Effects of very low nutrition during pregnancy on live weight and survival of ewes and lambs

D.C. SMEATON, T.K. WADAMS

Whatawhata Hill Country Research Station
Ministry of Agriculture and Fisheries, Hamilton

H-U.P. HOCKEY

Ruakura Agricultural Research Centre
Ministry of Agriculture and Fisheries, Hamilton

ABSTRACT

Previous work showed that nutrition during pregnancy substantially affected ewe live weight, but that subsequent effects on ewe and lamb survival and weaning weights were small. However, farm advisers have suggested that industry ewes suffer more weight loss than in the above trials with serious consequences for ewe and lamb survival.

These problems were investigated in a trial involving 2 levels of nutrition in mid-pregnancy followed by 3 levels of nutrition in late pregnancy. Average conceptus-free live weights of the 6 groups at lambing ranged from 47.6 to 38.1 kg. The ewes had weighed 53 kg at the start of the trial. Ewes severely under-nourished throughout had an 86% survival during the trial period compared with 94% for the 5 better-fed groups. A line of ewes within the severely under-nourished group had, however, only 80% survival. There was a decline in the percentage of ewes lambing due to very low nutrition in mid-pregnancy (78 *v* 85%). Similarly, lambing percentage of those ewes lambing was affected (126 *v* 142%). There was some effect on twin lamb survival. Birth weight, particularly of twin lambs, was reduced by low nutrition but there was no effect on weaning weight.

Keywords Ewe survival; lamb survival; birth weight; level of nutrition; pregnancy.

INTRODUCTION

Pasture allocation to ewes before lambing is important in a spring lambing situation as it affects the amount of saved winter pasture available to the ewes in early lactation. Smeaton *et al.* (1983) and Smeaton and Rattray (1984) considered that pasture reserves were best utilised after lambing rather than before. This confirmed the results of Coop (1950), Monteath (1971), Rattray *et al.* (1982a,b) and Rattray and Jagusch (1978) in that while ewe and lamb weaning weights can be affected by nutrition level during pregnancy, the effects of nutrition during lactation are much greater. The results suggested that farmers should restrict their ewes until as near lambing as possible before set-stocking them.

Not tested in the above trials, however, was the situation where ewes are very light in late pregnancy (<40 kg conceptus-free), when they may be more prone to catastrophic outbreaks of metabolic disease; a situation which seems to occur in practice. This paper describes a trial designed to investigate this question.

MATERIALS AND METHODS

In a 2 x 3 factorial design, 400 Romney and Coopworth ewes were given 1 of 2 feeding levels (Table 1) in mid-pregnancy (L = low, H = high nutrition) followed by 1 of 3 feeding levels in late pregnancy (L = low, M = medium, H = high). A line of mixed-age ewes from a farmer were also included. At lambing, all ewes were set-stocked in 1 of 2 paddocks at 18 ewes/ha until weaning. These set-stocked paddocks contained average herbage mass levels of 800 kg DM/ha at both lambing and docking.

Ewes were x-rayed at the end of mid pregnancy treatments. Ewe live weight, lambing day, lamb weights, rank, ewe and lamb survival and herbage levels were recorded. Pregnancy toxaemia was diagnosed via the symptoms and procedures of McClymont and Setchell (1955). Analyses of data were carried out using the Genstat statistical package. Binomial data were analysed using logit models.

RESULTS AND DISCUSSION

Nutrition Levels

The low levels of nutrition of the ewes in both mid- and late-pregnancy (Table 1) were certainly lower than recommended (Smeaton, 1983). Because the pastures in this trial were very open, denser swards of the same height could have yielded 200 to 300 kg/ha higher.

Live Weights

At the start of the trial (11 May) the ewes weighed 53 kg and the results show (Table 2) that considerable weight loss occurred particularly in the low nutrition treatments. The ewes on the lowest nutrition level throughout the trial were about 3 kg lighter at lambing than similar ewes described by Smeaton *et al.* (1983) and well into the hypothesised danger zone where substantial losses might be expected to occur. At weaning these ewes (LL treatment) were still 1 to 2 kg lighter than all the other treatments which were reasonably similar although the late pregnancy treatment effects were still significant ($P<0.01$) — results similar to those of Smeaton *et al.* (1983) and Rattray *et al.* (1982a).

Lamb birth weight (particularly twins) was affected by the late pregnancy treatments only. Most authors (Curll *et al.*, 1975; Wallace, 1948; Coop, 1950; Joyce *et al.*, 1976; McClymont and Lambourne, 1958; Smeaton *et al.*, 1983) have observed some effects on lamb birth weight, with low nutrition during pregnancy reducing birth weight by up to 25% (Thomson and Thomson, 1948). Frequently, however, the effects are much less than this. In fact, Rattray *et al.* (1982a), despite a wide range of nutrition in late pregnancy, observed no lamb birth weight effects. Apparently, extreme differences (probably greater than generally achieved in practice) are required to cause significant effects.

The fact that nutrition during pregnancy had minimal effects on lamb weaning weight (Table 2) confirms the observations of others (Rattray *et al.*, 1982a; Coop, 1950; Smeaton *et al.*, 1983). The latter authors found nutrition in pregnancy to have a small effect compared to the effects of nutrition during lactation.

The absence of interactions between mid- and late-pregnancy nutrition confirms an observation by Wallace (1948) that nutrition effects in late-pregnancy were independent of ewe condition in mid-pregnancy. Smeaton *et al.* (1983) found that nutrition during the 2 periods interacted but that compared to the main effects, the interaction effect was relatively small.

TABLE 1 Residual DM (kg/ha) on the pasture breaks up to lambing.

Period	Treatment		
	Low	Medium	High
Mid to late preg.	200	-	250
Late preg. to lambing	180	290	330

Ewe and Lamb Survival

Ewe survival throughout the trial was virtually unaffected by the treatments except for the LL group in which 14% of the ewes were lost compared with 6% in the other treatments (Table 3). Most ewe losses occurred in the 4 weeks prior to and during lambing. Many of these deaths appeared to be due to pregnancy toxaemia. Other workers have observed few, if any, effects of low nutrition during pregnancy on ewe losses (Coop, 1950; Smeaton *et al.*, 1983; Rattray *et al.*, 1982a). In fact, excessive nutrition during pregnancy appears more likely to affect ewe losses due to lambing difficulties (Coop, 1950).

Most of the ewe losses in the LL treatment in the present trial occurred in the 'ex-farm' ewes. About 20% of these ewes in this treatment died compared with 11% for the station-reared ewes. The reasons

TABLE 2 Effects of treatments on ewe and lamb live weight (kg)

Variate	Date	Treatment						Main effect SED	
		LL[1]	LM	LH	HL	HM	HH	Mid preg.	Late preg.
Ewes									
End mid-preg.trt	25 July	42.6	42.1	42.4	46.6	47.0	46.6	0.3 ***	0.3 NS
Immed.pre-lamb	5 Sept	46.1	50.9	53.3	49.9	52.4	55.6	0.5 ***	0.6 ***
Est.conceptus-free[2]	5 Sept	38.1	42.9	45.3	41.9	44.4	47.6	0.5 ***	0.6 ***
Weaning	7 Nov	48.9	51.3	51.8	49.7	50.7	50.9	0.5 NS	0.7 **
Lambs									
Single birth wt	11[3] Sept	4.0	4.5	4.6	4.4	4.4	4.6	0.1 NS	0.2 *
Twin birth wt	11 Sept	2.9	3.6	3.3	3.1	3.4	3.8	0.2 NS	0.3 ***
Single wean wt	7 Nov	17.8	17.2	17.6	16.5	17.2	18.0	0.4 NS	0.5 NS
Twin wean wt	7 Nov	12.5	13.7	13.3	14.0	14.2	14.1	1.1 NS	1.4 NS

[1]LL = low nutrition mid-pregnancy, low nutrition late pregnancy, M = medium, H = high etc.
[2]assumes 10 kg conceptus contents at lambing in 80% of the ewes
[3]mean lambing day

TABLE 3 Effects of treatment on lambing rate, ewe and lamb survival (fitted proportions), and ewe efficiency (kg lamb weaned/ewe mated)

Variate	Treatment						Main effect SED[1]	
	LL	LM	LH	HL	HM	HH	Mid-preg.	late preg.
Ewe survival to weaning	0.86	0.93	0.97	0.94	0.94	0.94	0.02 NS	0.04 NS[2]
EL/EPL	0.80	0.77	0.78	0.89	0.85	0.82	0.03 *	0.04 NS
EL/EPL (X-ray prediction)	0.84	0.82	0.83	0.85	0.86	0.86	0.03 NS	0.03 NS
ELM/EL	0.27	0.24	0.27	0.36	0.48	0.43	0.04 **	0.04 NS
ELM/EL (X-ray prediction)	0.33	0.33	0.29	0.42	0.45	0.45	0.04 *	0.04 NS
NLW/NLB (all)	0.85	0.82	0.91	0.72	0.78	0.84	0.03 *	0.03 *
(singles)	0.90	0.89	0.93	0.82	0.78	0.88	0.04 NS	0.05 NS
(twins)	0.77	0.73	0.89	0.63	0.77	0.87	0.05 NS	0.05 †
Ewe efficiency	11.6	11.9	14.1	12.8	14.7	15.2	-	-

[1]approx. as they are estimated from non-linear logit models
[2]flock x late pregnancy treatment — $P<0.05$
†$P<0.10$

for this difference in resilience to low nutrition are not clear. However, the station sheep were possibly of higher genetic merit, were well reared and were also a relatively young flock. The 'ex-farm' ewes were consistently about 4 kg lighter than the station ewes and had come from a property where culling had been minimal while flock numbers were being built up.

Low nutrition in mid-pregnancy depressed the proportion of ewes lambing (EL/EPL) to 78% compared to 85% in the other ewes (Table 3). The effects on ewes lambing multiples/ewes lambing (ELM/EL) was even greater (Table 3). Lamb survival to weaning (NLW/NLB), expressed as the proportion of all lambs born (dead or alive), appeared to be enhanced by low nutrition in mid-pregnancy, whereas in late pregnancy low nutrition reduced it. These apparently contradictory results can probably be explained by the fact that the mid-pregnancy low-nutrition treatments contained fewer twin lambs as described above. Twin lambs generally are lighter than singles at birth and hence have a lower survival rate than single-born lambs almost regardless of other factors (Dalton *et al.*, 1980). Survival of single-born lambs in the present experiment was unaffected by the treatments but low nutrition in late pregnancy depressed survival of twins (Table 3).

The effects on EL/EPL and ELM/EL contradict other work (e.g. Curll, 1975), possibly because the treatments were extreme enough to affect foetal survival. X-ray data at the end of the mid-pregnancy period showed very little effect of that treatment on EL/EPL (Table 3) implying that those ewes that failed to lamb aborted in the last 40 days of pregnancy or died. The X-ray results, however, confirmed the mid-pregnancy effects on ELM/EL suggesting that resorption or loss of one of the twin foetuses due to mid-pregnancy treatment occurred while the treatment was being applied.

Similar effects on lamb survival have been demonstrated elsewhere in extreme situations (Wallace, 1948; Curll, 1975; Thomson and Thomson, 1948; McClymont and Lambourne, 1958). Most of these authors observed that survival of twins was affected more than singles as in the present trial, and that it was associated with effects on lamb birth weight.

Concluding Comments

These results demonstrate that it is possible to detrimentally affect ewe weaning weight, lamb birth weight (particularly twins), twin lamb and to some extent ewe survival, EL/EPL and ELM/EL by **severely** under-feeding ewes in mid- and late-pregnancy. These effects **only** occur under situations of extreme under-feeding such that ewe flocks normally weighing >53 kg at mating achieve conceptus-free weights of <42 kg in late pregnancy. Below this weight is a 'zone of catastrophe' where losses in ewe production are likely to rise steeply — particularly below 40 kg. For example, combining the above factors showed that the LL group in the present trial had a ewe survival rate of 86% compared with 94% for the better fed animals and that they produced only 11.6 kg lamb weaned/ewe mated (Table 3). The comparable figure for the better fed ewes was 13 to 15 kg lamb weaned/ewe mated — a 10 to 20% difference in output.

In must not be assumed from this trial that ewes must be well-fed throughout pregnancy at the expense of feed at lambing time. Even the best-fed groups in this trial had average conceptus-free weights at lambing of only about 45 kg and were fed

at herbage residual levels of only 250 to 330 kg DM/ha. Hence, the results support the recommendations of Smeaton and Rattray (1984) that ewes can sustain substantial weight loss throughout pregnancy down to average conceptus-free weights of 42 to 44 kg. However, some lines of ewes may be more susceptible to low nutrition than others.

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