FLEECE CHARACTERISTICS OF AWASSI, AWASSI x MERINO CROSS, 
AWASSI BACKCROSS AND MERINO LAMBS.

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SUMMARY

Fleeces from the first shearing of pure Awassi, Awassi x Merino cross, Awassi backcross and Merino lambs at 4 months of age were analysed to determine effects on fleece characteristics due to genotype, dam age, embryo transfer, sex and type of birth. There were highly significant effects of genotype on all fleece characteristics. Yield, average fibre diameter, total staple length and innercoat length were significantly increased with increasing proportion of Awassi genes. These results were as expected based on the grading-up and breed substitution resulting from progressive backcrossing. There were, however, no effects of genotype on greasy fleece weight, nor any evidence of heterosis in any of the traits examined.

INTRODUCTION

Since the importation of Awassi fat tail sheep into Australia in 1986 (Lightfoot, 1987), breeding within quarantine has included a program of crossing with the Awassi over the Merino followed by progressive backcrossing of ewe progeny with Awassi rams. This process of grading up is expected to be the principal method of multiplication when Awassi rams and semen become available for large scale artificial insemination after quarantine ends. As a consequence, fleece characteristics in the various crosses is a matter of some commercial significance.

The fleece of the imported purebred Awassi sheep has not been altered significantly by genetic selection and remains a “primitive” double-coated carpet wool fleece type (Epstein, 1985; Goat, 1972). In Israel, homozygous FF Booroola Merino rams were crossed with Awassi ewes as part of a program to insert the F gene into the fat tail breed. Observations on the resulting Merino x Awassi progeny indicated that apparel wool production traits were improved over the maternal Awassi breed (Goot and Gootwine, 1991). The present authors are unaware, however, of any studies on fleece characteristics in progressive backcrosses to the Awassi (eg 3/4, 7/8, 15/16).

The observations reported here are part of a larger study of genotype, age and seasonal effects on fleece and follicle characteristics in a range of Awassi x Merino crossbreds when compared with both parental breeds. This paper reports on fleece characteristics from the first lamb shearing.

MATERIALS AND METHODS

The study involved 174 four-month old lambs comprising a range of genotypes from pure Merino to pure Awassi, including B1 (half), B2 (three-quarter), B3 (seven-eighth) and B4 (fifteen-sixteenth) Awassi-cross sheep. Numbers within the various classes was restricted to those available from the commercial Awassi-cross breeding program. The lambs were born in April and May 1991 within the quarantine facility at the...
Wongan Hills Research Station, 180km north east of Perth, Western Australia. They were intensively housed for 2-4 weeks before they were run under paddock conditions and then weaned in late July 1991 at approximately 3 months of age.

At shearing in August 1991 individual greasy fleece weights were recorded and right midside samples taken for further analysis. Ten staples from each midside sample were measured by ruler to determine total staple length (mm) and innercoat length (mm). The midside sample was minicORED and the subsample of 2mm snippets then solvent scoured and measured on an Optical-based Fibre Diameter Analyser (OFDA: SGS Melden Laboratories, Bibra Lake, W.A.) to determine average fibre diameter. The midside sample was scoured and air dried at 105°C to obtain the washing yield (regain = 16%).

The significance of a number of factors on greasy fleece weight, yield, fibre diameter, total staple length and innercoat length was examined by least squares analysis of variance. The model included effects of genotype, sex, type of birth (single versus multiple born) embryo transfer (i.e. whether the lamb was produced naturally, or by embryo transfer to a Merino recipient ewe) and age of dam (i.e. age of the natural mother, or of the egg donor for lambs produced by embryo transfer). Due to restrictions imposed by the commercial breeding program there was unavoidable confounding between genotype and both embryo transfer (only B3, B4 and Awassi lambs were produced by embryo transfer) and age of dam (B3, B4 and Awassi lambs were bred mainly from adult ewes). Effects due to increasing the proportion of Awassi genes and heterosis were estimated using a weighted regression of genotype mean on expected contribution using a standard direct genetic model.

RESULTS

There were highly significant effects of genotype on all fleece characteristics (Table 1). There was a significant increase in yield (p<0.02), average fibre diameter, total staple length and innercoat length (p<0.01) with increasing proportion of Awassi genes (Table 2). Greasy fleece weight did not show any trend with increased Awassi genes despite there being differences between genotypes. There was no evidence of heterosis for any of the traits examined.

Table 1. Summary of analysis of variance on fleece characteristics of Awassi, Awassi x Merino, Awassi backcross and Merino lambs (tabulated values are mean squares)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>DF</th>
<th>Greasy fleece weight</th>
<th>Average fibre diameter</th>
<th>Total staple length</th>
<th>Innercoat staple length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype</td>
<td>5</td>
<td>0.18***</td>
<td>197.58***</td>
<td>127.91***</td>
<td>65049.45***</td>
</tr>
<tr>
<td>Sex</td>
<td>1</td>
<td>0.34**</td>
<td>225.20***</td>
<td>32.22</td>
<td>5804.67***</td>
</tr>
<tr>
<td>Birth type</td>
<td>1</td>
<td>2.62***</td>
<td>11.39</td>
<td>157.02***</td>
<td>13091.50***</td>
</tr>
<tr>
<td>Emt. Trans.</td>
<td>1</td>
<td>0.00</td>
<td>4.32</td>
<td>0.94</td>
<td>22664.17***</td>
</tr>
<tr>
<td>Dam age</td>
<td>164</td>
<td>0.04</td>
<td>9.56</td>
<td>0.56</td>
<td>88.82</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>184.40</td>
<td>16.01</td>
<td>8.48</td>
<td>268.01</td>
</tr>
</tbody>
</table>

** p<0.01, *** p<0.001

There were significant differences between sexes for all fleece characteristics except fibre diameter and innercoat length. Compared with ewe lambs, ram lambs tended to cut heavier fleeces (0.95kg vs 0.86kg), have lower yields (76.5% vs 78.9%) and shorter total staple length (99.4mm vs 103.1mm). Type of birth did not affect yield but was associated with large differences in the other fleece characteristics. Single born lambs cut heavier (1.04kg vs 0.76kg) and coarser (29.4µ vs 26.3µ) fleeces than multiples. The
fleeces of single born lambs were longer than multiples in both total staple length (103.3mm vs 94.7mm) and innercoat length (65.4mm vs 58.4mm).

Table 2. The effect of an increasing proportion of Awassi genes on greasy fleece weight, yield, fibre diameter, total staple length and innercoat length (Data are presented as least-squares means ± se)*

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Greasy fleece wt. (kg)</th>
<th>Yield (%)</th>
<th>Average fibre diameter (μm)</th>
<th>Total staple length (mm)</th>
<th>Innercoat length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure Merino</td>
<td>0.99±0.08abcd</td>
<td>69.1±1.6a</td>
<td>19.5±1.1a</td>
<td>42.8±2.6a</td>
<td>5.9±2.2a</td>
</tr>
<tr>
<td>B1 (n = 30)</td>
<td>0.93±0.06</td>
<td>78.2±1.2b</td>
<td>24.6±0.8b</td>
<td>85.3±2.3b</td>
<td>63.6±1.9b</td>
</tr>
<tr>
<td>B2 (n = 91)</td>
<td>0.76±0.05b</td>
<td>80.4±1.9bc</td>
<td>26.4±0.7bc</td>
<td>99.5±2.1c</td>
<td>61.8±1.8bc</td>
</tr>
<tr>
<td>B3 (n = 74)</td>
<td>0.98±0.05c</td>
<td>77.6±1.0bd</td>
<td>29.7±0.8d</td>
<td>123.6±2.2d</td>
<td>71.4±1.8d</td>
</tr>
<tr>
<td>B4 (n = 8)</td>
<td>0.85±0.08</td>
<td>81.2±1.6be</td>
<td>31.5±1.2de</td>
<td>126.5±2.7de</td>
<td>74.7±2.3de</td>
</tr>
<tr>
<td>Pure Awassi</td>
<td>0.90±0.06</td>
<td>79.7±1.3f</td>
<td>32.2±1.0def</td>
<td>130.8±2.4ef</td>
<td>81.7±2.0f</td>
</tr>
</tbody>
</table>

* For each fleece characteristics, different superscripts within rows denote significant differences (p<0.05)

Innercoat length was the only fleece characteristic affected by age of dam. For lambs from maiden dams (mainly B1 and B2) innercoat lengths averaged 52.1mm compared with 57.6mm for lambs (mainly B3, B4 and Awassi) from adult dams. Embryo transfer did not significantly affect greasy fleece weight, yield or fibre diameter. However, lambs derived from embryo transfer (B3, B4, Awassi) had longer staple lengths (110.0mm vs 92.8mm) and innercoat lengths (64.8mm vs 54.9mm) than those produced naturally (mainly Merino, B1, B2).

DISCUSSION

The results clearly demonstrated highly significant differences between genotypes for all wool production traits measured in this study. The crossing and backcrossing of the Awassi over the Merino produces progeny with fleeces that are predictable in the case of yield, fibre diameter, total staple length and innercoat length. The relative lack of differences between the B3, B4 and pure Awassi genotypes is as expected due to the genetic basis of the grading-up process. Segregation during the formation of gametes in the halfbred Awassi x Merino cross and in all subsequent backcrosses would result in a range of gametes from one containing only Merino genes to one containing only Awassi genes. Therefore, the proportion of Awassi genes in the three quarter breeds and all subsequent crosses can range from 1/2 to 1 and it would be expected that after the second or third backcross is reached there would be little difference between the second and higher backcrosses (Nicholas, 1987).
With the exception of greasy fleece weight, the results from this study with 4 month old lambs are in general agreement with those of Goot and Gootwine (1991) with 10-17 month old sheep. In their study greasy fleece weight in the F1 Merino x Awassi crossbreeds was increased by 0.4kg over that for the Awassi ewes. Staple length was decreased by 2cm and the quality count was increased from 36/48 (i.e. approx. 33/48) to 50/58 (i.e. approx. 25/30).

The fact that greasy fleece weight showed no clear trend between successive Awassi backcrosses in the present study is surprising, especially given the lower yield of the Merino. In contrast average fibre diameter, total staple length and innercoat length were all substantially increased with increasing proportion of Awassi genes. With regard to this, it is important to note that the Awassi fleece is composed of four fibre types. Hair fibres form the outercoat of the fleece while the heterotype, wool and kemp fibres form the innercoat (Hatcher, 1991). In contrast the Merino fleece is composed almost entirely of wool fibres. The follicle densities of the two breeds also differ. The Merino has a nS:nP of 15 to 25:1 (Ryder and Stephenson, 1968) while that of the Awassi is 4:1 (Marai and Taha, 1976). Given such major differences between the Merino and the Awassi in these components of greasy fleece weight it seems likely that differences in fleece weight between the various genotypes will be expressed with advancing age at subsequent shearings.

This preliminary study with lambs highlights the need for more definitive research on fleece characteristics in adult Awassi, Awassi x Merino and Awassi backcross sheep. The senior author’s program will address this aspect, and also examine other fleece characteristics that could affect the suitability of the fleeces from the various crosses for either the apparel wool or carpet wool production systems. These characteristics include the relative proportions of different fibre types, the incidence of pigmentation, medullation, crimp, resistance to compression and vegetable matter content.

ACKNOWLEDGEMENTS

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REFERENCES