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Fleece tenderness: the effect of nutrition, age and lambing status on pregnant Romney and Coopworth mixed-age ewes

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ABSTRACT

The effect of winter and early spring feeding levels, lambing status and ewe age on staple strength, fibre diameter at the point of break, and position of staple break were measured in pregnant Romney and Coopworth mixed-age ewes at Whatawhata and Ruakura, respectively.

Mid-pregnancy feeding levels produced significant differences in staple strength (37 *v* 20 newtons/kilotex in the Romney; and 52 *v* 45 N/ktex in the Coopworth) and diameter at the point of break (37 *v* 34 μm in the Romney, and 39 *v* 36 μm in the Coopworth) for high and low nutrition treatments respectively. Subsequent late pregnancy and post-partum nutrition treatments did not generate staple strength differences.

Despite a high correlation (r = 0.95) between position of break and minimum fibre diameter, less than 30 percent of the variation in staple strength within each flock could be accounted for by the variation in fibre diameter at the point of break.

Keywords Fleece tenderness; staple strength; fibre diameter; mid-pregnancy nutrition

INTRODUCTION

It is estimated that fleece tenderness or low wool staple strength reduces the value of the national clip by between 5 and 10%, or $50 to $100 million annually (Ross, 1982). Sheep producing tender wool have lower fleece weights than those producing sound wool under the same conditions (Bigham *et al.*, 1978a; Hight *et al.*, 1976); often produce cotted fleeces, and have a higher incidence of unscourable wool staining (Ross, 1982).

The effects of management and breeding on the occurrence of fleece tenderness, both within and between flocks, have been reviewed recently (Bigham *et al.*, 1983). Much of the information was based on the 'finger' test, or traditional subjective appraisal of tender fleece, which can detect only very weak wools, or staples with a tensile strength less than about 25 newtons per kilotex (N/ktex) (Andrews, 1979). Since fleeces can vary in strength from 0 to 90 N/ktex (Heuer, 1979) some effects could be masked by the limitations of subjective staple strength assessment.

This paper examines the effect of nutrition level and lambing performance on objectively measured staple strength and associated position of staple break and mean fibre diameter.

EXPERIMENTAL

Trial designs

Wool data were obtained from 2 trials conducted in 1981 which examined the effect of winter-spring nutrition and management on ewe and lamb performance at Whatawhata Hill Country Research Station (Smeaton *et al.*, 1983) and at Ruakura Animal Research Station (K. T. Jagusch, unpublished). In trial 1 (Whatawhata) mixed-age Romney ewes were fed high and low nutrition allowances in mid and late pregnancy and during post-lambing in a 2^3 factorial design. Pasture residual levels for each of these periods have been published (Smeaton *et al.*, 1983). In trial 2 (Ruakura), mixed-age Coopworth ewes determined to be light, medium or heavy at end of joining were randomised and allocated pasture to achieve 3 different live-weight groups ($\simeq$45, 52, 59 kg) at mid pregnancy. During late pregnancy sheep were placed on 5 pasture allowances (0.7, 1.0, 1.4, 2.0, 3.0 kg DM/ewe/d). No differential post-lambing nutrition treatments were imposed. Wool data was collected from the highest and lowest nutrition groups for both mid- and late-pregnancy treatment periods. One hundred and ninety ewes were sampled from each trial.

Wool measurements

Treatment periods were marked by dyeband (Wheeler *et al.*, 1977) and the entire wool sample removed immediately prior to November shearing. Fibre diameter was measured by fibre fineness distribution analyser (Lynch and Michie, 1976). Staple strength was measured by staple strength tester (Heuer, 1979). The position of break was simultaneously assessed and fibre diameter was measured at this point.

RESULTS

Nutrition effects

Mid-pregnancy feeding levels produced significant differences in staple strength (37 *v* 20 N/ktex ($P<0.001$) in trial 1 and 52 *v* 45 N/ktex ($P<0.001$) in trial 2) for high and low nutrition treatments, respectively. Subsequent late-pregnancy and post-lambing nutrition treatments did not generate staple strength differences, although coarser wool was produced by the high nutrition groups (Table 1).

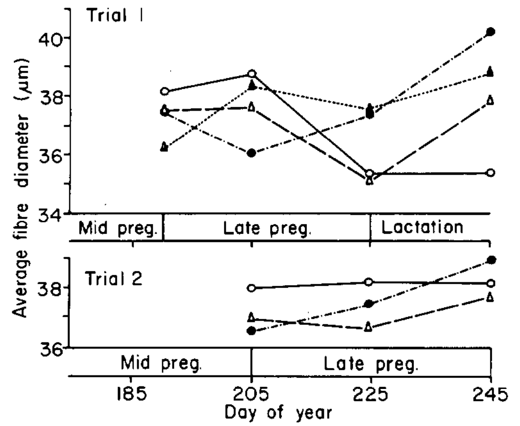

FIG. 1 Fibre diameter profiles for each position of break (▲ . . . Break position day 190, •-. BPD 205, △ -- BPD 225, ○- BPD 245).

TABLE 1 Effect of mid-pregnancy, late-pregnancy and post-lambing nutrition on fibre diameter (μm).

	Period of nutrition									
	Mid-pregnancy			Late pregnancy			Post lambing			
	High		Low	High		Low	High		Low	SED
Trial 1. Fibre diameter at										
day 100 of pregnancy	39.2	***	36.6							0.4
lambing	37.6	***	34.5	37.0	***	34.8				0.4
docking†	38.8	***	37.3	38.8	***	37.2	38.6	***	37.4	0.4
point of break	37.1	***	34.1	36.0	NS	35.3	36.1	NS	35.7	0.4
Trial 2. Fibre diameter at										
at day 100 of pregnancy	38.3	***	36.4							0.5
at lambing	38.6	NS	37.8	38.8	***	36.8				0.5
at point of break	38.5	*	36.2	37.9	NS	36.3				0.8

† End of post-lambing nutrition period.

Despite a significant mid-pregnancy effect on mean fibre diameter at the point of break (Table 1) there was no nutrition effect on position of break *per se*. Over 80% of animals in both trials produced the weakest staple region between mid-July and late August despite a 2 to 3 week difference in mean lambing date and consequent imposition of nutrition treatments. There was a close relationship between the mean minimum fibre diameter and the fibre diameter at the point of break ($r^2 = 0.95$) which is reflected in the fibre diameter by position of break profiles shown in Fig. 1.

Lambing status and age effects

Single bearing ewes grew stronger wool than twin-bearing ewes (30 *v* 24 N/ktex ($P<0.01$) in trial 1 and 52 *v* 43 N/ktex ($P<0.01$) in trial 2). There was an interaction between mid-pregnancy nutrition levels and lambing status in trial 1. Staple strength was significantly affected by lambing status in ewes that had been subjected to high but not low nutrition levels during mid-pregnancy (Table 2). In trial 2, staple strength was

TABLE 2 Mid-pregnancy and lambing status interactions on staple strength (N/ktex).

	Interactions†				
	HS	HT	LS	LT	SED
Staple strength					
Trial 1	39	32	22	17	2.6
Trial 2	55	44	49	37	3.0

† H (High) and L (Low) level of nutrition during mid-pregnancy; S (single), T (twin)-bearing ewe.

significantly affected by lambing status in both high and low mid-pregnancy nutrition groups (Table 2). Fibre diameter at the point of break was significantly affected by lambing status in the Coopworths (37.9 *v* 36.5 μm ($P<0.01$) for single and twin-bearing ewes respectively) but not in the Romney.

Ewe age had no effect on staple strength or fibre diameter at the point of break.

Staple strength and fibre diameter relationship

There was a poor relationship between staple strength and fibre diameter at the point of break in both trial 1 ($r^2=0.29$) and in trial 2 ($r^2=0.22$). The flock means for staple strength and fibre diameter at the point of break were 29 N/ktex and 35.6 μm for the Romney and 49 N/ktex and 37.1 μm for the Coopworth.

DISCUSSION

New Zealand crossbred sheep exhibit a pronounced seasonal wool growth pattern which determines the region of reduced wool growth and therefore the region of minimum diameter (Bigham *et al.,* 1978b). In both trials, the position of break occurred between mid July and late August at the point of minimum diameter. These results suggest that a mechanism exists which predisposes the production of weaker wool at this point, despite a concurrent immediate fibre diameter response to changing nutritional levels during pregnancy in both trials and during lactation in trial 1. This mechanism can be triggered by low nutrition levels during mid pregnancy and by lambing stress during late pregnancy. In trial 1, where animals exhibited a considerably lower mean staple strength, low mid-pregnancy nutrition levels alone triggered and 'set' this mechanism.

Despite a close relationship between minimum fibre diameter and fibre diameter at the point of break, less than 30% of the variation in staple strength between sheep can be accounted for by the diameter at the point of break. Orwin *et al.* (1980) have reported differences in cortical structure, particularly the varying proportion of paracortex and orthocortex, and protein composition between fibres of the same diameter from subjectively measured sound and tender staples. Preliminary work at Whatawhata indicates that at least some of the between-sheep variability in staple strength can be attributed to cortical structural differences (J. M. Fitzgerald, unpublished). These differences may be present throughout the year, suggesting a genetic base. It is yet to be determined whether they can be manipulated by nutritional level.

It has been suggested that since only very weak wool can be detected by subjective assessment of staple strength, the effect of nutrition and lambing status may be underestimated (Bigham *et al.* 1983). This was shown to be the case in this current work. In the Coopworth flock where subjective assessment was carried out, less than 5% of the flock were classed as tender at November shearing. No effect would have been considered significant on this basis. Furthermore 65% of this flock exhibited a staple strength below that which is considered to have some effect on processing performance (Andrews and Lunney, 1982).

Bigham *et al.* (1983) concluded that existing price differentials between sound and tender wool were insufficient to warrant improved feeding of the ewe during pregnancy at the expense of controlled grazing during winter which would allow some accumulation of pasture *in situ* for grazing after lambing. However differential feeding during mid pregnancy and not during late pregnancy does affect staple strength. More work is required to delineate this period and define more precisely management options a farmer may have to increase the strength and value of his wool clip.

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