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-------- Colour attributes of white Australian Mohair

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Introduction

White mohair is preferred by processors, as it can be dyed to a greater range of colours. Millington (2006a,b) provides comprehensive reviews of factors affecting photodegradation of animal fibres based on extensive research with wool. Exposure to UV light present in sunlight causes photo-bleaching, followed by progressive photo-yellowing and after a few months, the wool undergoes photo-tendering, characterized by reduced tensile strength.

The reflectance properties of wool are assessed prior to auction sales using international standards (IWTO-14, 2005). These methods describe the colour of an object in terms of tristimulus values (T units), where X refers to reflected red light, Y refers to reflected green light and Z refers to reflected blue light. Higher Y values indicate greater brightness (or lightness). Lower differences between the Y and Z values (Y-Z) indicate greater whiteness and higher differences greater yellowness. Perfectly white fibre would have Y = 100 and a Y-Z = 0. As the variation in the colour attributes of white Merino of wool is of commercial importance (Woolcheque, 2012), Australian mohair has been sold at auction with details of Y-Z values.

As no reports on factors associated with variation in colour attributes of white mohair have been located investigations have been conducted into factors associated with variation in the colour attributes of white mohair. The present work is the first part of studies aimed at quantifying factors associated with the colour attributes of white Australian mohair. This report will focus on the Y and Y-Z values.

Methods

To test the effect of farm of origin, mohair samples obtained from commercial mohair farms which participated in a national mohair enterprise benchmarking study were tested (McGregor, 2010). The samples used in the present study originated from New South Wales, Queensland, South Australia and Victoria. Samples represented a range in ages of goats harvested during the autumn 2006 shearing and represent the mohair grown over the previous six-month period during summer.

To test the effect of season, mohair samples were tested from goats grazed at Attwood, Victoria. The mohair tested came from goats shorn every 3 months during the period February 2004 to February 2006. The goats were progeny of various genetic sire lines including 100% South African origin (n = 2), 100% Texan origin (n = 3), and mixed origin sires approximately 50% South African and 50% Texan (n = 4).

A range of fibre tests were conducted including determining the colour attributes (Y and Z).

Effect of farm of origin

There was a large range in the age of goats (0.5 to 4.5 years), live weight at shearing (10 to 58 kg), greasy fleece weights (0.5 to 3.8 kg), mean fibre diameter (19 to 41 µm) and clean washing yield (66 to 96%; Table 1). There was also a large range in mohair Y (60 to 75 T units) and Y-Z (5.6 to 10.1 T units) values (Figure 1).

Table 1. Mean values and ranges in measured variables of white mohair from five farms.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of goat (years)</td>
<td>2.5</td>
<td>0.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Live weight at shearing (kg)</td>
<td>30.4</td>
<td>10</td>
<td>58</td>
</tr>
<tr>
<td>Greasy fleece weight (kg)</td>
<td>2.13</td>
<td>0.50</td>
<td>3.79</td>
</tr>
<tr>
<td>Clean washing yield (%. w/w)</td>
<td>82.6</td>
<td>66</td>
<td>96</td>
</tr>
<tr>
<td>Staple length (cm)</td>
<td>11.0</td>
<td>6.0</td>
<td>16.5</td>
</tr>
<tr>
<td>Mean fibre diameter (µm)</td>
<td>29.8</td>
<td>19.0</td>
<td>41.2</td>
</tr>
<tr>
<td>Fibre diameter coefficient of variation (%)</td>
<td>26.3</td>
<td>17.6</td>
<td>43.2</td>
</tr>
<tr>
<td>Y (T units)</td>
<td>68.0</td>
<td>60.4</td>
<td>75.5</td>
</tr>
<tr>
<td>Z (T units)</td>
<td>60.5</td>
<td>52.3</td>
<td>68.3</td>
</tr>
<tr>
<td>Y-Z (T units)</td>
<td>7.6</td>
<td>5.6</td>
<td>10.1</td>
</tr>
</tbody>
</table>

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Focus on the Y and Y+ colour attributes of white Australian mohair. This report will colour attributes of white mohair. been conducted into factors associated with variation in the attributes of white mohair have been located As no reports on factors associated with variation in colour at auction with details of Y+ values indicate greater brightness (or lightness). Lower values (T units), where X refers to reflected red light, Y refers to whiteness and higher differences greater yellowness. Perfectly differences between the Y and Z values (Y+ values). These UV light present in sunlight causes photo yellowing and after a few months, the wool undergoes photo strength.

Introduction
White mohair is preferred by processors, as it can be dyed to a whiteness and higher differences greater yellowness. Perfectly differences between the Y and Z values. (Woolcheque, 2012), Millington (2006a,b) provides a range of colours.

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<td>14 to 20</td>
</tr>
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Effect of farm of origin
Farm alone accounted for 24% of the variation in Y, and 30% of the variation in Y+. Once farm had been taken into account, the other measurements which affected the colour attributes were similar. The most important fleece attribute affecting Y was the clean washing yield. Fibre diameter attributes and staple length also affected Y. Decreasing clean washing yield, which normally means increasing the amount of grease and suint in the fleece, was associated with reduced Y. Increasing fibre diameter was associated with reduced Y.

For Y-Z the only fleece attribute of importance was mean fibre diameter. The effect of increasing mean fibre diameter was to increase Y-Z.

Effect of season and year
Autumn grown mohair had higher Y and summer grown mohair lower Y than mohair grown during other seasons. Mohair grown in Year 2005 had higher Y than mohair grown in Year 2004 (71.3 versus 69.1 T units).

The main effect of season was large, with each season having a different Y-Z, and the summer and autumn Y-Z being higher than the winter and spring Y-Z. Mohair grown in Year 2004 had higher Y-Z than for mohair grown in Year 2005 (8.16 versus 7.92 T units).

Again fibre attributes affected Y and Y-Z, particularly mean fibre diameter, incidence of medullated fibres, clean washing yield and there were small differences between the Sires.

Discussion
Y and Y-Z of white Australian mohair were affected by farm of origin, season of growth and genetic background. In addition, the Y of mohair increased with increases in clean washing yield and declined with increases in mean fibre diameter. The Y-Z of mohair increased as mean fibre diameter and the incidence of medullated fibres increased.

Variation between farms in the reflectance attributes of mohair may reflect differences between farms in: geographic and climatic factors; productivity of the goats; consumption by goats of different nutrients and plants; and genetics.

It is likely that the farms which supplied the mohair experienced different levels of solar radiation given the differences in latitude, altitude and climate of the farms (Godar, 2005). Differences in the ambient temperatures between farms may also alter sweating (suint production) which is also associated with yellowing of wool. Such an effect is likely to be part of the clean washing yield effect.

One mechanism for differences in Y and Y-Z between farms could be differences in the relative dilution of natural chromophores within the fleece consequent upon differences in rates of mohair growth (Table 1). This would imply that more productive Angora goats produce brighter (higher Y) and whiter (lower Y-Z) mohair. It is likely that the specific effect of differences in clean fleece weight on Y, Z and Y-Z was included within the farm effect.

An important fibre quality measurement related to evaluating the productivity of Angora goats and the value of mohair is the mean fibre diameter of mohair. In both the farm and the season studies, increasing mean fibre diameter was associated with lower Y and Z and higher Y-Z.
Part of the farm effect is likely to be related to goats grazing on farms located in different geographic and climatic regions where pastures are composed of different plant communities and grow on different soil types. Thus it is likely that the goats on different farms will ingest different nutrients and plant chromophores. Both the quantity and quality of plant food consumed by goats has been shown to affect the Y and Y-Z of white Australian cashmere (McGregor and Tucker, 2010) changes most likely mediated via changes in the amino acid content of the fibre and perhaps trace metal content of the fibre. Variation in soil type also causes variations in the trace metal content of wool (Fleet et al., 2010).

Summer grown mohair had the highest Y-Z and winter grown mohair having the lowest Y-Z than mohair grown in other seasons. The differences between years in Y, Z and Y-Z were not large. The differences detected between seasons are most likely to be related to the natural variation in solar radiation given the seasonal change in the altitude of the sun (Godar, 2005) but variation in the intake of natural plant chromophores and perhaps mineral intake may modify the effect of the natural rhythm of solar radiation on tristimulus values to varying extents.

**Conclusions**

In this study, the extent of the differences in Y and Y-Z values of mohair between seasons and years were not large and are unlikely to be of commercial importance. However, the extent of the differences in Y and Y-Z values between farms, and related to variations in mean fibre diameter and the incidence of medullated fibres were large enough to be of commercial importance.

**Acknowledgments**

The Rural Industries Research and Development Corporation provided financial support for research investigations. The author was employed by the Victorian Department of Primary Industries during field work. Mohair Australia and mohair producers who participated in the benchmarking project are thanked.

**References and further reading**

This is a summary of the following report:


