The influence of sward height on the mechanics of grazing in steers and bulls

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ABSTRACT

The relationships between sward height, bite dimensions and bite weight for one-year-old Friesian steers and bulls were examined. Eighteen turfs of uniform area of each of 3 pasture heights (5, 10, 15 cm) were cut from a ryegrass dominant sward in early spring and placed in polystyrene boxes. Sward height was measured prior to grazing and swards trimmed where necessary so that height in the surface horizon was uniform. The turfs were offered over 3 days to 3 bulls and 3 steers in a latin square design so that each animal had 20 bites of a turf of each height daily. Turfs were weighed to the nearest 0.1g before and after grazing. The height of grazed tillers was measured and all pasture was then removed above this height. The turf was then reweighed. Bite weight, depth, volume and area were then calculated for the steers and bulls. There was no significant difference between bulls and steers in bite dimensions. Sward height, which determines bite depth, appears to be the major determinant of bite weight and consequently of daily intake. The technique described has proved to be extremely useful in the study of specific sward structures and their effect on intake.

Keywords Bulls; steers; turf; sward height; bite weight; bite dimension

INTRODUCTION

There is a little comparative information on the behavioural response of young bulls and steers to variation in sward characteristics. It has been well established that bulls can grow faster than steers of similar weight in the same environments (Spedding, 1969; Turton, 1969; Price, 1978; Veira, 1983). It is still unclear whether bulls achieve greater liveweight gain by more efficient conversion of food, greater intake or a combination of these factors. If such differences are due to intake, when grazing a similar sward, bulls could be expected to graze to lower residuals and possibly graze longer. Bite weight of steers and bulls in such circumstances should differ as bite weight is the major determinant of grazing intake (Hodgson, 1985a). Bulls may increase intake marginally by either grazing longer than steers and / or increasing their rate of biting.

A short-term indoor experiment was conducted in early spring to investigate possible differences in bite weight and bite dimensions between steers and bulls offered the same range of sward heights. Bite components made up of bite volume (the product of bite area and bite depth) and the bulk density of the grazed horizon were measured to identify the major determinant of bite weight.

MATERIALS AND METHOD

Six yearling Friesian cattle (3 steers and 3 bulls; mean live weight 250 kg) of similar age and genotype obtained from the Lincoln College dairy farm were placed in individual pens and identified as S1, S2, S3 for steers and B1, B2, B3 for bulls.

Eighteen turfs of uniform area (0.17 m2; L) of each of 3 pasture heights (5, 10 and 15 cm) measured with a HFRO sward stick were cut (soil depth 15 cm) daily from a ryegrass dominant sward in early spring and placed in polystyrene boxes (dimensions 55 x 30 x 15 cm). Swards were wedged into the box with soil so that they did not move or disintegrate during grazing.

A rectangular grid (60 x 40 cm) mounted on adjustable tripod legs was positioned at the desired height above the turf. Stiff wires were then threaded through guide holes at 2 cm intervals from one side of the grid to the other causing a minimal disturbance to the sward so that material above the wire could be removed by clippers and a vacuum cleaner. Sward height was measured prior to grazing with a ruler. Turfs were trimmed where necessary so that the surface horizon was uniform

at or about the desired grazing height (either 5, 10 or 15 cm). Turfs were offered over 3 days to 3 bulls and 3 steers in a Latin Square design so that each animal had 20 bites of a turf of each height daily. All cattle received good quality lucerne hay ad libitum which was removed only when turfs were offered.

Turfs were weighed to the nearest 0.1 g pre (W1) and post (W2) grazing (Sartorius Scales DV no: 5708004). Sward height pre grazing (H1) and post grazing (H2) was the mean of 20 values. Turfs were trimmed using the frame and technique described above at the grazed tiller height (H2). All pasture above the grazed tiller height (H2) was removed by using the frame, clippers and a vacuum cleaner. Samples of grass from this cut horizon were taken, weighed and dried at 100°C to constant weight for dry matter (DM) determination. The turf was again reweighed (W3).

The time spent grazing (20 bites) was recorded using a stop-watch. Grazing time for animals that failed to graze continuously for 20 bites were discarded.

Bite depth (H3), bite size (W4), bulk density of the grazed horizon (BD), bite volume (BV) and bite area (BA) were then calculated using the following equations:

$$H3 = H1 - H2$$
$$W4 = (W1 - W2) / 20$$
$$BD = (W1 - W3) / (L \times H3)$$
$$BV = W4 / BD$$
$$BA = BV / H3$$

The data were subject to analysis of variance using a Genstat package.

RESULTS AND DISCUSSION

Mean bite weight and bite dimensions for both steers and bulls are shown in Tables 1 and 2.

This trial was conducted in early spring when pasture quality differences due to height or stage of maturity would be expected to be small.

While steers tended to have have larger bite weights and bite dimensions than bulls at all sward heights, these differences are not significant (Table 1) and data for steers and bulls were combined (Table 2). No comparative data on bite weight and bite dimensions for entire and castrated cattle of similar live weight and genotype were found. If bulls do have higher intakes than steers the results from this short term study suggest they must graze longer rather than alter their bite dimensions and therefore bite weight, as rates of intake were similar.

Bite weight depends on the volume of the bite and the bulk density of plant material it encompasses, where bite volume is the vertical projection of bite area from the sward surface to the mean depth at which plant material was severed.

Bite weight increased with sward surface height despite a two-fold reduction in the bulk density of the grazed horizon. A three-fold increase in bite

TABLE 1 Mean bite weight and bite dimensions of yearling steers and bulls derived from 20 bites technique. ($P>0.05$ for differences between steers and bulls)

	Pre-grazing height (cm)					
	5		10		15	
	Steers	Bulls	Steers	Bulls	Steers	Bulls
Bite weight:						
fresh (g/bite)	2.20	2.10	3.0	2.70	3.60	3.20
DM (g/bite)	0.39	0.37	0.59	0.51	0.69	0.56
Bite depth (cm)	2.60	2.40	6.1	5.40	8.60	8.50
Bite volume (g/cm^3)	117.00	103.00	322.00	238.00	372.00	388.00
Bite area (cm^2)	45.20	42.40	52.20	43.90	43.00	45.80
Bulk density of grazed horizon (mg/cm^3)	19.60	20.30	9.60	10.30	9.60	8.80

TABLE 2 Mean bite weight and bite dimension of yearling Friesian cattle derived from 20 bite technique.

	Pre-grazing height (cm)		
	5	10	15
Bite weight:			
fresh (g/bite)	2.20	2.80	3.40***
D.M. (g/bite)	0.38	0.55	0.62***
Bite depth (cm)	2.50	5.70	8.60***
Bite area (cm^2)	43.80	48.30	44.40ns
Bite volume (cm^3)	110.00	280.00	380.00***
Bulk density of grazed horizon (mg/cm^3)	20.94	10.45	9.18***

***=Significant difference between 5 and 10 and 15 cm.

volume due entirely to an increase in bite depth (bite area remained unchanged) was sufficient to overcome the reduction in bulk density and ensure bite weight increased with sward height (Table 2).

Bite depths recorded at the three heights (Table 2) are similar to those in the literature for perennial ryegrass (*Lolium perenne*) swards grazed with dry and lactating cattle (Hodgson, 1985b; Hodgson and Forbes, 1980; Phillips and Leaver, 1986). On both the 5 and 10 cm swards, animals grazed below the pseudo stem level.

Bite weight was strongly influenced by bite depth with deeper bites resulting in heavier bite weights. This trend is similar to that reported in the literature for cattle (Hodgson, 1985b) and for detailed grazing studies with sheep (Penning, 1985). The effects of height and density on bite weight were found to be additional and independent by Black and Kenney (1984) in sheep.

There are no published data for cattle as detailed bite dimensions have not previously been measured. In this study there is an inadequate range of of heights and densities to isolate independent effects of height and density although height appears to be more important.

As discussed above, both bite weight and bite depth increased with sward height. Bite area was not influenced by either sward height or density as it remained unchanged as sward height increased from 5 to 15 cm and the bulk density of the grazed horizon decreased from 20.94 to 9.18 mg/cm3 (Table 2). In studies with sheep where height and density were not correlated (Burlison and Hodgson, 1985) bite area was not related to sward height or density. Further work with heavier cattle grazing spring ryegrass white clover swards also found bite area unchanged as sward surface height increased from 5 to 15 cm (Elliot, 1988). The significant changes in bite weight in this trial were due to increased bite depth which resulted in greater bite volume.

Bite weights estimated from weighing turfs before and after grazing are presented in dry matter (DM) terms and must be converted to organic matter (OM) for comparasion with published data (OM content has been assumed to be 88 % of DM). Adjusted bite weights (range 304 - 620 mg OM or 1.2 - 2.0 mg OM/kg lwt) fall within the range of published values for cattle on predominantly ryegrass pasture; 70 - 1610 mg OM or 0.3 - 4.1 mg OM/kg lwt (Hodgson, 1985a), 1.7 mg OM/kg lwt (Jamieson and Hodgson, 1979) and 3.0 mg OM/kg lwt (Zoby and Holmes, 1983).

Bite depth and bite weight values measured by this technique agree well with published values which suggests this grazing technique produces valid results.

Results from this trial suggest for the limited sward use that bite depth is the major determinant of intake. Sward surface height was the best predictor of bite depth. Further research is required where the seperate effects of height and density on bite weight can be assessed for a range of commonly encountered sward conditions.

The technique described has proved to be extremely useful in the study of specific sward structures and their effect on intake and provides

a means of identifying sward characteristics restricting bite depth. Furthermore bite variables can be related specifically to the vegetation grazed, avoiding the problems of trampling and fouling. In contrast to other published techniques for estimating bite dimensions (Burlison and Hodgson, 1985) this procedure does not require surgical modification of the animal.

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