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THE EFFECTS OF WINTER GRAZING SYSTEMS ON SOME WOOL CHARACTERISTICS

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SUMMARY

Five different grazing systems were analysed with respect to weight of wool produced, fibre diameter, fibre length, quality number, character, staple length, crimp frequency, handle, lustre, soundness, tippiness, colour, cotting, and tensile strength for 5 groups of 21 pregnant New Zealand Romney ewes.

Treatments had a highly significant effect ($P<0.001$) on weight of wool produced per unit area of skin, fibre diameter, tensile strength, and soundness.

Forage crop (swedes) grazing was associated with lower feed intake and produced wool of reduced fibre diameter, fibre length, lower tensile strength and soundness, and less total wool per unit area than pasture grazing treatments.

Differences were found between rotational grazing and set-stocking, but neither was better over all characters assessed.

INTRODUCTION

The effects of winter grazing systems on the wool produced by pregnant ewes have seldom been studied, even though some of the most important faults of New Zealand wool appear to be greatly influenced by sheep management over the winter period and most of this wool is produced by breeding ewes. In particular, unsoundness (break or tenderness) appears generally to result from poor nutrition accentuating the inherent winter and early spring depression in wool growth rate (Wickham, 1968).

Some farms in New Zealand rely heavily on fodder crops for winter feeding, whereas others rely solely on fresh and conserved pasture. Since pasture grows more slowly in winter, the sheep are frequently fed less adequately in winter and early spring than during the rest of the year. This would suggest that sheep set-stocked at high stocking rates, and hence short of feed, would be most prone to unsoundness, but severe undernutrition may not result in marked unsoundness if the sheep are accustomed gradually to the lower level of feeding (Wickham, 1968). Sudden

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changes in nutrition can cause break (Brown, 1971), and unsubstantiated observations suggest that moving sheep on or off a fodder crop, or even sometimes changing from one pasture to another, can be associated with a wool break.

The present trial was set up to investigate the effects of some pasture- and crop-based winter grazing systems, involving dietary changes, on wool production and wool characteristics of ewes over the mid-pregnancy period.

MATERIALS AND METHODS

Over the period from June 13 to July 25, 1977 (corresponding approximately to days 86 to 128 of pregnancy), 5 treatments were imposed on groups of 21 mixed-age New Zealand Romney ewes. Randomization was restricted to ensure that the age and time of mating of ewes were similar in all treatments. Mean group liveweights were similar at the start of the treatment.

The treatments were:

T1: All sheep received 100% of their diet from swedes on a daily break.

T2: For the first 3 weeks, 100% of the diet was in the form of medium-quality pasture hay; for the following 3 weeks, 100% from a crop of swedes on a weekly break.

T3: 75% of the diet from a daily break of swedes and the remaining 25% from a daily hay ration.

T4: Pasture allocated on a daily rotational grazing system with back fencing.

T5: Pasture allocated in one block (set-stocked).

All ewes were set-stocked on grass prior to the treatment period. After removal from the treatments the ewes were rotationally grazed together on pasture until lambing, after which they were set-stocked. Lambing commenced 16 days post-treatment, and 87% lambed within 20 days from this time.

Feed allowances were based on the recommendations of Milligan and McConnell (1976). The allowance was planned to result in a pasture intake of about 0.85 kg DM/day, regarded as the maintenance intake for a 55 kg ewe in early pregnancy, grazing a mixed-length leafy pasture. In the final 2 weeks, intake was designed to rise to 1.1 kg DM/day. The swede crop was assumed to have a metabolizable energy concentration of 13.5 MJ ME/kg DM. Similar feed allowances were offered on pasture and crop treatments according to the relative metabolizable

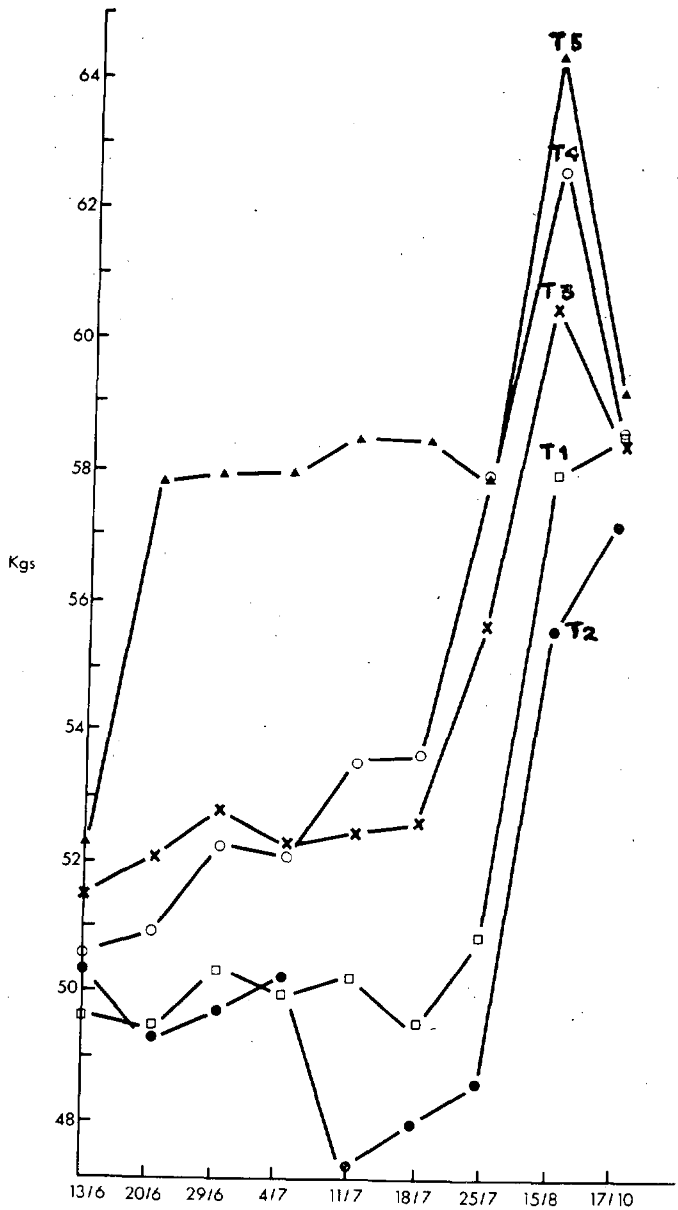

FIG. 1: *Average liveweight of sheep on each treatment.*

energy value for the fodder. Estimates of the intake of pasture, crop and hay were derived from before- and after-grazing yield data and from comparison of yields on grazed and caged areas.

The sheep were weighed at weekly intervals from 1 week before the trial commenced. Wool was clipped from a midside patch at 3-week intervals from 3 weeks before treatment until 3 weeks after treatment. A final sample was removed prior to shearing 8 weeks later.

Midside samples were analysed with respect to weight of wool produced, fibre diameter, and fibre length. Covariance analysis was used to adjust for variations in the pre-treatment values in these data.

RESULTS

"Intake" and Liveweights

Average DM "intakes" for all five treatments are listed in Table 1. Feed utilization figures over the total period were T1, 64%; T2, 67% on hay and 60% on swedes; T3 and T4, 70%. Figure 1 indicates the unadjusted mean treatment liveweights throughout the trial. Treatment had a highly significant effect ($P<0.001$) throughout the trial period until August 15, 1977.

TABLE 1: AVERAGE DAILY "INTAKE" (kg DM/ewe/day) FOR EWES ON EACH TREATMENT

	T1	*T2*	*T3*	*T4*	*T5*
Intake	0.68	0.59	0.84	0.90	1.68

Wool Growth Rate

Table 2 presents the mean clean weight of wool per unit area for each group and each period after adjusting for pre-treatment wool growth, age, and lambs born. The treatment effects were

TABLE 2: ADJUSTED MEANS OF WEIGHT OF WOOL PRODUCED PER UNIT AREA ($\mu g/cm^2/day$)

	0-3 weeks	*4-6 weeks*	*Post-treatment*	*Post-lambing*
T1	381 ab[1]	285 a	366 a	1 244
T2	318 a	224 a	334 a	1 176
T3	390 b	303 a	428 a	1 144
T4	523 c	568 b	707 b	1 254
T5	683 d	761 c	632 b	1 270

[1] Values with differing letters are significantly different ($P<0.05$).

highly significant ($P<0.001$). T1 and T3 (swede/hay variations) produced significantly less wool than either pasture grazing treatment during treatment and for 3 weeks after. There was no carryover effect in the sample grown from 3 to 11 weeks after treatment.

Older ewes ($\geqslant$ 5 years) produced less wool throughout the trial ($P<0.05$ to $P<0.001$). From about the 100th day of gestation onward through lactation, ewes with single lambs produced significantly more wool than those bearing twins. In the period just prior to lambing, single-bearing ewes produced 26% more wool than those bearing twins.

Fibre Diameter

Table 3 indicates the mean fibre diameter changes. Treatments had a significant ($P<0.01$) effect in the first 3 weeks and a highly significant ($P<0.001$) effect to lambing. There was no carryover effect post-lambing.

TABLE 3: ADJUSTED MEANS OF FIBRE DIAMETER (μm)

	0-3 weeks	*4-6 weeks*	*Post-treatment*	*Post-lambing*
T1	28.8 ab	27.0 b	26.0 a	39.1
T2	27.1 a	24.0 a	25.7 a	38.5
T3	28.5 ab	27.1 b	26.6 a	37.3
T4	30.3 bc	31.7 c	30.5 b	37.6
T5	31.3 c	33.7 d	29.6 b	37.5

Fibre Length

Treatments had a highly significant ($P<0.001$) effect on fibre length. Pasture feeding treatments had greater length growth rates than those involving swedes and/or hay (Table 4). There was no carryover effect of treatments post-lambing.

TABLE 4: ADJUSTED MEAN FIBRE LENGTH TREATMENT MEANS (mm/day)

	0-3 weeks	*4-6 weeks*	*Post-treatment*	*Post-lambing*
T1	0.320 a	0.370 b	0.389 a	0.487
T2	0.308 a	0.320 a	0.413 ab	0.440
T3	0.311 a	0.338 ab	0.399 ab	0.515
T4	0.393 b	0.440 d	0.440 b	0.511
T5	0.427 c	0.404 c	0.438 b	0.497

Fleece Characteristics

Table 5 gives mean treatment means for fleece characteristics that were significantly affected by treatment; these were greasy fleece weight ($P<0.10$), colour ($P<0.05$), tensile strength ($P<0.001$), and soundness ($P<0.001$). There were no significant treatment effects on quality number, staple length, cotting, character, tippiness, lustre, and handle. Three-year-old and older-aged ewes ($\geqslant$ 5 years) had significantly ($P<0.01$) lower tensile strength than either the 2- or 4-year-old ewes (5.73 and 4.51 *vs* 8.66 and 7.97 kg/g/cm). This age effect was not evident for soundness grade.

TABLE 5: LEAST SQUARES MEANS FOR WOOL CHARACTERISTICS

	Staple Strength (kg/g/cm)	*Soundness Grade*	*Colour Grade*	*Greasy Fleece Weight (kg)*
T1	4.75 a	5.63 ab	6.46 b	3.30
T2	3.87 a	4.91 a	6.50 b	3.18
T3	6.26 ab	6.24 bc	5.97 a	3.15
T4	9.99 c	7.03 cd	6.66 b	3.49
T5	8.71 bc	7.48 d	6.24 ab	3.62

Those ewes bearing singles had sounder wool ($P<0.05$) (6.60 *vs* 5.90), higher character grade ($P<0.10$), and more blocky staple tips ($P<0.05$) than those bearing twins. The higher staple strength of single-bearing ewes was not statistically significant. The position of the break relative to the dye bands at the start and finish of treatment indicated that the major proportion of break occurred at entry to and exit from the forage crop treatments.

DISCUSSION

Intake and Liveweights

It was initially intended that the mean daily energy intake of sheep on all five treatments should be similar, but this was not achieved. Pasture growth rate was well in excess of what was expected and the group set-stocked on pasture (T5), which should have been encountering increasing feed supply limitations, was apparently able to maintain its intake at a reasonable level throughout the trial. The liveweight data suggest that there may have been some restriction of the feed supply to this group in the last week of treatment, even though this is not supported by the "intake" data. This is probably a reflection of the inaccuracy of the "disappearance" technique in estimating intake of animals set-stocked on pasture.

The "intake" of crop was generally slightly lower than had been expected. This was probably due to the difficulty of combining reasonable rates of utilization of the bulbs with adequate intake by the sheep.

The sheep on the swedes with hay supplement (T3) had higher intakes and increased liveweight in comparison with the all-swedes treatment (T1) or the 3 weeks swedes, 3 weeks hay (T2). There are several possible explanations for this, including:

(1) difficulty of harvesting material from swede bulbs;

(2) the pregnant ewes may have had insufficient remaining abdominal capacity for the extra water in the swedes;

(3) the change in diet may have necessitated adaptation of the microbial population of the rumen and the animals' own enzyme systems; hay may have acted as a buffer, reducing the adaptation necessary.

If digestive and metabolic upsets do occur with these types of dietary changes, this could be a major causal factor in wool break. The liveweight data suggest that these upsets may have occurred but, if they did, they did not last longer than 1 week. This agrees with the findings of Annison *et al.* (1959). If digestive upsets occurred at removal from crop, these could not be seen in the liveweight data, since weights were taken only at 3-week intervals in the post-treatment period.

Gut fill may have contributed substantially to some of the liveweight differences during the treatment period; in particular those between T4 and T5. The sheep on T4 were shifted daily and grazed off most of the feed on their allotted area within 6 hours of shifting. In comparison, set-stocked sheep in T5 grazed over much of the day, including early morning. Since weighing took place in the morning before shifting sheep to new areas, the T4 sheep were probably relatively empty.

Wool Growth and Characteristics

There were major differences in the wool production of the pasture-fed and the swedes-(and hay)-fed sheep. The level of intake is probably a major factor, but there are clear differences between T3 and T4 even though the "intake" estimates are similar. A liveweight difference was also established between these two groups during treatment. Feed quality appears the most likely cause.

The reduced wool growth was reflected in reductions in fibre length and fibre diameter. The diameter changes were the major components of the reductions in wool growth, and the length changes were relatively small.

The differences in greasy fleece weight were not significant, since variation in the rate of wool growth over the rest of the year tended to obscure the effects of the treatments.

Staple strength and soundness of the wool are inversely related to the minimum diameter along each fibre. As can be expected from the diameter measurements, the fodder crop treatments resulted in lower staple strength and soundness grades in the wool produced. The reduction in staple strength was proportionately far greater than the reduction in mean cross-sectional area of the fibres. This suggests that the effects on minimum fibre diameter may have been considerably greater than the effect on the mean diameters of the samples. The staple strength and soundness grade were generally related to the "intake" estimates. However, T4 produced stronger staples than T3 (although the difference in soundness grade was not significant) even though the intakes were similar. The use of the hay supplement with swedes tended to be associated with stronger, sounder staples, although clearly significant differences were not found.

The T2 treatment was designed to increase the magnitude of dietary changes and hence to increase the risk of digestive or metabolic upsets and the effects of such changes on wool production. This group had a lower rate of wool production and greater depression in fibre diameter than the swede-fed groups during the first 3 weeks when it was being fed hay. On transfer to swedes for the second 3-week period, the sheep showed a further reduction in wool production and fibre diameter. Not surprisingly, T2 produced the weakest-stapled, most unsound wool.

Unsoundness of wool produced in the late winter period is frequently referred to as "lambing break" (Ross, 1965). In this study all break occurred before lambing. With crop-fed treatments most break occurred in the staple at a point coinciding with transfer from the crop back on to pasture, although in T3 20% of the break coincided with the sheep going on to the crop. Surprisingly in T2, despite the marked reduction in wool growth rate and diameter during treatment, there was little break until the sheep were transferred back to pasture at the end of the treatment period.

Some systems of rotational grazing have resulted in more wool break than set-stocked grazing in similar conditions (Collin, 1966). This break is probably due to marked nutritional changes when sheep have been moved from one paddock to another. This type of effect did not appear in T4, probably because the sheep were grazed in similar conditions from one day to the next.

No significant differences in the level of cotting were recognized. This may indicate that the reduction in fibre diameter due to treatment was not sufficiently marked to lead to fibre shedding, or, more likely, that the hand-and-eye appraisal of cotting grade was not sufficiently accurate.

The poorer colour of the T3 fleeces is difficult to explain. It may just reflect the accumulation of mud around the hayrack.

The results of this trial are far from conclusive, since they may have been very different on other soil types and in different climatic conditions. The swede crop may not have been truly representative of the types of crops used for feeding ewes throughout the country, and further trials in different environments, with additional crop species and using higher daily crop allowances, should be carried out. Nevertheless, the trial offers additional evidence supporting the suggestion that crop-feeding systems can freqently lead to wool break if sheep are enclosed on an area of crop or taken off crop suddenly without gradually conditioning them to the new diet. The results also suggest that feeding hay with the crop can reduce the risk of break.

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