the cattle in each replicate, were collected on Days 7, 8, 15 and 16 to assess herbage digestibility. After the samples were freeze dried, ground to pass a mesh of 1 mm and pooled by dry weight within replicates, each sample was analysed *in vitro* by the method of Roughan and Holland (1977). Six standards of known *in vivo* digestibility were run with each batch. Samples were analysed for percent ash, dry matter digestibility (DMD), organic matter digestibility (OMD) and digestible organic matter in the dry matter (DOMD).

Twenty-four hour behaviour studies were carried out during the period of faecal sampling on days 7,8,10 and 14. To ensure representative measurements of behaviour, each day was divided into four 6 hour periods. The first period began on day 7 at 0700 h and on subsequent days at 1300 h (day 8), 1900 h (day 10) and 0100 h (day 14). Observations were made from a vehicle parked in one replicate. This replicate was not used for observations because of excessive disturbance to the heifers. A spotlight was used during night hours (1800-0600) to establish animal identification and grazing behaviour. Animals were accustomed to the light and the observer. Three activities were recorded during each observation for each animal; grazing, ruminating and idling, as defined by Jamieson (1975). Each animal's activities were coded by letter once every ten minutes. Rates of biting (BR) during peak morning grazing times were measured during the period of faecal collection from Day 7 to Day 20. The time taken for 20 bites was used to compute bites/minute and OMI per bite for each animal.

Five heifers (14%) regurgitated their CRC but in one case the CRC was reinserted on the day it was found and the faecal data were subsequently inspected and used in the final calculations. The records of two heifers that had regurgitated their CRC before sampling were discarded, but the first week of records for the two heifers that lost capsules during the final week of sampling were analysed. Sward height, herbage mass and *in vitro* digestibility data were subjected to ANOVA but the unbalanced design for animals due to loss of CRC required a GLM (general linear model) procedure for faecal output data. Least square means and standard errors were calculated for these records. The interaction term SSH x pregnancy status was not significant and was therefore deleted from the model.

RESULTS AND DISCUSSION

Average fasted liveweights increased by 18 kg on the 7 cm sward and 24 kg on the 11 cm sward over the 22 day trial period. There were significant differences in daily liveweight gain between the two sward heights (P<0.05) (Table 2) but growth rates of pregnant and non-pregnant heifers were not significantly different (1.10 *vs* 0.90 kg /hd /day). A slightly lower growth rate in pregnant heifers could have been expected because of increased heat dissipation from the developing foetus (A.R.C., 1980).

The estimates of organic and dry matter intake were not significantly different between pregnancy status or sward height treatments (Table 2). The higher ash content of pasture in the 7 cm sward (Table 1) meant that the derived DMI was greater for this treatment than for the heifers on the longer pastures. The predicted energy intakes (MJ ME/kg DM) were higher than the values calculated from A.R.C. values for heifers of similar liveweight and rate of growth (Table 2). This discrepancy may reflect the fact that the digestibility of the herbage consumed was based on hand plucked samples which, although collected by closely observing heifers as they grazed, could have been biased towards more green and less dead and stem material. An overestimate of digestibility would increase the derived DMI values.

TABLE 2 The effect (±SEM) of sward height and pregnancy status on liveweight, liveweight gain and intake of 20-month heifers.

	Sward Height		Pregnancy Status	
	7 cm	11 cm	Pregnant	Non-Pregnant
Number of animals	18	16	16	18
Initial liveweight (kg)	359 ± 6	361 ± 6	356 ± 6	364 ± 6
Final liveweight (kg)	377 ± 7	385 ± 7	379 ± 7	384 ± 7
Liveweight gain (kg/d)	0.8 ± 0.1	1.1 ± 0.1*	1.1 ± 0.1	0.9 ± 0.1
OMI				
(kg/hd/d)	7.7 ± 0.4	8.1 ± 0.3	8.0 ± 0.4	7.9 ± 0.3
(kg/100 kg LW/d)	2.1 ± 0.1	2.2 ± 0.1	2.2 ± 0.1	2.1 ± 0.1
DMI				
(kg/hd/d)	8.8 ± 0.4	9.1 ± 0.4	8.9 ± 0.4	8.9 ± 0.4
(kg/100kg LW/d)	2.4 ± 0.1	2.4 ± 0.1	2.4 ± 0.1	2.4 ± 0.1
Energy intake (MJME/d)	87 ± 9	105 ± 9	103 ± 9	89 ± 8

*P<0.05

Protein content of the pasture may have been at a level which resulted in energy being diverted from liveweight gain to dealing with excess protein through the urea cycle (Holmes and Wilson, 1984). Although the N content of herbage was not measured in the present trial, Reid (1986) measured a N content in autumn/winter pasture of 31.6 - 35 g /kg DM which was 46% higher than in pasture grown in spring. The associated weight gains in cattle were higher in spring than in autumn at the same herbage allowance, even though there were no differences in the digestibility of pasture. Morris *et al.*, (1991) recorded a similar pattern of difference between spring and autumn liveweight gains in bulls and steers.

The effect of sward height on ingestive behaviour is shown in Table 3. There were no significant effects of pregnancy status or sward treatment on biting rate or total grazing, ruminating and idling times. However, there were slight differences in day ruminating (P<0.1) and day idling times (P<0.1) between SSH. Idling time during daylight hours was also less for pregnant than for non-pregnant heifers (148 *vs* 173 minutes; P<0.1). Heifers on the lower sward height ingested 0.24 g OM/bite compared with 0.23 g OM/bite for heifers on the longer sward. Hodgson (1977) reported that herbage intake was related to the size of individual mouthfuls of herbage and that animals could maintain daily herbage intake by increasing grazing time. However, no heifers on the 7 cm sward appeared to do so. The intake of 22.75 - 23.8

TABLE 3 The effect (± SEM) of sward height and pregnancy status on ingestive behaviour of 20-month heifers.

	Sward Height		Pregnancy Status	
	7 cm	11 cm	Pregnant	Non-Pregnant
Biting rate (bites/min)	54.3 ± 1.7	57.2 ± 1.6	57.1 ± 1.7	54.5 ± 1.6
OMI/bite (gOM/bite)	0.24 ± 0.01	0.23 ± 0.01	0.21 ± 0.01	0.24 ± 0.01
Grazing time (min/day)				
Day[1]	483 ± 14	508 ± 18	509 ± 15	482 ± 16
Night[2]	114 ± 14	80 ± 17	103 ± 14	91 ± 15
Total	597 ± 18	589 ± 23	612 ± 19	573 ± 20
Ruminating time (min/day)				
Day	48 ± 13	78 ± 10	63 ± 11	63 ± 12
Night	255 ± 14	239 ± 18	238 ± 15	256 ± 16
Total	333 ± 20	317 ± 26	301 ± 21	319 ± 23
Idling time (min/day)				
Day	159 ± 12	163 ± 15	148 ± 12	173 ± 13
Night	350 ± 16	399 ± 20	378 ± 17	371 ± 18
Total	509 ± 21	562 ± 26	526 ± 22	544 ± 23

[1] Day = 0600-1800 hr
[2] Night = 1800-0600 hr

mg OM/kg LW derived indirectly from Cr_2O_3 controlled release capsules was above the range reported by Jamieson (1975) for pregnant heifers (15.6 - 20.4 mg OM/kg LW), but no comparable information is available for New Zealand heifers. There is increasing evidence that intake per bite and the quality of herbage on offer, rather than total grazing time, determine intake and production. Bite size appears to be directly related to sward conditions and, in particular, to SSH and the density and morphology of the sward (Jamieson and Hodgson, 1979). Ryegrass and white clover pastures, where the greenest leaf is produced near the surface of the sward, allow the animals to select for leaf rather than stem or senescent matter and this may explain the better performance of heifers on the 11 cm sward in the present study. Thus, although differences in the botanical composition of the herbage offered in each treatment were not significant, heifers on the 11 cm sward probably achieved higher rates of liveweight gain because they were likely to be able to select a more highly digestible diet, avoid soil contamination and select more leaf than those maintained on the 7cm sward. In terms of the OBH production system the results indicate that heifers can achieve target liveweight gains of 0.8 kg /day during mid-pregnancy while continuously stocked on ryegrass-white clover swards maintained at 7.0 cm, and above 1.0 kg /hd /day if allowed an 11 cm sward. Liveweight gains of 0.8 kg/day during early to mid-pregnancy will ensure an adequate carcass weight is achieved in a once-bred heifer system.

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