LESSONS FROM THE STAPLE STRENGTH RESOURCE FLOCKS

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SUMMARY

The establishment of the staple strength resource flocks is described. The average staple strength and coefficient of variation of fibre diameter for the sound, control and tender lines were 34.4, 30.6 and 22.8N/ktex (P<0.001) and 19.1, 20.0 and 23.1% (P<0.001), respectively. These lines demonstrate that selection for improved staple strength is possible.

Keywords: Merino wool, staple strength, selection.

INTRODUCTION

Tenderness is an important problem of Merino wools. About 40% of Merino combing wool sold at auction in Western Australia was classified as part-tender, tender or rotten compared to between 19 and 33% in the Eastern states (K. Curtis, pers. comm.). Such wools are subject to a price penalty which results in a substantial financial loss for wool growers.

The potential to improve staple strength of Merino wool genetically was investigated by Howe *et al.* (1991) and Lewer and Ritchie (1992), who showed that staple strength is a heritable trait (h^2=0.40) that should respond to selection. This encouraged Agriculture Western Australia to establish lines of Merino sheep that differ markedly in staple strength to provide a resource for further investigation of both the biological and genetic factors controlling staple strength. Preliminary results were published by Lewer and Ritchie (1992). This paper reports the establishment of these lines, the results obtained to date and the lessons learnt from these lines under Western Australian farm conditions.

MATERIAL AND METHODS

Selection of animals. The establishment of the staple strength selection lines commenced with the screening of 20,440 (7237 ewes and 13203 rams) Merino hoggets on 15 Western Australian properties between 1991 and 1995. Flock sizes varied between 200 and 600 animals. Midside samples were collected from each animal and analysed for yield (Y), fibre diameter (FD), staple length (SL) and staple strength (SS). Fleece (GFW) and live weights (LWT) were recorded at shearing.

As price discounts for low SS were greater in finer wools (AWC, 1991) only those hoggets whose FD was below average within each flock qualified for selection. SS was regressed against FD and animals were selected on their deviation from the predicted SS. Animals with the largest positive and negative residuals qualified for the high and low line respectively, and animals with residuals close to zero qualified for the control line. Only animals that were within one standard deviation from the mean for LWT, clean fleece weight (CFW), FD and SL were selected. A high selection intensity was applied with 0.7% rams and 1.9% ewes selected per line on each property.

Sheep management and measurement. Animals were transfered to Mt Barker Research Station (38°38'S, 117°32'E), shorn and managed as a single group. Mt Barker has a typical Mediterranean climate with cold wet winters and hot dry summers with an average annual rainfall of 650mm.

Single sire matings were carried out in February each year and no selection was practise within lines. Each line consists of 7 sires mated to unrelated animals within lines. Only during mating and from lambing until lamb marking were animals separated into different groups in order to record pedigrees. Lambs were born in July, weaned in October and shorn in November. Midside samples were collected at shearing and measured for the important wool traits.

Changes in wool growth along the staple were studied in 143 ewes that were born in 1990. They were dyebanded and weighed at pasture senescence in November 1991, at mating in late summer (February), at the first rainfall in May, at lambing in July, at weaning of their lambs in October and were shorn in November 1992. The distance between dyebands was used to provide an indication of the amount of wool grown during different periods of the year. The change in FD during the year was determined on a 2mm snippet cut just below each dyeband.

Statistical analysis. The data were analysed with the LSMLMW computer program of Harvey (1987). Selection line, year of measurement, age of the ewe, farm of origin, year of birth and rearing rank of their lambs were fitted as fixed effects in the model. All interactions were initially included but none were found to be significant. The model for the analyses of wool growth during the year included selection line, farm of origin, time of the year and rearing rank of their lambs as fixed effects.

RESULTS

Only SS, SDFD and CVFD differed significantly between lines (Table 1). As no significant interaction was found between line and age in mature ewes it indicates that animals from the sound and tender lines consistently produce sound or tender wool during their lifetime. A strong negative correlation of -0.51 was found between CVFD and SS.

The changes in fibre diameter along the staple at different times of the year are shown in Table 2. No significant differences were found between lines for average FD of the midside sample. However, an interaction ($P=0.06$) was found between time of the year and line. The sound line had a higher average FD in February and April but a lower average FD in September and November than the tender line. This resulted in the tender line having a FD increase of 4.8 micron from the break of the season until shearing in November compared to the 3.7 micron increase in the sound line.

A similar time of year x line interaction ($P<0.01$) was found for length of wool growth during the different periods as indicated in Table 3. No significant differences were found between lines for the accumulated staple length (105mm) over the whole year which confirms the staple length results of Table 1. However, the sound line grew significantly more wool during the dry period (December to April), but less wool during the period of abundant green feed availability (June until November, than the tender line.

Table 1. Least squares means of live weight and wool traits of Merino ewes of the SSRF

Trait	Tender n=239	Control n=255	Sound n=158	P-value
Live weight (kg) at				
mating	52.8	54.3	55.6	0.22
break of season	54.6	54.9	56.6	0.34
lambing	62.2	62.7	64.0	0.58
weaning of lambs	63.9	63.9	65.8	0.50
shearing	64.4	63.2	65.8	0.36
Greasy fleece weight (kg)	5.12	5.01	4.67	0.06
Clean fleece weight (kg)	3.79	3.74	3.52	0.17
Yield (%)	74.2	74.5	75.5	0.54
Staple length (mm)	102	104	100	0.39
Staple strength (N/Ktex)	22.8	30.6	34.4	0.00***
Fibre diameter (μm)	21.2	21.1	21.3	0.86
Position of break (% from tip)	43.3	45.0	41.8	0.46
Standard deviation of FD (μm)	4.88	4.21	4.02	0.00***
Coefficient of variation of FD (%)	23.1	20.0	19.1	0.00***

***P<0.001

Table 2. Least squares means of fibre diameter within a staple at different times of the year

Line	Number of animals (n)	Average FD of midside	February Mating	April B.o.s	June Lambing	September Weaning	November Shearing	FD change (April to November)
Tender	48	20.8	20.4	18.3	19.9	22.1	23.1	+4.8
Control	46	20.3	19.6	18.3	19.5	21.5	22.7	+4.4
Sound	49	20.9	20.9	19.0	20.3	21.6	22.7	+3.7
Mean	143	20.7	20.3	18.6	19.9	21.7	22.8	

Table 3. Least square means of wool growth (mm) during different times of the year

Line	n	Staple length (mm)	Dec-Feb	Feb-Apr	Apr-Jun	Jun-Sep	Sep-Nov
Tender	48	104	23.1	12.9	24.9	32.1	10.9
Control	46	106	22.1	13.6	25.8	32.5	11.2
Sound	49	106	24.7	14.6	24.6	30.8	10.8
Mean	143	105	23.3	13.7	25.1	31.8	11.0

No significant differences were found between lines in weight gains or weight losses during different periods of time throughout the year (Table 4). The weight loss between weaning of their lambs and shearing can be attributed to the removal of the fleece at shearing.

Table 4. Least square means of live weight changes of ewes during the year

Trait	Tender n=50	Control n=48	Sound n=50	P-value
Weight gain/loss (kg) from				
Mating - Break of season	4.26	3.91	4.85	0.16
Break of season - Lambing	9.39	9.31	8.44	0.30
Lambing - Weaning of lambs	1.50	2.27	2.45	0.64
Weaning of lambs - Shearing	-5.96	-5.36	-5.34	0.66
Overall gain (kg)	9.19	10.13	10.40	

CONCLUSIONS

The following can be concluded from the results.

1. A strong negative phenotypic relationship exists between SS and CVFD.
2. A small change in CVFD results in a large change in SS.
3. SS is a repeatable trait as animals from the different lines stayed in their different selection categories during their lifetime.
4. The progeny of the selection lines performed in a similar fashion as their parents, which provides further evidence that SS is a heritable trait and that it can be improved by selection (Greeff *et al.* 1995).
6. The progeny of the sound line had a significantly lower CVFD than the progeny of the tender line which provides further evidence for a strong negative genetic correlation between SS and CVFD (Greeff *et al.* 1995).

The results provide some insight into how animals from the sound line manage to produce sound wool. They grow wool with less variation of fibre diameter along the staple than the tender line. As no differences were found between lines in weight gains or weight losses, this suggests that they may differ in feed intake, efficiency of feed utilisation for wool growth and/or grazing behaviour.

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