The effects of various factors on the relationship between lamb growth rate and ewe milk production

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ABSTRACT

The relationship between lamb growth rate and ewe milk yield was examined using 213 ewe-lamb sets in 6 experiments. Factors included ewe breed, lamb rearing status, herbage allowance, lambing date and season.

Lamb growth and ewe milk production were greater for twin- than single-lamb groups, for Dorset than Romney ewe breeds and for late than early lambing dates. Ewe live weight showed the reverse trend. Regression parameters indicated lamb growth rate was generally more dependent on milk supply during the first 6 than during 12 weeks of lactation. The exception was Romney ewes with low milk production rearing twin lambs.

Comparisons among groups of regression coefficients and nominal ordinates (i.e. growth rate at low milk yield) showed that twin lambs were proportionately more dependent on pasture for growth than singles as were lambs reared by Romney compared with Dorset ewes. Similarly, a high herbage allowance, good seasonal pasture growth and a late lambing date caused a greater contribution of pasture to lamb growth. However, among groups there was much variability in the relationship and generally lamb live-weight gain was a poor indicator or ewe milk yield (approx. r^2=0.25 birth to 6 weeks and 0.20 birth to 12 weeks).

Keywords Ewe milk yield; lamb growth; sheep breeds; sheep nutrition; single lambs; twin lambs

INTRODUCTION

The relationship between lamb growth rate and ewe milk production is usually strongest during the early weeks of lactation when lambs are most dependent on milk for growth (Wallace, 1948; Coombe *et al.*, 1960; Peart *et al.*, 1975; Geenty, 1979). Consequently, lamb live weight gained early in life or at weaning, around 10 to 12 weeks, is often used as an indicator of ewe milk production. The New Zealand flock recording scheme "Sheeplan" includes lamb weaning weight in a ewe productivity index for genetic selection.

Information from sheep grazing high quality spring pasture has shown the intake of herbage by lambs from an early age can mean reduced dependence on milk for growth, particularly with low milk production or with twins (Geenty *et al.*, 1985). This suggests that use of lamb weight as an indicator of ewe milk production should be reviewed according to the effects of various factors on the relationship.

The experiments discussed here allowed investigation of the effects of breed, rearing status, herbage allowance, lambing date and season on the relationship between lamb live-weight gain and ewe milk production.

MATERIALS AND METHODS

Summary of Experiments

In 6 experiments during 1972-80 lamb live weight and ewe milk yield and live weight were measured. A summary of the experiments, showing treatment factors, numbers of animals and references is given in Table 1. In Expts. 2 and 5 numbers of lambs declined during weeks 6 to 12 because of comparative slaughter studies.

TABLE 1 Summary of experiments showing factors and numbers of ewe-lamb sets available from birth to 6 weeks (B-6) and birth to 12 weeks (B-12).

Experiment No.	Reference	Factors	No. of ewe-lamb sets B-6	B-12	Ewe breed	Lamb rearing status (S-single, T-twin)
1	Geenty (1979)	Breed	20	20	Romney (R), Dorset (D)	T
2	Geenty *et al.* (1985)	Breed	38	23	R, RxD, DxR, D	S
3	Geenty *et al.* (1985)	Breed/ Rearing status	50	50	R, RxD, DxR, D	S and T
4	Geenty (1986)	Lambing date/ Rearing status	30	30	D	S and T
5	Geenty & Sykes (1981)	Season only	17	10	D	S
6	Geenty (1983)	Herbage allowance	58	—	D	T

Animals and Management

Breed of ewe and lamb rearing status are shown in Table 1. Sire breeds were the same as ewe breeds in Expt. 1, terminal meat breeds in Expts. 2, 3, 5 and 6 (Southdown, Suffolk, Border Leicester), and Corriedale in Expt. 4.

In each experiment ewes and lambs rotationally grazed white clover-ryegrass dominant pastures with shift intervals of about a week except in Expts. 5 (daily) and 6 (3 to 4 d). With the exception of Expt. 6, post-grazing herbage mass was subjectively maintained above 1,200 kg DM/ha. Lambs were weaned at 6 (Expt. 6) or 12 (expts. 1 to 5) weeks of age.

Measurements

Measurements of milk yield and live weight were made each week during the first 4 weeks of lactation then at approximately 2 week intervals until 10 to 12 weeks of age. Milk yield was estimated by sample milking with machines following oxytocin administration (McCance, 1959; Corbett, 1968) with lamb suckling and weighing in combination in Expt. 6. Live weight was recorded 4 to 6 h off pasture and with twins is the total for both animals.

Statistical Methods

Ewe milk yields and ewe and lamb weights were subjected to analysis of variance. Linear regressions of lamb live-weight gain (kg/d, Y) on milk yield (kg/d, X) were calculated for the periods birth to 6 weeks and birth to weaning. Because zero milk yield has little biological relevance an adjusted nominal ordinate (a_1) was calculated at a nominal milk yield of 1 kg/d

$$a_1 = y\text{-}b\ (x\text{-}1)$$ (Fig. 1)

An index of efficiency (I) was calculated as

$$I = r^2/b$$

which gives the quantity of milk apparently utilised for each unit of lamb live-weight gain taking into account the strength of the relationship between lamb growth and ewe milk production.

RESULTS AND DISCUSSION

Group means for lamb growth rate, ewe milk production and ewe live-weight change during the period birth to 12 weeks (Fig. 2) show total lamb growth rate and ewe milk production was greater for twin- than single-lamb groups, for Dorset than Romney ewe breed groups and for late than early lambing groups. Ewe live-weight change showed the reverse trend. There was less variation between breed groups in lamb growth rate than in ewe milk production or live-weight change. These results indicate that between groups level of ewe milk production was inversely related to ewe live-weight change and substitution of pasture by lambs countered milk supply influences on lamb growth rate.

Means for lamb growth rate, ewe milk yield and ewe live-weight change, during the 6-week lactation period in Expt. 6, are given in Table 2. A similar trend was apparent here as in the other experiments with increasing lamb growth rate and ewe milk yield as

Group	Herbage allowance (kg DM/ ewe/d	Lamb no.	Lamb growth rate (g/d)	Ewe milk yield (kg/d)	Ewe live-weight change (g/d)
Low	2	19	307	1.99	-264
Medium	5	20	507	2.54	-151
High	8	19	528	2.66	-116
Standard deviation			75	0.463	130

TABLE 2 Twin lamb growth rate, ewe milk yield and ewe live-weight change during 6 weeks of lactation—Experiment 6.

TABLE 3 Comparison of regression parameters and efficiency index (I), pooled within groups, according to period of lactation, ewe breed, and lamb rearing status (R—Romney, D—Dorset, S—single, T—twin, e—early, l—late).

Ewe breed	Lamb rearing status	Experiments	Regresssion parameters birth-6 weeks			birth-12 weeks		
			b	a_1	I	b	a_1	I
R	S	2,3	0.096	0.249	1.5	0.081	0.284	1.6
RxD	S	2,3	0.051	0.253	2.6	0.014	0.295	1.5
DxR	S	2,3	0.064	0.244	5.8	0.065	0.264	5.6
D	S	2,3,4(l)	0.085	0.255	4.5	0.030	0.323	3.2
D	S	4(e)	0.021	0.282	14.5	0.028	0.279	18.7
D	S	5	0.065	0.242	2.9	0.081	0.248	3.9
R	T	1,3	0.028	0.396	1.2	0.108	0.442	2.6
D	T	1	0.116	0.350	6.1	0.101	0.446	4.1
D	T	3,4(l)	0.043	0.511	3.1	0.027	0.592	2.8
D	T	4(e)	0.103	0.303	2.7	0.073	0.420	1.6

herbage allowance increased. The relatively high ewe live-weight loss was possibly due in part to intensive measurement procedures for estimates of herbage intake and milk production by the ewes.

Regression parameters and efficiency indices according to period of lactation, ewe breed and lamb rearing status are given in Table 3. Various groups within the same treatment have been combined across seasons to give at least 10 ewes per group. Regression coefficients tended to be greater during the period birth to 6 weeks than birth to 12 weeks (Fig. 3) indicating a greater dependence of lamb growth rate on milk supply during the initial 6 weeks. A notable exception was twin lambs reared by Romney ewes where it appears that lamb dependence on milk supply increased beyond 6 weeks of age. Water turnover measurements in these lambs (Geenty *et al.*, 1985) indicated that up to 30% of their feed intake during the initial 3 weeks of life was herbage.

The efficiency with which milk was used for live-weight gain (Table 3) on average showed little difference between the 2 periods of lactation.

There appeared to be no consistent difference between Romney and Dorset breed-groups in regression coefficients or intercepts but on average, Romneys had a considerably lower efficiency index (1.8) than Dorsets (5.8). It appears that lambs suckling low milk producing Romney ewes utilised the milk more efficiently than those suckling Dorsets with higher milk production. Reciprocal crosses between these 2 breeds showed large differences in average efficiency; RxD being similar to Romney (2.0) and DxR similar to Dorset (6.1). Within the Dorset breed (Expt. 6) a similar phenomenon occurred where nutritionally induced low milk production gave an efficiency index of 4.0 compared with 6.5 at higher herbage allowance and milk production.

In the linear regression model used a decline in regression coefficients would generally be expected as the nominal ordinate (a_1) increased i.e. the increasing contribution of pasture is associated with a decreasing contribution of milk to lamb growth. The net effect is illustrated in Fig. 4 where these parameters are plotted for individual groups for the period birth to 6 weeks. There is a higher elevation for the average relationship for groups of twin than single lambs. However, if allowance is made for the doubled actual lamb live weight of twin-rearing ewes, the effect would be reversed as individual twins consume only about 60% of the milk consumed by singles and so substitute more pasture.

The increasing proportional contribution of pasture to lamb growth corresponds to movement down the broken lines in Fig. 4 i.e. decreasing regression coefficients and increasing nominal ordinates. This is illustrated by the L, M and H groups (Expt. 6) which, respectively, represent progressively increasing herbage allowances and probable pasture intakes by lambs. There is a suggestion of seasonal differences in the relationship with the single-rearing ewe breed groups in Expt. 3 being further down the line than their equivalents in Expt. 2. Rainfall and pasture growth during September and October were considerably greater in Expt. 3 than Expt. 2 and this may have meant improved pasture quality/quantity for lambs. Apart from these general trends experimental design and variable group sizes prevent examination of interactions among the various factors.

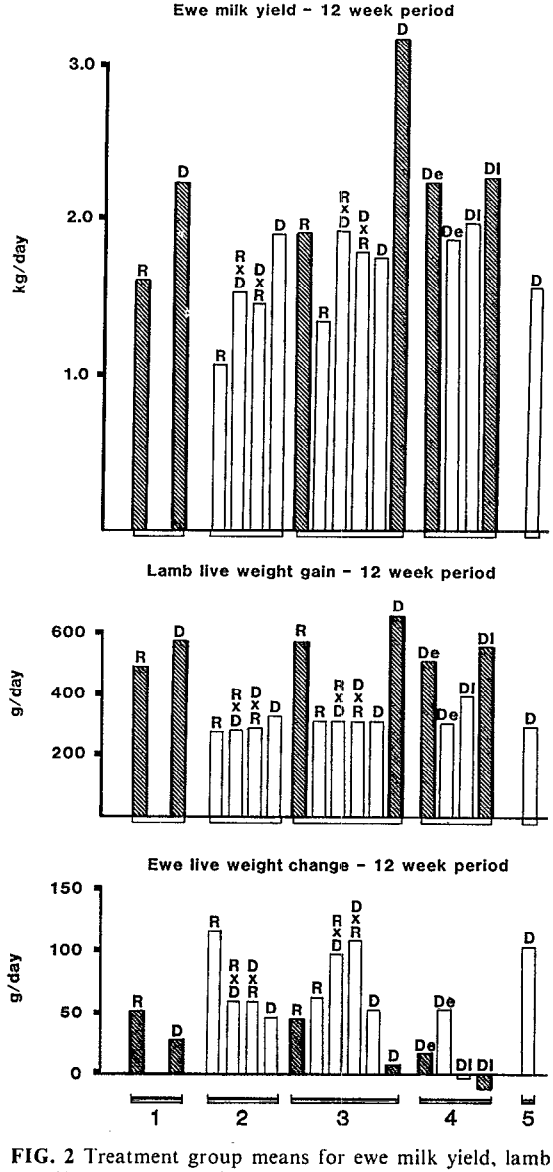

FIG. 2 Treatment group means for ewe milk yield, lamb growth rate, and ewe live-weight change during the period birth to weaning at 12 weeks. Groups with ewes rearing twins are shown by the hatched bars and experiment number is shown on the axis (see Table 1 for details).

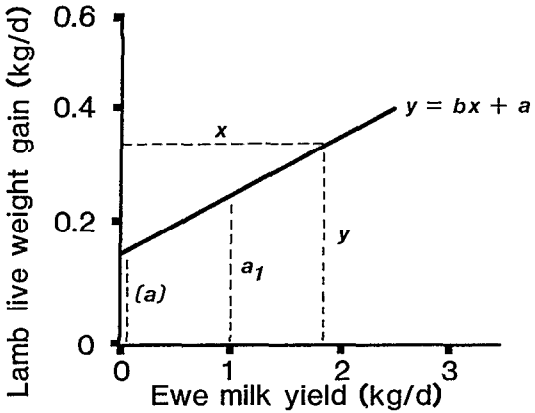

FIG. 1 The linear regression model used showing the nomial ordinate a_1.

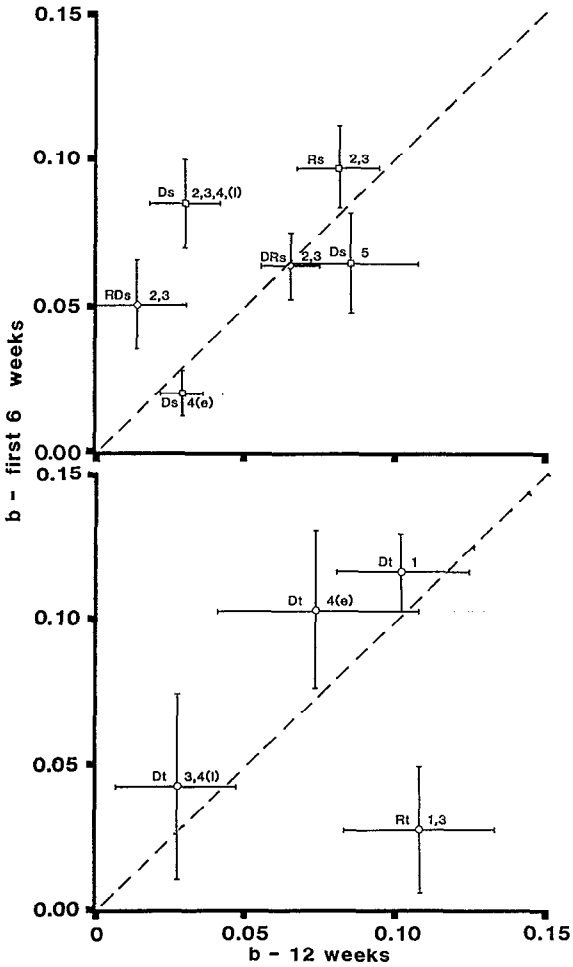

FIG. 3 The relationship between regression coefficients for the period birth-6 weeks versus birth-12 weeks. Vertical and horizontal bars are standard errors and treatment notation is shown in Table 3.

CONCLUSIONS

With sheep grazing high quality spring pasture the relationship is highly variable and generally lamb liveweight gain is a poor indicator of ewe milk production (approx. $r^2 = 0.25$ birth to 6 weeks and 0.20 birth to 12 weeks), particularly in low milk-producing breeds such as the Romney and with twins. Lambs suckling ewes with low milk production compensate by utilising milk more efficiently for growth and consuming more pasture than those suckling ewes with high milk production. The substitution or pasture for milk is greater in twin than single lambs and increases with increasing herbage allowance or in seasons with

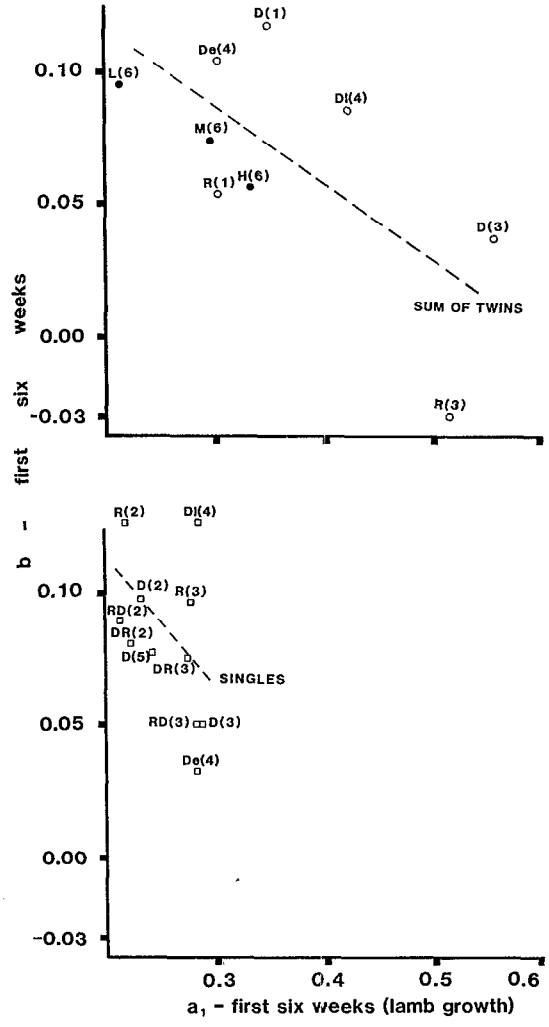

FIG. 4 The relationship between the regression coefficient birth-6 weeks and the nominal ordinate (a_1). Treatment notation is shown in Table 3.

relatively good pasture production. Other indicators of ewe milk production such as udder volume ($r^2 = 0.16$, Geenty *et al.*, 1982) and ewe live weight change (r^2 up to 0.25 within breeds—present experiments) appear equally unsatisfactory.

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