
VOLUME 62 2002

THE FEED INTAKE OF FRIESIAN DAIRY BEEF ANIMALS

K. S. MACLEAN, J. P. JOYCE and P. V. RATTRAY
Ruakura Agricultural Research Centre, Hamilton

SUMMARY

Digestible organic matter intakes (DOMI) were measured over a 9-month period, divided into 4 sub-periods, on free-grazing 4- to 15-month-old Friesian dairy beef steers and bulls stocked at rates of 1½, 2 and 2½ per acre. Faecal outputs were estimated using the chromic oxide grab sampling method and these were checked using the total collection method on bagged steers. DOMI were calculated from faecal outputs of individual animals and the *in vitro* digestibility of pasture samples.

Levels of feed intake ranged from 77 to 98 g DOMI/kg $LW^{0.75}$. The utilization of DOMI for liveweight gain (LWG) was 5.8 to 6.7 kg DOMI/kg LWG.

An attempt was made to relate DOMI to LWG and $LW^{0.75}$ using multiple regression analysis. Partitioning of DOMI was poor except in the first and possibly the fourth period because of little variation in either $LW^{0.75}$ or LWG between individual animals.

THE NUMBER of dairy type cattle being used in New Zealand for young beef production has greatly increased over recent years yet little information exists on either the feed intakes or feed requirements of grazing traditional beef or dairy beef animals. Relatively little is known of their feed conversion efficiency compared with other forms of livestock.

This paper describes an experiment where an attempt has been made to measure the feed requirements of Friesian dairy beef animals. The present work is part of a study briefly reported by Joyce and Rattray (1969).

EXPERIMENTAL

ANIMALS

Fifty-four artificially bred Friesian cattle were available — half were entire males and the remainder castrated when weaned at 8 weeks of age. Fourteen were stocked at a rate of 1½ beasts per acre, eighteen at 2 per acre and twenty-two at 2½ per acre. The average liveweight at the commencement of the trial in October 1968 was 77 kg (8 weeks of age) and varied for the different groups between 320 and 450 kg at slaughter in November-December, 1969.

Management

Each group was strip-grazed around separate 9 acre areas (six 1½ acre paddocks) with the speed of rotation around the paddocks being the same for all three groups. Surplus feed was conserved as either hay or silage and fed back on a group basis during periods of feed shortage in either hay racks or on a wintering pad. The highest stocking rate was not self-contained in terms of conserved feed and some hay or silage was brought in from outside the system to maintain cattle liveweights.

All animals were weighed at the end of each paddock grazing period (5- to 10-day intervals).

Pasture Measurement

Pasture availability, growth and disappearance during grazing were measured using grass cages and a clipping technique. Pasture cuts were made at the beginning of the grazing period and grass cages laid at the same time on similar adjacent uncut sites. At the end of the grazing period, further cuts were made both within and outside the grass cages. The pasture cut from within the grass cages was bulked within each paddock, dried, ground and analysed for ash, nitrogen and *in vitro* digestibility.

Intake Measurements

Fourteen animals from each group were dosed with 10 g Cr_2O_3 twice daily at 7.30 a.m. and 4.30 p.m. Grab samples were taken at the same time and bulked for individual animals over each grazing period. The accuracy of the grab sampling method of measuring the faecal output of free-grazing dairy beef animals was checked against the total faecal collection method using faecal collection bags on a sample of the animals.

The intakes of pasture DOM were calculated from the faecal output of individual animals and the *in vitro* digestibility coefficient of the pasture sample. DOM intakes of hay and silage were calculated from the direct measurement of DM intake on a group basis and concurrent *in vivo* digestibility measurements on wethers in metabolism crates.

RESULTS

Liveweight Gain

The growth rates of cattle in the three stocking rates used for intake measurements are shown in Fig. 1. The

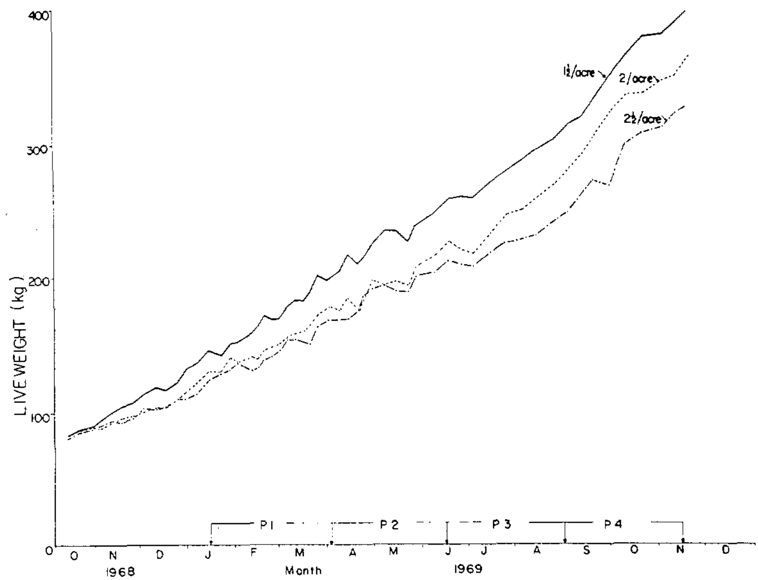

FIG. 1: *Liveweights of Friesian cattle stocked at rates of 1½, 2 and 2½ beasts per acre (1968-9 season). Faeces sampling periods shown as P1–P4.*

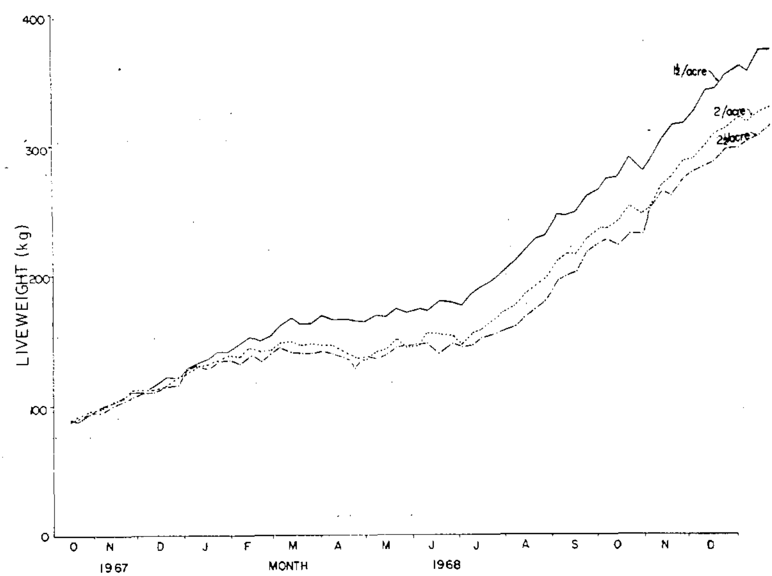

FIG. 2: *Liveweights of Friesian cattle stocked at rates of 1½, 2 and 2½ beasts per acre (1967-8 season).*

period over which grab sampling was carried out — February to November — was arbitrarily divided into four sub-periods (see Fig. 1).

No significant differences in growth rates at any stocking rates could be shown between bulls and steers.

Growth rates of cattle were somewhat atypical in this season, compared with the two previous years of the experiment (Joyce and Rattray, 1969), in that little depression in liveweight gain (LWG) occurred over the autumn and winter periods (*cf.* Fig. 2, growth rates of cattle in 1967-8 season).

Pasture Production

Levels of pasture production are given in Table 1. The seasonal distribution of pasture production is shown in Fig. 3. The higher levels of pasture production in September-November 1968 resulted in higher levels of pasture conservation as silage for winter feeding. This, together with the better pasture growth in March-April, 1969, conserved as autumn-saved pasture, ensured that the level of winter feeding was greater than in previous years. The final result was a better rate of winter growth and an average slaughter date two months earlier than in previous years.

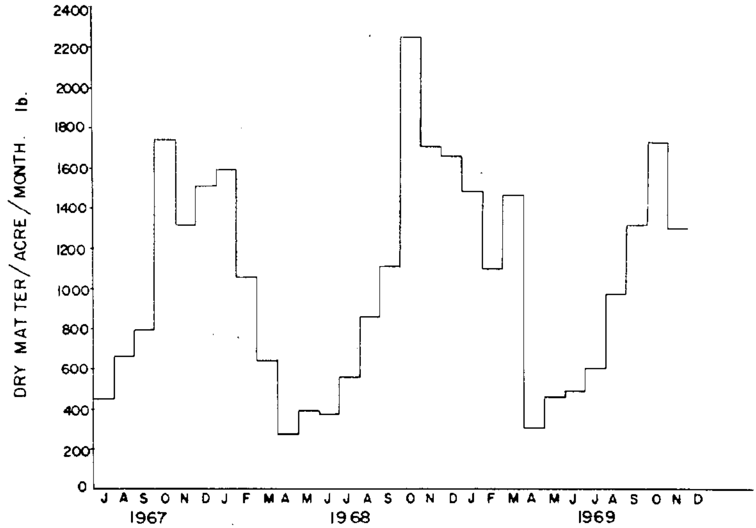

FIG. 3: *Levels of pasture production, averaged for all cattle areas, for the period 1967-9.*

Digestible Organic Matter and Dry Matter Intakes

DOM and DM intakes and initial and final liveweights are shown in Table 2. Despite differences in stocking rate of 40%, differences in apparent DOM intake were less than 7%. This was a reflection on the large amounts of conserved winter feed available for the two lower stocking rates and the extra feed brought in for the highest stocking rate from outside the trial. As a consequence of the small difference in DOMI, the difference in LWG between the highest and lowest stocking rate was only 10%. Most differences in LWG between stocking rates occurred in the three-month period prior to the start of grab sampling.

The utilization of DOM for LWG (Table 3) averaged over the entire trial period ranged from 5.8 to 6.7 kg DOMI/kg LWG or 9.4 to 11.4 (mean 10.5) kg DM/kg LWG. Best utilization of feed intake occurred in Period 4 when

Table 1: Pasture Production (lb DM/acre/year)

Cattle/acre	*1967-8*	*1968-9*
1½	11050	13830
2	9650	13540
2½	10990	12710

Table 2: Liveweight and Feed Intake per Animal (Data for period 15.2.69 to 10.11.69)

Cattle/acre	*Initial LW (kg)*	*LW Gain (kg)*	*DOM Intake (kg)*	*DM Intake (kg)*
1½	162.5	235.5	1,583	2,553
2	160.0	212.6	1,237	1,995
2½	136.3	202.7	1,435	2,315
All	153.0	216.6	1,412	2,277

Table 3: Utilization of DOM Intake (kg DOMI/kg LWG)

	1½/ac	*2/ac*	*2½/ac*	*All Groups*
Period 1	5.98	6.41	6.22	6.19
Period 2	8.32	8.28	12.91	9.44
Period 3	7.39	5.99	7.87	6.97
Period 4	5.83	4.76	4.87	5.13
All periods	6.72	5.82	7.08	6.52

pasture represented the sole diet (5.13 kg DOMI/kg LWG). The least efficient use of DOMI for LWG was during the June-September period, when silage represented the major part of the ration. At this stage 84% more DOM was required per kg LWG than in the September-November period. When feed intakes were related to metabolic body size ($LW^{0.75}$), levels of intake for individual groups ranged from 77 to 98 g DOM/day/kg $LW^{0.75}$. The regression relating DOMI on a metabolic body size basis to LWG, while highly significant, accounted for only 14% of the variation in DOMI ($r = 0.38, P < 0.001$).

Multiple Regression of DOM Intake on LWG and Average Body Weight

An attempt was made to relate the DOMI to LWG and $LW^{0.75}$ using multiple regression analysis. Results for the three combined groups are shown in Table 4. The partitioning of DOMI into fractions related to LWG and $LW^{0.75}$ was poor. Except in Periods 1 and 2, LWG did not account for a significant part of the variation associated with DOMI. There are two possible reasons for these results. First, silage was group fed during the major part of Periods 2 and 3. This meant it was necessary to assume identical intakes of silage and hence faecal output originating from silage for all animals in each group. Secondly the ranges of LWG within each group and between groups were extremely small during each period.

Of the twelve regression coefficients for individual stocking rate groups in the four periods, only six of those relating DOMI to LWG were above 1.60. All twelve regression coefficients relating DOMI to $LW^{0.75}$ fell within the range of 0.05 to 0.08. The maintenance requirements of animals weighing 200 and 400 kg, estimated from the overall regression equations for each period, are compared

TABLE 4: MULTIPLE REGRESSION OF DOMI (kg/day) ON LWG (kg/day) AND AVERAGE LW ($kg^{0.75}$)

Period	*b′ (LWG)*	*b″ ($LW^{0.75}$)*	*SD of LWG*
1	2.01*** (± 0.52)	0.0601*** (± 0.0077)	± 0.184
2	0.13NS (± 0.62)	0.0833*** (± 0.0057)	± 0.096
3	0.43NS (± 0.41)	0.0723*** (± 0.0046)	± 0.107
4	0.75* (± 0.31)	0.0685*** (± 0.0058)	± 0.249

N.S. = Not significant
*, $P < 0.05$; ***, $P < 0.001$

TABLE 5: ESTIMATED MAINTENANCE REQUIREMENTS FOR CATTLE
Data from present and published experiments
(kg DOMI/day)

Source of Data	*200 kg LW*	*400 kg LW*
Present experiment:		
Period 1	3.2	5.3
Period 2	4.4	7.4
Period 3	3.9	6.5
Period 4	3.6	6.1
Holmes *et al.* (1961)	3.2	5.4
Hodgson and Wilkinson (1967)	3.5	5.9
Hutton (1962)	3.4	5.6

with other published estimates in Table 5. Except for Period 2, the estimated requirements of DOM for maintenance are in reasonable agreement with those previously published.

DISCUSSION

Before any intake measurements, determined indirectly in the field on free-grazing animals, can be related satisfactorily to rates of LWG and metabolic body size of the animal, two criteria should be satisfied. First, the methods used to estimate the feed intake of individual animals must be sufficiently accurate. Secondly, the methods of measuring LWG must be sufficiently precise to be related to the levels of energy and protein retention by individual animals. The chromic oxide method of measuring the faecal output of individual animals by grab sampling was checked in this experiment by total faecal collection using harnessed and bagged animals. Although these results have not been presented, the method appeared to be satisfactory under the prevailing experimental conditions. The *in vitro* digestion for determining OM digestibility, while being capable of being checked against standard samples, may have been at fault in that the samples used for *in vitro* digestion may not have been truly representative of the pasture material being eaten by the free-grazing animal. Although these samples were taken from caged areas, it is probable that, under a strip-grazing system, errors associated with the method were kept to a minimum.

The major problem associated with this experiment was that all animals tended to gain in liveweight at similar rates. While there was a satisfactory range in liveweights at the commencement of the measurement period, the LWG of animals in all three stocking rates tended to be very similar both within and between the three treatments.

The results of this experiment emphasize the importance of ensuring adequate rates of LWG throughout the lifetime of the growing dairy beef animal to ensure maximum conversion efficiency of pasture into meat. If it is assumed that the daily maintenance requirement of an animal is related to LW by the equation:

$$DOMI_{MR} = 0.065\ LW^{0.75}$$

and that 2.0 kg DOM are required for each kg LWG, then for an animal growing from 80 to 360 kg LW as the rate of LWG increases from 0.5 to 1.0 and to 1.5 kg per day the total maintenance requirement as a percentage of the total feed requirement falls from 79 to 65 and 55%.

It can also be calculated from the estimated requirements for maintenance and production that, to produce a 360 kg LW animal in 12 months from an 80 kg weaner, 1,912 kg of DOM are required. This would indicate that a pasture producing 5,900 kg DM per year (13,000 lb DM/yr) and having an overall pasture utilization of 90% (as has been found in the past three years of this experiment) should support 1.94 animals per acre producing 300 kg of net carcass weight per acre per year, a result which corresponds to the measured production of 302 kg net meat per acre averaged over the three-year period for animals stocked at a rate of 2.0 per acre on pasture producing 11,000 to 14,000 lb DM per acre.

In this experiment there was found to be a wide range in the feed conversion efficiencies of individual animals. For all the cattle the most efficient 25% of the animals averaged 8.3 kg DM per kg LWG and the least efficient 25% 12.9 kg DM per kg LWG. On this basis, if only animals of the same feed conversion efficiency as the top quarter were used, then 350 kg of net carcass weight per acre should be produced from a pasture growing 13,000 lb DM per acre per year compared to 230 kg meat per acre if only animals of the poor feed conversion efficiency were utilized.

Assuming a dressing-out percentage of 55% and a schedule price of $20 per 100 lb for beef, it is possible to calculate the feasibility of feeding barley and other concentrates to promote satisfactory economic LW gains over the winter period. If 2 kg of DOM are required per kg LWG, then barley, at 0.7 kg DOM per kg air-dry weight, would be required to be fed at a rate of 2.86 kg per day over and above the maintenance requirement to promote a LWG of 1 kg per day. If none of the barley was partitioned off to meet the maintenance requirement, then the break-even price for rolled barley on a feeding basis alone would be 8.47 cents/kg or 3.85 cents/lb — a figure slightly higher than the present price of 2.5 to 3.0 cents/lb.

REFERENCES

Hodgson, J.; Wilkinson, J. M., 1967: *Anim. Prod., 9*: 365.
Holms, W.; Jones, J. A. W.; Drake-Brockman, R. M., 1961: *Anim. Prod., 3*: 251.
Hutton, J. B., 1962: *Proc. N.Z. Soc. Anim. Prod., 22*: 12.
Joyce, J. P.; Rattray, P. V., 1969: *Proc. N.Z. Soc. Anim. Prod., 29*: 176.