# STAPLE STRENGTH IN SEASONAL ENVIRONMENTS IN SOUTH-WESTERN AUSTRALIA

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## SUMMARY

Associations between median staple strength of merino fleece wool and the age and sex of the flocks, and the length of the pasture growing-season in south-western Australia were studied using data collated from a wool broker and from the Australian Wool Corporation in the 1989/90, 1990/91 and 1991/92 wool-selling seasons. The wool clip in 1991/92 contained a higher proportion of tender or part tender wool (≤ 30 N/ktex) than the clips in the previous 2 wool-selling seasons. About 64% of the wool clip in 1991/92 was from mature sheep (> 1.5 years old) but the high incidence of tender or part-tender wool cannot be explained fully by the relative contributions of wool from sheep of different ages or sex. There is some evidence of an effect of the length of the pasture growing-season on the proportion of the wool that was tender or part-tender and on staple strength. This is discussed in terms of the seasonality of the pasture growing-season in south-western Australia.

*Keywords:* staple strength, wool quality, seasonality.

## INTRODUCTION

Marked seasonality of wool production in south-western Australia is well documented (Purser 1980). In addition to this seasonal pattern, wool growth (kg/hd.year) decreases progressively from areas of low rainfall to areas of high rainfall (Purser and Southey 1984). In general, pasture from areas of high rainfall is used less efficiently for wool growth (g wool per unit energy available) than is pasture from areas of low rainfall, and winter pasture promotes more efficient wool growth than does spring pasture (Purser and Southey 1984, 1987).

Staple strength is a commercially important attribute of raw wool because it influences the processing performance of the wool during top-making; wools of low staple strength are discounted severely at auction. The average and range in staple strength of the Western Australian wool clip varies considerably between years (Couchman *et al.* 1992). As well, Baker *et al.* (1993) have reported differences in average staple strength between merino fleece wools from mature sheep (> 1.5 years old) and weaner and hogget sheep (≤ 1.5 years old), and between wools produced in regions with pasture growing-seasons of different length. In this study we have focussed on the relationships between staple strength of tender or part-tender wool (≤ 30 N/ktex) and sound wool (> 30 N/ktex), and the age and sex structures of the flock, and the length of the pasture growing-season.

## METHODS

Data were collated in Western Australia from records held by Elders Ltd and the Australian Wool Corporation (AWC) of merino fleece wool that was produced and sold at auction in the 1989/90, 1990/91 and 1991/92 wool-selling seasons. Information was collected from sale lots for which the following criteria were met: the lot contained 10 or more bales of merino fleece wool (in order to include farms with flocks of 400 or more sheep), the wool was presented for sale with additional staple measurement, the wool was produced in the agricultural region of south-western Australia, and the wool producer sold 3 or more lines of fleece wool in that sale.

Quality attributes of the wools were obtained from the AWC records and the sale lots were grouped according to staple breaking strength; tender or part-tender (≤ 30 N/ktex) or sound (> 30 N/ktex) (Table 1). Using the classers' notes the sale lots were grouped according to the age of the sheep (weaners and hoggets (≤ 1.5 years old), mature sheep (> 1.5 years old), or unknown) or the sex of the mature sheep (ewes, wethers, or unknown). The number of sale lots of each category can be calculated from the data in Tables 1 and 2. Meteorological records of rainfall and water evaporation for the previous 10 years and the approximate location of the farm on which the wool was produced were used to group the sale lots according to regions of common length of the pasture growing-season. The length of the pasture growing-season was calculated as the period of time (months) that effective rainfall exceeded evaporation (Cornish 1985). The distributions of staple breaking were compared using the nonparametric test criterion of Kruskal and Wallis (1952).

**Table 1. The size of the data set used in this study and the range in staple strength**

| Wool-selling season | Number of sale lots | | Range in staple strength (N/ktex) |
|---|---|---|---|
| | Sound wool (> 30 N/ktex) | Tender or part-tender wool (≤ 30 N/ktex) | |
| 1989/90 | 711 | 437 | 15 to 77 |
| 1990/91 | 684 | 366 | 13 to 58 |
| 1991/92 | 817 | 863 | 13 to 67 |

## RESULTS

Overall the mean staple strength of sound wool in the 3 wool-selling seasons was only 35.5-36.8 N/ktex (data not shown), despite the high staple strength of some of the wool in the study. The proportion of wool that was tender or part-tender increased from 35-38% in 1989/90 and 1990/91 to 51% in 1991/92 (Table 1).

The median staple strength of both sound and tender or part-tender wool was higher in wool from mature sheep than in wool from weaners and hoggets ($P < 0.05$), with the exception of sound wool in the 1991/92 wool-selling season when the median staple strengths of wool from mature sheep and from weaners and hoggets were similar (Table 2). Wool from weaners and hoggets made up 18-20% of the wool in this study, but between 23-38% of the tender or part-tender wool and only 10-14% of the sound wool was from weaners and hoggets.

Of the wool from mature sheep the median staple strength of sound wool from ewes and wethers was similar ($P > 0.05$), and was between 34 and 37 N/ktex. The same was true of tender or part-tender wool, except in the 1991/92 wool-selling season when the median staple strength of wool from ewes was lower than that of wool from wethers ($P < 0.05$). Between 52 and 56% of all wool in this study was identified as coming from ewes, and between 51 and 59% of both sound wool and tender or part-tender wool was from ewes.

Most of the wool in this study was produced in 3 regions where the pasture growing-season was between 5 and 8 months in length, and each of these regions contributed respectively 22-28%, 38-45% and 21-31% of all wool in this study. More of the sound wool (42-50%) was produced in the region where the pasture growing-season was 6-6.9 months in length than was produced in the other 2 regions (Table 2). In the 1989/90 and 1991/92 wool-selling seasons a higher proportion (36-32%) of tender or part-tender wool was produced in the region where the pasture growing-season was 5-5.9 months in length than would be expected from the proportion of all wool in this study that came from that region. The median staple strength of both sound and tender or part-tender wool was similar across all regions irrespective of the length of the pasture growing-season (Table 2) except in 1989/90 when, in the regions where the pasture growing-season was between 5 and 8 months in length, median staple strength of sound wool was greatest in the region with a pasture growing-season of 6-6.9 months ($P < 0.05$). There was a similar trend in sound wool in 1990/91 but the differences were not statistically significant.

## DISCUSSION

Poorer staple strength of wool from weaners and hoggets than from adult sheep with liveweight loss during summer and autumn in the mediterranean climatic environment of south-western Australia is well-recognised (Peter *et al.* 1992) but not well documented. In the wool produced in this environment in the 3 wool-selling seasons between 1989/90 and 1991/92 this poorer staple strength was reflected by a high proportion of tender or part-tender wool in the wool from weaners and hoggets, rather than in large differences between the median staple strengths of wool from mature sheep and weaners and hoggets. The wool clip in 1991/92 contained a higher proportion of tender or part-tender wool than the clips in the previous 2 wool-selling seasons. Although 58-70% of wool from weaners and hoggets was tender or part-tender, only about 20% of all wool in the clip was from weaners and hoggets. By contrast 47% of wool from mature sheep was tender or part-tender in 1991/92, compared with 25-26% in 1989/90 and 1990/91. Of the wool from mature sheep, 48% and 43% respectively of wool from ewes and from wethers was tender or part-tender in 1991/92 compared with 26% and 21-23% in the other 2 wool-selling seasons. There is evidence that in ewes a decrease in staple strength is associated with pregnancy and

**Table 2. Staple strength (N/Ktex) in 3 wool-selling seasons of merino fleece wool grouped according to age of the flock, sex of flocks of mature sheep, or regions of common length of pasture growing-season**

| | 1989/90 | | | 1990/91 | | | 1991/92 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Median | SD | %[A] | Median | SD | % | Median | SD | % |
| | | | | *Grouped according to age* | | | | | |
| Sound wool (> 30 N/ktex) from: | | | | | | | | | |
| Weaners and hoggets | 33[abB] | 6.7 | 10 | 34[a] | 4.6 | 11 | 35 | 5.3 | 14 |
| Mature sheep | 36[ac] | 5.6 | 44 | 36[a] | 4.5 | 40 | 34 | 4.2 | 70 |
| Unknown | 35[bc] | 5.4 | 46 | 36 | 5.2 | 49 | 34 | 5.3 | 16 |
| Tender or part-tender wool (≤ 30 N/ktex) from: | | | | | | | | | |
| Weaners and hoggets | 26[ab] | 3.7 | 38 | 26[ab] | 3.6 | 28 | 25[ab] | 3.6 | 23 |
| Mature sheep | 28[ac] | 2.7 | 24 | 28[a] | 3.8 | 27 | 27[a] | 3.1 | 58 |
| Unknown | 27[bc] | 3.3 | 38 | 27[b] | 3.4 | 45 | 27[b] | 3.3 | 19 |
| | | | | *Wool from mature sheep* | | | | | |
| Sound wool (> 30 N/ktex) from: | | | | | | | | | |
| Ewes | 36 | 4.6 | 53 | 36 | 4.7 | 56 | 34 | 4.2 | 51 |
| Wethers | 37[a] | 7.1 | 45 | 36 | 4.3 | 42 | 35 | 4.3 | 39 |
| Unknown | 34[a] | 1.9 | 2 | 36 | 5.2 | 2 | 34 | 5.1 | 10 |
| Tender or part-tender wool (≤ 30 N/ktex) from: | | | | | | | | | |
| Ewes | 28 | 3.0 | 59 | 28 | 3.1 | 56 | 27[a] | 3.3 | 54 |
| Wethers | 28 | 2.1 | 37 | 28 | 1.6 | 33 | 28[a] | 2.5 | 34 |
| Unknown | 30 | 2.5 | 4 | 26 | 3.8 | 11 | 26 | 3.5 | 12 |
| | | | | *Pasture growing-season (months)* | | | | | |
| Sound wool (> 30 N/ktex) from: | | | | | | | | | |
| 4 - 4.9 | 34 | 3.0 | 1 | 33 | 2.8 | 1 | 32 | 1.8 | 1 |
| 5 - 5.9 | 34[a] | 5.0 | 24 | 35 | 4.1 | 22 | 34 | 4.8 | 23 |
| 6 - 6.9 | 36[ab] | 5.0 | 50 | 36 | 4.9 | 45 | 34 | 4.6 | 42 |
| 7 - 7.9 | 35[b] | 4.4 | 21 | 35 | 5.3 | 30 | 34 | 4.3 | 28 |
| 8 - 8.9 | 35 | 10.6 | 4 | 37 | 4.5 | 2 | 35 | 4.9 | 6 |
| Tender or part-tender wool (≤ 30 N/ktex) from: | | | | | | | | | |
| 4 - 4.9 | 25 | 2.9 | 1 | 25 | 2.3 | 2 | 25 | 3.6 | 2 |
| 5 - 5.9 | 27 | 3.8 | 36 | 28 | 3.7 | 22 | 27 | 3.4 | 32 |
| 6 - 6.9 | 27 | 3.3 | 37 | 27 | 3.3 | 37 | 27 | 3.2 | 35 |
| 7 - 7.9 | 26 | 3.0 | 21 | 27 | 3.2 | 34 | 27 | 3.4 | 28 |
| 8 - 8.9 | 26 | 3.6 | 5 | 28 | 4.2 | 5 | 28 | 2.4 | 3 |

[A]Median and standard deviation (SD), and % of sale lots within each category of staple strength.
[B]Pairs of median values within a column in each subcategory of staple strength have been compared using nonparametric statistics. Those which are followed by the same letter are different ($P < 0.05$).

lactation (Masters *et al.* 1992), but there was little or no difference between median staple strengths of wools from ewes and wethers in this study in the 3 wool-selling seasons between 1989/90 and 1991/92. Of the wool from mature sheep, wool from ewes accounted for similar proportions of all wool, sound wool and tender or part-tender wool. This would suggest either that a large proportion of ewe flocks were not mated in 1989/90 and 1990/91 or that in general wool producers managed their flocks to minimise any adverse effects on staple strength of pregnancy and lactation in ewe flocks compared with flocks of mature wethers.

In this study and in a previous report (Baker *et al.* 1993) wools were grouped according to either regions of common average length of the pasture growing-season, calculated from meteorological records for the previous 10 years, or to the average length of the pasture growing-season over the period that meteorological records have been kept. In these studies there is some evidence of an effect of the length of the pasture growing-season on the proportion of the wool that is tender or part-tender and on staple strength, but significant environmental effects on staple strength may be masked by the broad categorisation that we have used. Bellotti *et al.* (1992) found that for a 6-year period in low, medium and high rainfall environments in Western Australia there was appreciable variation in, the distribution of annual rainfall and it was reflected in large variation in the start and length of the pasture growing-season. Baker *et al.* (1994) found that the timing of the opening rains at the beginning of the season ranked highly in explaining variation in staple strength, and they suggested that the way in which wool producers manage their flocks in response to the uncertainty of the timing of the break of the season contributes significantly to the variation in staple breaking strength in south-western Australia. This, rather than the relative contribution of wool from sheep of different ages or sex, may explain the higher proportion of tender or part-tender wool in the 1991/92 wool-selling season compared with the previous 2 wool-selling seasons.

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