
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

THE RELATIONSHIP OF PASTURE PARAMETERS TO LIVEWEIGHT GAIN OF HOGGETS ON NORTH ISLAND HILL COUNTRY

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SUMMARY

On steep hill country with second-class pasture, liveweight gain of weaned ewe lambs (LWG) was measured for 12 months after weaning in the first year and for 9 months in the second. It was then related to the following live pasture parameters: daily herbage allowance, herbage allowance, residual herbage, residual white clover and residual height. Fifteen farmlets were used to compare two rotational and one continuous stocking managements at five feeding levels.

LWG was low in summer although autumn ill thrift was not observed. Residual herbage related best to LWG, but the actual value associated with a given rate of LWG varied with season, twice as much being required in summer as in spring. Bivariate equations did not appreciably improve the fit between pasture measurements and LWG. Knowledge of this relationship could be useful in feed budgeting and for day-to-day management decisions.

INTRODUCTION

Liveweight gain (LWG) of weaned lambs is often unsatisfactory on hill country of the North Island, and for this reason a trial was set up to study different managements of young sheep. This paper is a progress report on this work.

Height and herbage mass are measures of the ease of prehension of pasture by animals and potentially useful indicators of grazing pressure where stock are left in one paddock for many days or even weeks and where rate of pasture growth is unknown. But sole reliance on this type of parameter has obvious disadvantages. For example, at low levels of herbage mass or height, small changes in residual live herbage can result in large changes in LWG (Fig. 1). Thus the use of a quantity term such as daily herbage allowance may improve the assessment of feed availability.

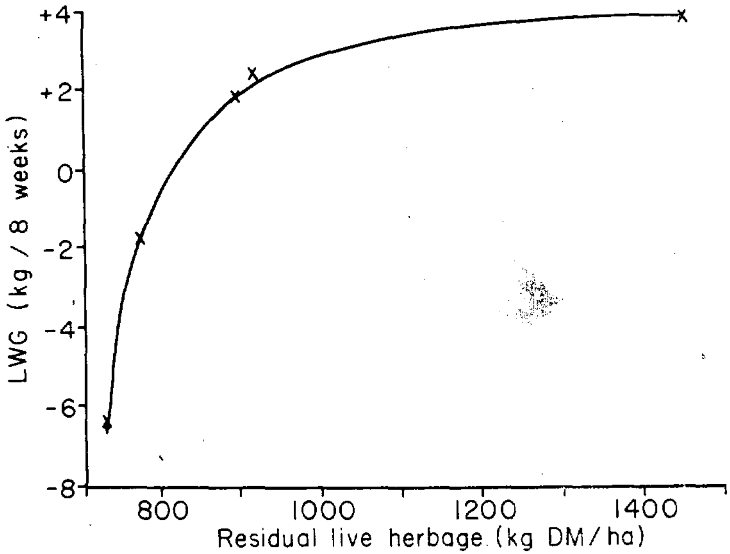

FIG. 1: *The relationship of LWG to calculated residual live herbage, good pasture, Ruakura (from Rattray and Jagusch, 1978).*

The drawbacks of using quantity terms alone must also be mentioned. Difficulty in prehension limits intake well before quantity. Rattray *et al.* (1978) found that at low levels of green herbage mass ewes were not successfully flushed in spite of high pasture allowances. On hill country, sheep and cattle often graze together, and pasture long enough for one may be too short for the other. Is it sound to calculate daily pasture allowance on the same basis for both (*i.e.,* to ground level) instead of making provision for the differences in their relative ability to harvest short herbage?

This experiment was designed to examine the relationship between the LWG of hoggets and measures of ease of prehension and quantity where the hoggets were grazed alone or with cattle and other sheep.

EXPERIMENTAL

TREATMENTS AND MANAGEMENT

Three managements were compared:

QR = quick rotation: twice weekly shifts over 10 paddocks.

SR = slow rotation: shifts every 10 to 14 days over three paddocks.

SS = continuous stocking: stock kept on the same paddock for 40 to 60 days.

These treatments were compared at five levels of feeding (Table 1). Weaned lambs (n = 24 to 60) were allocated to each farmlet in January and retained in the trial until early December. Extra grazers — lambs, hoggets, adult sheep or cattle — were used to maintain relative levels of pasture on offer during the year, and cattle or sheep followed hoggets in the rotation, when required, to maintain herbage quality. Rotation lengths ranged from 2 to 5 weeks depending on pasture growth rate. On SS farmlets, except at the "low" level of feeding, a few cattle were present for most of the year to control bracken and browntop. The size of farmlets ranged from 2 to 6 ha. Pastures were kept relatively short to maintain high digestibility and to control browntop and bracken fern.

TABLE 1: PASTURE MEASUREMENTS RELATED TO FEED LEVELS

Treatment	*Residual Live Herbage (RH) (kg/ha)*	*Residual Live Height (Ht) (cm)*	*Mean Daily Herbage Allowance (g DM/kg LW)*
Low	400 to 1 000	1.2 to 2.5	65
Low-Medium	600 — 1 200	2 — 4	80
Medium	700 — 1 400	2 — 5	100
High	800 — 1 600	2.5 — 5	150
Very High	1 000 — 2 000	3. — 8	200

PASTURE

Except for two farmlets with rolling contour, the area was hilly or steep. Generally, ryegrass and white clover contributed slightly more than 50% of the green herbage, but *Lotus hispidus*, browntop and moss were prominent.

In the rotation treatments, herbage samples were cut at ground level before and after grazing and dissected into live and dead matter, and the live matter samples were further dissected into white clover, ryegrass and other species. On the SS treatments, herbage was cut fortnightly. At the same or at slighly longer intervals, herbage was cut at about 10 mm height for the determination of rate or herbage growth, using a pre-trim technique.

The mean height of the live herbage was also estimated, using mean height on a 25 cm^2 area on 60 sites on QR farmlets and on 120 sites on the SR and SS farmlets. The following herbage measurements, using the terminology suggested by Hodgson (1979), were related to LWG of the hoggets:

RH — Residual live herbage on QR and SR farmlets, and mean live herbage on SS farmlets (kg dry matter/ha).

Ht — Residual height of live herbage (QR + SR) or mean height (SS) in centimetres.

Trp — Residual live white clover (QR + SR) or mean white clover mass (SS) (kg/ha).

DHA — Daily herbage allowance; grams of herbage at beginning of grazing plus herbage accumulation during grazing per kilogram of hogget equivalent per day.

CH — Herbage allowance; grams of mean live herbage mass at any one time per kilogram of hogget equivalent.

In calculating CH for the SS treatments, cattle were ignored because it was considered that by lowering the level of herbage mass their influence on CH was already taken into account. Thus CH was commonly 8 to over 10 times larger on SS than on QR farmlets, but the range of DHA was similar on all managements.

Hogget equivalents were calculated by converting individual animals grazing with hoggets by the relationship:

$$\text{Hogget equivalent per animal} = \frac{(\text{mean estimated weight of animals other than hoggets})^{0.75}}{(\text{known mean weight of ewe hoggets})^{0.75}}$$

In calculating DHA for the QR and SR treatments, herbage grown during grazing had to be estimated from the data obtained on the SS farmlets. This and the general variability of pasture on hill country may have introduced large errors into all estimates. Drenching was carried out at 3-weekly intervals from December to mid-June.

RESULTS AND DISCUSSION

REGRESSION EQUATIONS

The response of LWG to single herbage variables was described adequately by log transformation:

$$\text{LWG} = \text{b} \ln x - a \qquad (1)$$

where x = herbage variable.

The bivariate equation (2) was designed to allow for the negative interaction of ease of prehension (x_a) and for quantity (x_q) factors as found by Rattray *et al.* (1978) when flushing ewes.

$$\text{LWG} = b\ln(c\,x_a + x_q) - a \qquad (2)$$

A weighting parameter c was introduced to test which weighting ratio of x_a and x_q gave the best fit. Alternative bivariate equations were not tried.

Pasture Measurements and Liveweight Gain

The results of "overall" regressions only are shown, partly for the sake of simplicity and partly because the "pooled within management" analyses did not consistently improve the fit.

Table 2 shows the correlation coefficients for the overall regression analyses (n = 15) for six separate seasonal periods.

TABLE 2: REGRESSIONS OF LWG UPON RESIDUAL EASE OF PREHENSION AND PASTURE QUANTITY MEASUREMENTS (r or $R \times 100$)

	Univariate					*Bivariate*				*Comments*
Period	*RH*	*Ht*	*DHA*	*CH*	*Trp*	*RH DHA*	*RH CH*	*Ht DHA*	*Ht CH*	
Feb.-Mar. 78	79†	Not Done	75	77	Not done					V. dry, warm
Winter 78	85	89	66	−13	75	89				
Oct.-Nov. 78	81	48	56	89	54	83	94		91	
Jan.-Feb. 79	84†	74	53	62	73			81	76	Damp summer
Apr.-May 79	89	70	76	49	69			81	74	Damp, warm
Winter 79	69	67	69	36	74	72		72		
Median	82	70	67	55	73					

† Linear, untransformed; otherwise log transformed.
$r > 0.76$ was significant ($P < 0.1$). Bivariate correlation coefficients are shown only in cases of improvement over RH or Ht alone.

RH gave the best overall correlation with LWG (r = 0.82).

Ht by itself proved to be weakly related to LWG overall. It gave the best overall fit only in winter 1978 (May to August inclusive) when pasture had been bared by a persistent drought, and regrowth was slow.

Trp was the second best indicator to RH for LWG (r = 0.73). The relatively high correlation in winter 1979 does not mean that white clover, then a minor component of the sward, was critical to the rate of LWG at that time. Trp was simply an indirect measure of grazing pressure.

DHA did not correlate highly with LWG ($r = 0.67$). This is thought to be in part a function of the high spatial variability in herbage mass on hilly and steep land. Mean values of herbage mass commonly thought desirable on relatively uniform flat land may be impracticably high in hill country swards. For this reason ease of prehension is likely to be more severely limiting on hill country than on flat land and, conversely, a quantity factor such as daily herbage allowance less so.

CH was always highest on SS farmlets irrespective of all other factors. Thus the magnitude of the correlation coefficient (LWG/CH) in great part reflected the relative LWG of hoggets on the SS treatments. When this coefficient was high as in the dry summer 1978 and again in late spring, LWG was generally better on the SS treatments than on the rotational treatments. When this coefficient was low, as in late autumn 1979 and in both winters, the opposite applied. Possible reasons for these management effects will be discussed in a later paper.

Rate of LWG at Different Times of Year

Lambs with "starved" liveweights of 20 to 22 kg in January reached 30 to 35 kg by the end of November depending on treatment. But although the final weights of the animals on the two highest feed levels were very satisfactory, it proved difficult to achieve good LWG in both summers in spite of high levels of RH (Fig. 2) and seemingly adequate white clover and high DHA. The means of the three highest DHA were 165 and 320 g/kg hogget in 1978 and 1979, respectively. The means of the corresponding growth rates were 54 and 72 g/day. Thus, without a special effort of providing hoggets with very high levels of choice and feed allowance in summer, it was difficult to reach desirable liveweight targets in autumn. To maintain a modest LWG of 50 g/day required an estimated RH of 600, 1000 and 1200 kg/ha for winter, autumn and summer, respectively (Fig. 2).

In the two years of the experiment no autumn ill thrift was encountered. However, at all but luxury levels of RH or DHA, LWG was higher in winter than in autumn.

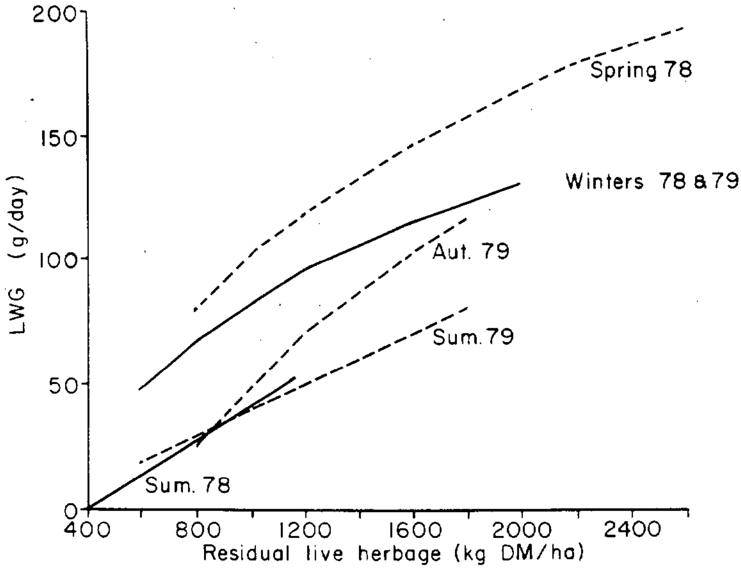

FIG. 2: *The relationship of LWG of hoggets in different seasons to residual live herbage.*

CONCLUSIONS

On hilly and steep land, RH correlated better with liveweight gains of hoggets than the four other parameters examined. The RH that needed to remain after grazing to obtain a given LWG varied with season. This fact and its superior correlation with LWG suggests that RH should be used to estimate available daily herbage allowance for any given target of liveweight gain — *i.e.*, available target DHA = (Initial herbage mass + growth) − target RH: where target RH = the estimated RH value for the target LWG.

However, in summer abundant and seemingly high quality herbage led to only moderate LWG. Thus with efficient control of internal parasites, low LWG in summer rather than autumn ill thrift may be the problem that needs to be overcome on the northern hills of the North Island.

ACKNOWLEDGEMENTS

To J. McLean, farm manager, Whatawhata, for his special effort in developing facilities; to L. D. Bell, P. Evans, K. Harray,

O. F. Parker, K. Prangley and M. Stanaway for help in the field; to the Herbage Laboratory for dissections and DM determinations; and to P. Hunt for the figures.

REFERENCES

Hodgson, J., 1979. *Grass and Forage Sci.,* 34: 11.
Rattray, P. V.; Jagusch, K. T., 1978. *Proc. N.Z. Soc. Anim. Prod.,* 38: 121.
Rattray, P. V.; Jagusch, K. T.; Smith, J. F., 1978. *Proc. Ruakura Fmrs' Conf.*: FPP 155.