THE INFLUENCE OF LEVEL OF NUTRITION DURING PREGNANCY AND LACTATION ON LAMB AND WOOL PRODUCTION OF GRAZING SHEEP

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Introduction:

THIS paper presents a summary of the results obtained from a series of trials conducted at the Kirwee Experimental Farm over the years 1946-48. The object of these trials was to determine the influence of nutrition, both before and after lambing, on the productivity of grazing sheep maintained under fat lamb producing conditions—productivity being measured in terms of ewe and lamb mortality, rate of lamb growth and wool production.

A review of the literature shows the inadequacy of our knowledge on this subject. The influence of level of nutrition during pregnancy in stall fed sheep has, however, been studied intensively. The work of Snell, Fraser and Thomson, Wallace, Barnicoat, Logan and Grant and Thomson and Thomson has emphasised the importance of good nutrition of the ewe during pregnancy and especially during late pregnancy in regard to lambing mortality, milk production and lamb growth. The numbers of sheep used in these trials have been small and, further, the nature of the feeding and environment has borne no resemblance to practical grazing conditions. The only field trials so far reported have been those of Underwood and his collaborators in Australia. They found evidence of improved lamb growth and lower pregnancy toxaemia losses as a result of good feeding during late pregnancy.

The influence of level of nutrition after lambing has not been specifically studied though Wallace, Barnicoat et al. have found a strong correlation between the food intake and the growth rate of lambs.

In regard to wool production a number of authors—Clunies Ross et al, Dumaresq, McMahon and Henderson—have shown annual fleece weight differences in grazing sheep of the order of 1 - 3 lbs. due to nutritional environment. Stall feeding trials by McMahon have shown 300% differences in annual fleece production between super-maintenance and sub-maintenance ewes. Marston has likewise shown similar differences in wool production of wethers by fortnightly clippings from delineated skin areas. However, these intensive stall-feeding trials have not been elaborated on a field scale with grazing sheep, and further, no attempt has been made to measure wool production in the three separate physiological stages of the ewe—the dry, pregnancy and lactation periods.

OUTLINE OF TRIALS

To fill some of the gaps in our knowledge on these subjects a series of nutritional grazing trials, falling into four different types, was conducted at Kirwee.

Type A. High and low planes of nutrition were maintained during pregnancy. As the ewes lambed they and their lambs were alternately switched to high and low planes which were continued until weaning. In this way four different treatments or groups were obtained, HH, HL, LH, and LL.

Type B. On the assumption that a high plane of nutrition during pregnancy was beneficial, groups of ewes were shifted from a low to a high plane of nutrition at various intervals, before lambing, in order to determine the optimum time for this improvement in nutrition.

Type C. Ewes were maintained on a low plane of nutrition throughout pregnancy. During the last month half of the ewes were given a concentrate supplement. After lambing all ewes were on a high plane.

Type D. A low plane of nutrition was maintained during the whole of pregnancy and differential high and low planes applied from lambing to weaning.

The ewes employed were selected in a store condition typical of the breeding ewes to be found on fat lamb farms in the autumn. Live weight gain was used as the objective criterion of level of nutrition. Weight gains of 20-30 lbs. during pregnancy were considered to be equivalent to a high plane of nutrition and a gain of —5 lbs. to +5 lbs. to be a low plane. Except for periods during the winter when supplements of hay, turnips and green feed were used, pasture formed the sole diet of the sheep. Improved pastures of perennial and short rotation ryegrasses with subterranean, white and red clovers formed the basis of the high plane, while deteriorated pastures of sweet vernal, browntop and hairgrass formed the low plane. At all times the type of sheep used and the feeding and management of them were related as closely as possible to practical farming conditions. The high and low planes were designed to simulate good and bad feeling typical of well managed and poorly managed farms.

In the data to be presented all ewes not weaning a lamb have been excluded while lamb weights have been corrected for age and sex ratio. All lamb growth and fleece weight data have been subjected to statistical analysis.

RESULTS

A. 1946 Trial

Three hundred 5-year-old Corriedale ewes, of initial weight 132 lbs., were used in this trial, giving 75 per group. The weight gains during pregnancy were high plane (HH & HL) +27 lbs., and low plane (LH & LL)+6 lbs. At weaning the weights (including fleece) were HH 149 lbs., HL 132 lbs., LH 139 lbs. and LL 125 lbs., showing that in the post lambing period the difference between HH and LL was maintained whereas HL and LH were intermediate, as expected.

The results are summarised in Table I.

TABLE I. SUMMARY OF A. 1946 TRIAL.

Group	Mortality of lambs	Weaning Weight Singles	Weaning Weight Twins	Fleece Weight
HH	11%	71.9	60.8	9.27
HL	14%	65.4	51.0	8.93
LH	10%	71.5	60.2	8.14
LL	12%	61.5	50.2	7.57

There were no significant differences between groups in ewe and lamb losses. The growth rates of the lambs showed significant differences due to the level of nutrition after lambing but no differences due to level of nutrition before lambing. On the other hand the fleece weight data showed greater effects due to pre-lambing than to post-lambing nutrition.

A. 1947 Trial

The 1946 trial was repeated the following year, using 250 4-year-old Corriedale ewes of mean weight 98 lbs. The live weight gains during pregnancy were high plane (HH & HL) + 21 lbs., and low plane (LH & LL) —4 lbs. At weaning the ewe weights (with fleece) were HH 109 lbs., HL 100 lbs., LH 97 lbs. and LL 90 lbs.

TABLE 2. SUMMARY OF A. 1947 TRIAL.

Group	Mortality of lambs	Weaning Weight Singles	Weaning Weight Twins	Fleece Weight
HH	18%	67.5	56.5	7.30
HL	23%	56.2	45.4	7.23
LH	16%	64.8	57.5	6.14
LL	26%	56.9	42.6	5.92

Lamb mortality was high this year and group differences indicated greater losses resulting from the low plane of nutrition after lambing. As in the A. 1946 trial the influence of level of nutrition before lambing on weaning weight of the lambs has been slight, whereas most of the group differences could be attributed to the post-lambing level. Fleece weights again showed the predominating effect of level of nutrition before lambing.

B. 1946 Trial

Two hundred and fifty 5-year-old Corriedale ewes were randomised into five groups of 50 ewes and raised from a low plane of nutrition to a high plane at intervals of 13, 10, 7, 4 and 1 weeks before the mean lambing date (Group I - V, respectively). After lambing all groups continued on a high plane. From an initial weight of 115 lbs. the weight gains to lambing varied from +37 lbs. to —10 lbs. At weaning all weights lay within 145 - 136 lbs.

TABLE 3. SUMMARY OF B. 1946 TRIALS.

Group	Mortality of lambs	Weaning Weight Singles	Weaning Weight Twins	Fleece Weight
I	21%	76.5	62.8	9.24
II	21%	83.4	69.6	8.41
III	12%	82.5	68.9	8.31
IV	17%	79.0	70.9	8.31
I	12%	80.6	73.0	8.17

The significant feature of this trial was the poor showing of Group I, probably due to excessive weight gain of the ewes. The ewe and lamb mortality was high and the lambs were the worst of all the groups. Between the remaining groups no significant differences were obtained in rate of lamb growth. The fleece weight data again showed the influence of pre-lambing nutrition, though the differences between groups were not consistent.

B. 1948 Trial

The 1946 trial was repeated in 1948 with 260 6-year-old Romney ewes. Five groups were raised from a low to high level of nutrition at intervals of 11, 7, 3, 0 weeks before lambing and 4 weeks after lambing. From an initial weight of 117 lbs. the gains to lambing ranged from +44 lbs. in Group I to +7 lbs. in Groups IV and V. Ewe weaning weights varied from 154 - 132 lbs.

TABLE 4. SUMMARY OF B. 1948 TRIAL.

Group	Mortality of lambs	Weaning Weight Singles	Weaning Weight Twins	Fleece Weight
I	12%	76.5	70.5	8.29
II	12%	76.7	66.7	7.70
III	8%	77.9	66.9	7.14
IV	10%	78.2	68.2	7.07
V	23%	77.6	63.0	6.58

The lamb losses were significantly higher in Group V in which the low plane was continued for 4 weeks after lambing. No differences were observed in the rate of growth of single lambs but in the twins the Group V lambs were clearly inferior. But between the first four groups no differences of any kind could be attributed to treatment. On the other hand the level of nutrition again affected fleece weight considerably.

Type C. Trials

In the C. 1947 trial 200 5-year-old Romney ewes were divided into two groups and maintained on a low plane of nutrition, losing 5 lbs. live weight in the first 4 months of pregnancy. During the last month of pregnancy the control group was maintained on the same low plane, while the other group was given a supplement of ½lb. of concentrate per ewe per day. After lambing both groups were placed on a high plane of nutrition. This trial was repeated in 1948 (C. 1948) with 130 6-year-old Corriedale ewes, increasing the supplement to 1 lb. of concentrate per ewe per day for the last month of pregnancy. In neither trial were any differences between groups observed in respect to ewe and lamb losses, rate of growth of the lamb and mean fleece weights.

D. 1948 Trial

One hundred and eighty Corriedale and 180 Romney ewes were maintained on a low plane until lambing with no weight gain. At lambing half of each breed was transferred to a high plane of nutrition and half remained on low. The differential feeding after lambing produced 20-30 lb. differences in weaning weight of the ewes, and 13-18 lb. differences in weaning weight of the lambs, thus showing the importance of post-lambing nutrition. On the other hand fleece weight differences amounted to only 0.37 lbs. in the Corriedales and 0.24 lbs. in the Romneys.

DISCUSSION OF RESULTS

1. Ewe and Lamb Mortality. The mean mortality of ewes throughout the trials was 4%. The number dying was so small that considerable caution must be exercised in interpreting any differences observed. However, two broad generalisations can be made. Firstly, the low plane of nutrition either before or after lambing did not cause an increase in ewe mortality. Secondly, the only large increases in ewe losses were obtained in high plane groups, in those where large weight gains occurred during pregnancy. Pregnancy toxaemia was not influenced by level of pre-natal feeding, though it should be added that very few deaths from this condition occurred in any sheep on the Kirwee farm during the three years concerned.

Lamb mortality amounted to 14% over all the trials. The significant features of this mortality were as follows:—

(i) A low level of nutrition during pregnancy alone did not increase lamb losses but a low level after lambing caused an increase in mortality, especially if it followed a low level during pregnancy.

(ii) Lamb losses were higher in those groups where the ewes made excessive weight gains during pregnancy.

2. Lamb Growth. The most striking feature of the lamb growth or weaning weight data has been the insignificance of pre-natal nutrition of the ewe, and the over-riding importance of nutrition after lambing. The latter accounts for most, if not all, of the differences between groups Highly significant differences in weaning weight have been obtained due to post-lambing levels but in no case was a significant difference due to pre-lambing nutrition observed.

The relative importance of pre-lambing and post-lambing nutrition is well exhibited in a comparison of the HL and LH groups in the Type A trials. In these groups the ewes commenced and ended the trials with similar live weights, yet the LH lambs were invariably much better than the HL lambs. In fact, the LH lambs were as good as the HH lambs and the HL lambs little, if any, better than the LL lambs.

Some explanation must be given for the complete failure in these field trials to confirm the observations made from stall feeding trials regarding the importance of good nutrition during pregnancy. Firstly, the levels of nutrition applied at Kirwee were generally not as extreme as those used in the stall feeding trials. It is considered that those applied at Kirwee relate more closely to practice. Secondly, under grazing conditions those sheep which have been fed poorly until lambing probably eat more after lambing than those which had been fed well before lambing. This is suggested by the convergence of ewe weights from after lambing till weaning. Thirdly, under grazing conditions there is a period of several weeks in the early summer when there is an excess of pasture growth. During this period the ewes and their lambs are able to wipe out any existing or potential differences which had been established by previous nutritional treatment.

3. **Wool Growth.** The difference in mean fleece weight between groups can be resolved into pre-lambing and post-lambing nutritional effects. The magnitude of these differences was consistently of the order 1-1½ lbs. and ¼-½ lb. respectively, which is equivalent on a per week basis to 0.09 and 0.03 lbs. For wool growth, the level of nutrition is therefore of much greater importance during pregnancy than during the lactation period.

We have the situation then, of two opposing factors in wool and lamb production. This is again best brought out in the HL and LH groups where ewe weights were the same at the beginning and end of the trial. The HL system of feeding gives fleece weights 1 lb. higher, but lamb weaning weights 10 lbs. lower, than the LH system.

4. The broad conclusions can therefore be made that, within the nutritional limits applied at Kirwee, the level of feeding during pregnancy is not important for lamb growth but is very important in wool production. In complete contrast to this, the post-lambing level of nutrition appears to be all-important for lamb growth but unimportant for wool growth.

For maximum efficiency of fat lamb production the results of these trials suggest that one should adopt an LH type of feeding programme. Time does not permit a discussion of ways and means of perfecting such a system but two contributions might be made. Firstly, emphasis is thrown upon the conservation of high quality feed such as autumn saved pasture and greenfeed for immediate post-lambing period, and the stimulation and prolongation of the early summer surplus. Secondly, more sheep could be maintained through the winter on a low level of nutrition so that more ewes and lambs would be available to take full advantage of the early summer surplus. On the other hand the field experiments at Kirwee suggest that such a system for fat lamb production is in open conflict with the HL type which is the most efficient for wool production, and here the relative importance of lamb and wool would have to be taken into consideration.

In conclusion it should be emphasised that the results obtained at Kirwee apply only to that or to a similar type of environment. It is suggested that the results would have application throughout most fat lamb producing areas, but no claim is made that they apply to hill country environments.

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Discussion on Prof. Coop's Paper

MR. J. E. DUNCAN: Did the different nutritional treatments have any influence upon wool quality and the percentage of breaks?

PROF. COOP: Yes, there was a definite effect. The low level of nutrition during pregnancy decreased the character grading by a unit and sometimes two units. On an average it increased the percentage of breaks by about 20% Even in our high planes, however, we still got a considerable percentage of breaks. The influence of level of nutrition after lambing on wool quality was less pronounced.

MR. E. A. CLARKE: Did any of the ewes shed their fleeces?

PROF. COOP: The low levels of nutrition were not as low as all that. In the absence of scrub or fern to help tear the fleece the level would have to be very low. On the other hand the wool tore easily if the ewes were caught by the fleece.

PROF. I. L. CAMPBELL: You stated that after lambing those ewes which had been previously on a low plane ate more than those which had been on a high plane. What is the evidence for this?

PROF. COOP: There is no direct evidence since intakes were not measured. My reason for making the suggestion is that from after lambing until weaning the LH ewes gained more weight than the HH and the LL more than the HL. It was a suggestion, not a statement of fact.