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Influence of reducing wool fibre diameter away from the winter minimum, on fibre length after carding

M.C. SMITH AND A.R. BRAY

AgResearch, Canterbury Agriculture and Science Centre, P O Box 60, Lincoln, New Zealand.

ABSTRACT

The length of fibres after carding is strongly influenced by the minimum fibre diameter (MinFD) in winter in Low Staple Tenacity (LST) and High Staple Tenacity (HST) Romney sheep. In this study a further weakness was induced by a temporary reduction in fibre diameter at a point away from the winter minimum, and the influence on fibre length after carding (barbe) was determined.

Forty adult rams of four genotypes (LST, HST, Drysdale and Merino) were offered a restricted diet for 14 days in early February. Fibre diameter was reduced over the treatment period in LST (by 26%), HST (19%), Drysdale (5.5%) and Merino (0.5%). Barbe was only significantly associated with MinFD during treatment in LST ($r^2=0.62$, $P<0.01$) and not at all with change in fibre diameter. For each 1 μm reduction in MinFD during treatment, barbe was reduced by 1-3 mm.

Keywords: wool; fibre diameter; staple tenacity; fibre length after carding.

INTRODUCTION

The length of wool fibres after carding is of concern to processors, largely through effects on spinning performance. It is a function of the length of fibres before carding, breakage of fibres during carding, and the position of break along the fibre. A fibre will break on the card when the force exerted by the teeth of the card exceeds its tensile strength. It will break at the weakest point between the points of restraint. A primary cause of weakness is likely to be a thinning of the fibre.

Studies on selection lines of Romney sheep selected for (High Staple Tenacity, HST) and against staple tenacity (Low Staple Tenacity, LST) have shown that fibre length after carding is strongly influenced by the minimum fibre diameter in winter through effects on fibre strength (D. R. Scobie, unpublished). In the tangled wool entering a carding machine, there is no certainty that the winter weakness will be located between the points of restraint of the section of fibre pulled by a tooth of the card. That means that weaknesses produced at other times may also affect fibre length after carding. This study evaluated the effect of inducing a weakness in autumn on staple tenacity and fibre length after carding.

MATERIALS AND METHODS

Forty adult rams of four genotypes (LST, HST, Drysdale and Merino) were offered a restricted diet (0.6 x maintenance) for 14 days in early autumn. The genotypes were selected to provide a range in fibre length, diameter and medullation. No attempt was made to obtain individuals representative of their breed. On days 6 to 10 of restricted feeding, they were treated with corticosteroid (dexamethasone sodium phosphate, 0 to 42 mg/day by subcutaneous injection) to induce a temporary reduction in fibre diameter.

Samples of mid side wool were collected 7, 14 and 28 days after corticosteroid treatment began, for measurement of fibre diameter by OFDA. Twelve-month fleece samples were harvested in spring for measurement of fibre diameter and length, staple tenacity (Scobie *et al.*, 1994), and fibre length after carding (NZ Standard 8719:1992). Staple tenacity is defined as the peak force to break a bundle of fibres, per unit of cross-sectional area at the point of break. Fibre length after carding data was used to calculate mean barbe and the proportions of short (< 0.4 x 95% length) and long (> 0.9 x 95% length) fibres.

Treatment effects were examined by analysis of variance and relationships between traits within groups were determined by correlation and regression analyses.

RESULTS

Fibre diameter and length measurements for the corticosteroid treated groups were not significantly different from the control group, so data was pooled within genotypes. Significant differences were found between the genotypes and results for each genotype are presented separately.

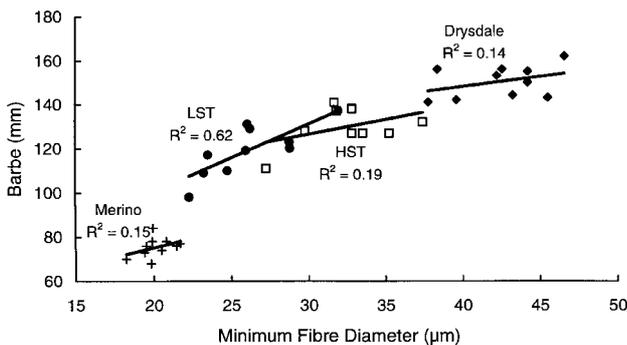
Relative to pre-treatment values, fibre diameter was reduced during the treatment period in LST (by 26%), HST (19%), Drysdale (5.5%) and Merino (0.5%) (Table 1). Between individuals within genotypes, change in fibre diameter during treatment (ΔFD) were negatively associated with staple tenacity in autumn in LST ($r^2=0.56$, $P<0.01$), and with staple tenacity in winter in HST ($r^2=0.38$, $P<0.05$). ΔFD was not significantly correlated with any of the fibre length after carding parameters.

Minimum fibre diameter during treatment (MinFD) was positively correlated with staple tenacity in autumn in all genotypes, and significantly so in LST ($r^2=0.66$, $P<0.01$) and HST ($r^2=0.61$, $P<0.01$). It was also positively corre-

TABLE 1: Mean fibre diameter (FD) and length of raw wool, staple tenacity, and fibre length after carding data for each genotype. (LST - Low Staple Tenacity Romney, HST - High Staple Tenacity Romney)

	Genotype			
	LST	HST	Drysdale	Merino
Fibre diameter during treatment (μm)				
Pre-treatment FD	35.3	40.4	48.2	21.0
Change in FD	-9.2	-7.6	-2.7	-0.1
Minimum FD	26.1	32.8	45.5	20.9
Length of raw wool (mm)				
Staple length	155	154	238	92
Fibre length	175	173	213	97
Staple tenacity (N/mm^2)				
Autumn	16.6	33.8	28.1	24.1
Winter	34.4	39.6	28.9	NA
Fibre length after carding				
Barbe (mm)	119	130	150	75
% Short fibres	21.8	14.0	24.7	21.7
% Long fibres	23.3	27.9	12.7	17.5

FIGURE 1: Relationships between minimum fibre diameter during the treatment period and fibre length after carding. (LST - Low Staple Tenacity Romney, HST - High Staple Tenacity Romney).



lated with barbe in all genotypes although the relationship was significant only in LST ($r^2=0.62$, $P<0.01$) (Figure 1). For each $1 \mu\text{m}$ reduction in MinFD during treatment, barbe was reduced by 3.1 mm in LST, 1.3 mm in HST, 0.9 mm in Drysdale and 1.7 mm in the Merinos. Although not significant, there was a positive correlation between MinFD during treatment and the proportion of long fibres in all genotypes. A negative correlation with the proportion of short fibres was significant in LST ($r^2=0.44$, $P<0.05$) and HST ($r^2=0.76$, $P<0.001$).

Staple length was positively correlated with barbe in all genotypes (Drysdale $r^2=0.50$, $P<0.05$). Fibre length measured in the raw wool was also positively correlated with barbe in LST ($r^2=0.50$, $P<0.05$) and Merino ($r^2=0.44$, $P<0.05$).

Barbe was positively but not significantly correlated with staple tenacity in autumn in all genotypes.

The above results are for associations within genotypes. When allowance was made for genotype differences in the data from the four genotypes, the single most important factor associated with barbe was MinFD during treatment ($r^2=0.94$, $P<0.001$). Addition of fibre length in raw wool to the regression model reduced the error term by 16% ($P<0.01$) and increased the percentage variation accounted for to 95% . No other measured traits nor interactions with breed had significant effects.

DISCUSSION

Reductions in barbe of 10 mm and greater are of concern to processors. The results indicate that reductions of that order would be produced by 3 to $10 \mu\text{m}$ reductions in MinFD during treatment. Given that 14 days under-feeding produced genotype mean ΔFD values of up to $9.2 \mu\text{m}$, it is apparent that the impact of farm practices outside winter on fibre length after carding can be important in practice.

MinFD during treatment was more closely associated with fibre length after carding parameters than was ΔFD . This indicates that the fineness of the fibre had more effect on staple tenacity and fibre length after carding than did the magnitude of the reduction in fibre diameter.

To date the focus of studies to improve staple tenacity and fibre length after carding in longwool sheep has been upon factors likely to affect the fibre in winter (Fitzgerald *et al.*, 1984; Bray *et al.*, 1995). While the winter minimum fibre diameter is undoubtedly the weakest point in most wool from longwool breeds, this study provides a reminder not to ignore the impact of practices at other times of the year.

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