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FEED INTAKE OF GRAZING FRIESIAN BULLS

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SUMMARY

The digestible organic matter intakes of two groups of 12 Friesian bulls stocked at 7.4/ha were estimated each month for 2 years by the chromic oxide dilution and difference techniques. There was no significant difference between the two methods. The average daily ME intake was 47.3 MJ. The annual requirement of a Friesian bull growing from 90 to 330 kg was 17 027 MJ of ME (1470 kg DM), a conversion efficiency of 6.9 kg DM/kg liveweight gain.

Seasonal intakes were 3.50, 3.21, 3.16 and 6.22 kg DM/bull/day for summer, autumn, winter and spring. Pasture allowances varied from 2.9 to 11.8 kg OM/100 kg LW/day in summer and autumn and from 2.1 to 4.6 in the winter and spring. *In vitro* organic matter digestibilities varied from 62 to 79% in summer and autumn and 67 to 82% in winter and spring. Daily liveweight gain was linearly related to allowance in winter and spring (0.6 kg/kg OM/100 kg LW), but quadratically related in summer and autumn with a maximum at 8.5 kg OM/100 kg LW/day. Organic matter digestibility was related to liveweight gain (0.036 kg/% OMD) in the summer and autumn but had no effect in winter and spring.

INTRODUCTION

Intensive beef production from pastures requires a knowledge of the seasonal demands for different levels of liveweight gain. It is also necessary to know to what extent pasture quality and age of animal affect the relationship between liveweight gain and pasture allowance.

Much debate has occurred over the effects of grazing activity and weather on the feed requirements of beef cattle. Early New Zealand and other grazing experiments reviewed by Joyce (1971) suggested that maintenance requirements of grazing cattle could be 100% greater than recommended in published feeding standards. A recent review by Joyce *et al.* (1975) gave estimates much closer to the U.K. and U.S.A. feeding standards.

The objectives of the experiment described here were:

- (1) To measure the annual pasture requirements of Friesian bulls at a high stocking rate.
- (2) To compare these requirements with New Zealand and other feeding standards.
- (3) To compare two methods of measuring grazing intake.
- (4) To relate liveweight gain to pasture and animal parameters.

EXPERIMENTAL

TREATMENTS

The experiment was part of a larger pasture management experiment, some results of which have been published by Brougham *et al.* (1975). An area of 3.24 ha was divided into two farmlets of equal area. Each farmlet was divided into eight paddocks by electric fences. These were grazed in strict rotation and further subdivided to give a daily ration of fresh pasture. Rotation length varied through the year as part of the management experiment (Fig. 1).

Twenty-four Friesian bull calves (7.4/ha) of 80 kg liveweight (LW) entered the experiment in November each year and were removed 13 to 16 months later at 360 kg LW. A lenient summer grazing pressure (L) was obtained by grazing only with calves from mid-January onwards each year. A high summer grazing pressure (H) was obtained by grazing calves ahead of yearling bulls until mid-March. All animals were weighed at 3-weekly intervals after a 16 h fast.

The pasture was predominantly perennial ryegrass and white clover, topdressed with 250 kg superphosphate/ha/yr. No pasture was conserved or topped, and no supplementary feed used. Treatment effects on pasture and animal production will not be discussed in detail in this paper.

INTAKE

Faecal output of individual bulls was measured by the chromic oxide dilution technique. Each animal was dosed twice daily with a gelatin capsule containing 10 g of chromic oxide for 17 days each month for 2 years. Faeces were collected at the time of dosing over the final 10 days. *In vitro* organic matter digestibility (OMD) and crude protein (CP) contents of ingested pasture were estimated from samples cut above grazing height from enclosure cages. These results were used to estimate digestible organic matter intake (DOMI).

Estimates of group intakes were also obtained by cutting thirty 0.1 m² areas to ground level with hand shears immediately before and after grazing. These measurements coincided with the sampling period for faecal output and were made on 6 to 12 days each month. All samples were washed to remove soil contamination.

For comparative purposes, DOMI estimates were converted to metabolizable energy (ME). The ME content of pasture was

estimated from the *in vitro* DOMD (digestible organic matter expressed as a percentage of the dry matter) and CP contents using an equation developed by Terry *et al.* (1974):

$$\text{DE (MJ/kg DM)} = 0.1233 \text{ CP} + 0.1705 \text{ DOMD} + 0.285 \dots (1)$$

ME and DOMD were predicted from DE and OMD using the equations:

$$\text{ME} = 0.815 \text{ DE} \dots (2)$$

$$\text{DOMD} = 0.92 \text{ OMD \%} - 1.2 \dots (3)$$

Observed intakes were compared with those predicted from feeding standards (MAFF, 1975; NRC, 1970) and New Zealand grazing trial data summarized by Joyce *et al.* (1975) in the following equation:

$$\text{ME (MJ/day)} = 0.143 \text{ LW} + 39.77 \text{ LWG} \dots (4)$$

Measured liveweight and liveweight gain were substituted into the appropriate equations. In the NRC (1970) standards, net energy requirements for maintenance and gain were converted back to ME by using efficiency factors that vary with pasture ME concentration. An extra 10% was added to the U.K. standards to allow for grazing activity as suggested by MAFF (1975).

RESULTS AND DISCUSSION

COMPARISON OF INTAKE MEASUREMENT TECHNIQUES

The relationship between DOMI measured by the chromic oxide dilution technique (Y) and the difference technique (X) was:

$$Y \text{ (kg/day)} = 0.30 (\pm 0.216) + 0.96 (\pm 0.079) X$$

$$r = 0.87, \text{ RSD} = 0.59, \bar{X} = 2.54 (\pm 0.15), \bar{Y} = 2.75 (\pm 0.08).$$

The equation is not significantly different from $Y = X$. The agreement of these techniques increases confidence in the accuracy of the intake measurements. In contrast, the high residual standard deviation emphasizes the lack of precision of current methods of measuring grazing intake. The difference method becomes increasingly inaccurate as single grazing utilization decreases and when soil moisture is high. The chromic oxide method requires animal handling facilities and liquid faeces in spring pose sampling problems.

TABLE 1: EFFECT OF SEASON ON MEAN PASTURE AND ANIMAL PARAMETERS
(Mean of 2 treatments and 2 years)

	<i>Summer</i>	<i>Autumn</i>	<i>Winter</i>	<i>Spring</i>	<i>Total</i>	<i>SEM</i>
Liveweight (kg)	124	173	171	251		±9.6
Liveweight gain (kg/day)	0.69	0.29	0.25	1.12		±0.12
Liveweight gain requirement (MJ ME/kg)	29.0	39.4	36.9	35.0		±7.9
Pasture intake (MJ ME/bull/day)	38.6	36.7	37.2	73.8	17 027 ¹	±4.62
Pasture intake (kg DM/bull/day)	3.50	3.21	3.16	6.22	1 470 ²	±0.40
Pasture allowance (kg OM/100 kg LW/day)	8.29	4.16	2.59	3.47		±0.43
Pasture ME content (MJ/kg DM)	11.0	11.4	11.8	11.9		±0.24
Pasture crude protein (% DM)	18.3	20.5	22.0	19.9		±1.44

¹ MJ ME/bull/year.

² kg DM/bull/year.

COMPARISON OF OBSERVED AND PREDICTED FEED REQUIREMENTS

Liveweights of bulls are shown in Fig. 1. Liveweight gain ranged from -0.24 to 1.81 kg/day and liveweight from 96 to 310 kg. Calves grazed at low grazing pressure from January to March 1975 had higher liveweights, but by November compensatory growth by calves on the high grazing pressure treatment had nullified this effect.

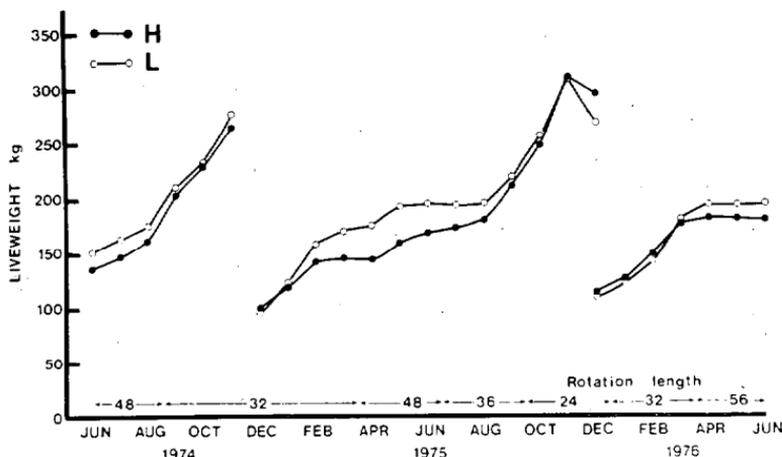


FIG. 1: Seasonal change in mean liveweight.

Intakes, measured by the chromic oxide technique, for the two treatment groups are shown in Fig. 2. Intakes predicted by NRC (1970) are included for comparison. In Table 1 the seasonal variations in the ME and crude protein content of pasture and pasture intake are shown. In the December-July period, intakes range from 20 to 40 MJ ME/bull/day. The low intakes in March and April result from increasing rotation length to build up winter pasture reserves. From August, intakes increased to maximum levels of 90 MJ ME/bull/day in October-November.

TABLE 2: REGRESSION INTERCEPTS AND COEFFICIENTS (\pm SE) FOR PREDICTED ME INTAKE REGRESSED ON MEASURED ME INTAKE

Feeding Standard	Intercept	Coefficient	RSD	Mean
NRC (1970)	0.57 (± 4.19)	+0.92 (± 0.08)	11.5	43.9 (± 1.60)
MAFF (1975)	3.44 (± 4.24)	+0.88 (± 0.08)	11.7	45.1 (± 1.62)
Joyce <i>et al.</i> (1975)	3.98 (± 4.40)	+0.97 (± 0.09)	12.1	49.8 (± 1.68)
Chromic oxide method				47.3 (± 2.74)

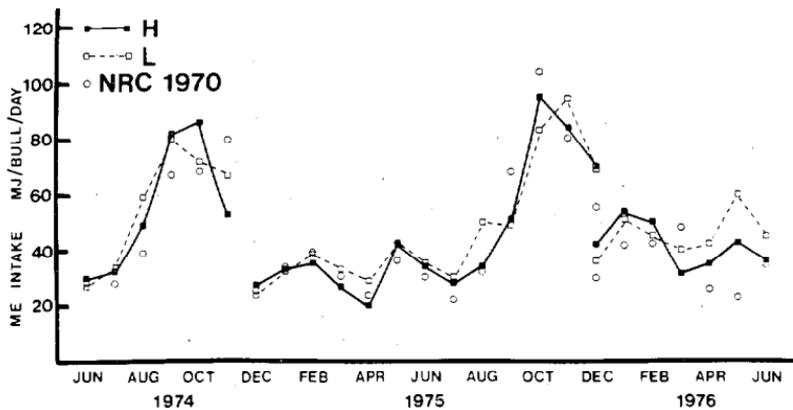


FIG. 2: Seasonal change in mean ME intake and intakes predicted by NRC (1970) feeding standards.

The relationship between intakes predicted by various feeding standards and those measured are summarized in Table 2.

There was no significant difference between the experimental intakes and those predicted from NRC (1970), MAFF (1975) and Joyce *et al.* (1975). This suggests that grazing activity and weather conditions had little effect on feed requirements in this experiment.

The ME content of pastures was predicted to be 11.0, 11.4, 11.8 and 11.9 MJ/kg DM in summer, autumn, winter and spring. These are 5 to 10% higher than the values assumed by Joyce *et al.* (1975) for spring (11.3) and other (10.34) pasture. Such variation could be an important source of error when using the above feeding standards.

The seasonal requirements for liveweight gain are shown in Table 1. They were calculated after subtracting a constant maintenance requirement of 0.143 MJ ME/kg LW/day (from equation 4). The ME requirement for liveweight gain is similar in winter and spring. This result is unexpected because both MAFF (1975) and NRC (1970) predict a 65% increase in requirement given the higher spring liveweights and gain. This anomaly may result from either increased winter maintenance requirement or an altered relationship between ME intake and liveweight gain in spring as suggested by Joblin (1968).

Multiple regression analysis has been used by a number of New Zealand experimenters to predict maintenance and liveweight gain requirements (Joyce *et al.*, 1975; MacLean *et al.*, 1970).

Some of these have given maintenance requirements 100% greater than published feeding standards (e.g., MacLean *et al.*, 1970). Joyce (1971) reviewed some New Zealand and overseas grazing experiments and concluded that maintenance requirements in published feeding standards were too low for New Zealand conditions. In a later, more detailed review of New Zealand work, Joyce *et al.* (1975) obtained maintenance and liveweight gain requirements similar to the NRC (1970) standards and only slightly higher than ARC (1965). Multiple regression analysis was not used in the present experiment because of the small range of liveweight and gains in some seasons.

FEED REQUIREMENTS FOR BULL BEEF SYSTEM

Table 1 shows the seasonal and annual ME and DM requirements for heavily stocked Friesian bulls. A bull growing from 90 to 310 kg LW over 12 months requires 1470 kg DM; 40% of this was supplied in spring and approximately 20% in each of the other three seasons. MacLean *et al.* (1970) studied a similar system, and their intake data suggest 2575 kg DM/yr would be required for the same weight range. In their trial, 50% bulls and 50% steers were used and some hay and silage were fed, but it is unlikely that these factors could cause such a large difference.

In the present experiment a stocking rate of 7.4/ha gave 1630 kg LWG/ha/yr with a requirement of 11 200 kg DM (6.9 kg DM/kg LWG). The fact that the experimental area has produced 2000 kg LWG/ha/yr from 13-14 000 kg DM as measured by a frame enclosure technique (Brougham *et al.*, 1975) further supports the accuracy of the intake measurements.

The results suggest that either the NRC (1970) or MAFF (1975) feeding standards can be used to plan beef production from pasture. However, the errors associated with measuring grazing intake and the ME content of pastures mean that some small safety factor should be added to these standards.

RELATIONSHIP OF GAIN TO ALLOWANCE AND DIGESTIBILITY

The seasonal variation in *in vitro* OMD for both treatments is shown in Fig. 3. It follows a similar pattern to that described by Hutton (1962) and Rattray (1977). Levels of seasonal relative pasture allowance are presented in Table 1. They varied from 2.9 to 11.8 kg OM/100 kg LW/day in summer and autumn, and from 2.1 to 4.6 kg OM/100 kg LW/day in winter and spring.

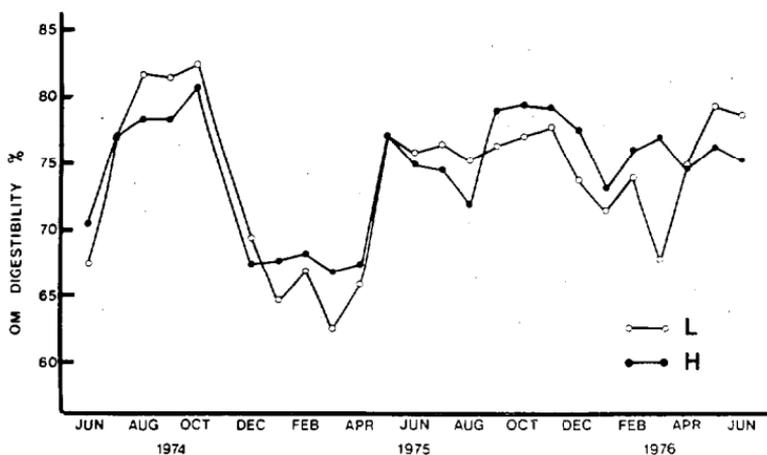


FIG. 3: Seasonal change in organic matter digestibility.

Multiple regression analysis was used to relate liveweight gain (LWG) to pasture allowance (A) and OM digestibility (D) on a seasonal basis. The winter and spring equations were not significantly different and were therefore combined, as were the summer and autumn ones. The equations were:

Winter-spring

$$\text{LWG} = -1.13(\pm 0.257) + 0.60(\pm 0.082)A \quad (n = 28, R^2 = 0.67, \text{RSD} = 0.32)$$

Summer-autumn

$$\text{LWG} = -3.60(\pm 1.13) + 0.41(\pm 0.12)A - 0.024(\pm 0.008)A^2 + 0.036(\pm 0.012)D \quad (n = 24, R^2 = 0.55, \text{RSD} = 0.25)$$

These equations are plotted in Fig. 4 to show how the relationship between liveweight gain and allowance may be affected by season, animal age and digestibility. The effects of season and animal age are confounded because only young bulls grazed summer-autumn pasture and only older animals winter-spring pasture. Animals on summer-autumn pasture had a curvilinear response to increasing allowance with a maximum at 8.5 kg OM/100 kg LW/day. Hodgson *et al.* (1977) reported maximum intakes at a sward height of 40 to 45 cm, with declining values above and below. A similar relationship between gain and allowance was obtained by Marsh (1977) for 6-month-old steers grazing summer pasture of 70 to 75% OMD.

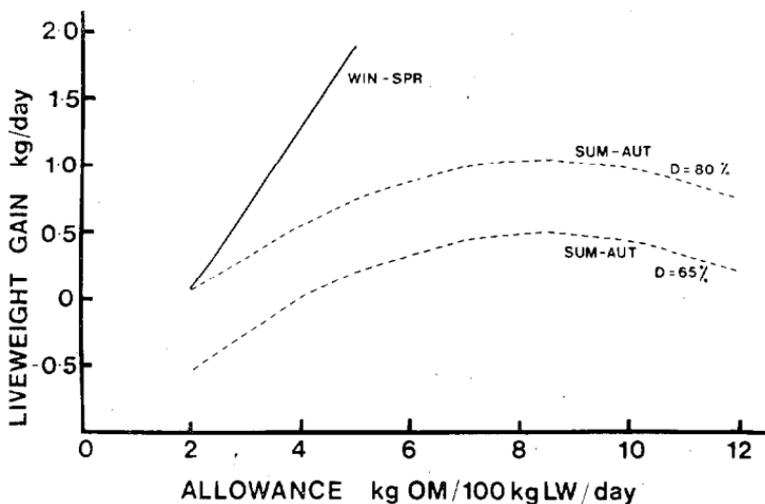


FIG. 4: Relationship between liveweight gain and pasture allowance.

There are few estimates of the effect of digestibility on gain, but the value of 0.036 kg/% OMD for summer-autumn pastures is within the range of 0.024 to 0.054 predicted by Hodgson *et al.* (1977) from intake and allowance relationships.

Older bulls on winter and spring pasture gained 0.60 kg/kg OM/100 kg LW, a greater response than young bulls and with no curvilinear effect. There was no effect of OMD on liveweight gain for winter-spring pasture in the 67 to 82% range compared with the significant effect on summer-autumn pasture from 62 to 79%.

These results have important implications for the grazing management of young stock on summer-autumn pastures. Offering increased allowances above about 9 kg OM/100 kg LW/day did not increase liveweight gains. High liveweight gains (0.8 kg/day) will be obtained only if pasture OMD ingested is >75% and allowances are optimal. Offering very high allowances to encourage selective grazing would be agronomically unsound and may not increase diet digestibility because of increased stem and dead matter.

Provision of highly digestible summer pasture might be obtained by improved summer-active pasture varieties, a leader-follower grazing system or mechanical topping.

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