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A NOTE ON THE ASSESSMENT OF DOWN PRODUCTION IN AUSTRALIAN ‘CASHMERE’ GOATS

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ABSTRACT

Down production of 93 feral, F₁ and F₂ cashmere-producing goats run in Victoria was investigated. The goats were visually assessed for down production and shorn. Their fleeces were evaluated for total fibre, down yield, fibre diameter, grease and moisture content. Analyses on down yield and fleece characteristics indicated that they compared favourably with those of traditional cashmere-producing countries. Mean down production ranged from 330 g for males to 148 g for females. Sampling at three body sites was accurate in determining total fleece measures and visual assessment proved a reliable screening technique for on-farm selection. Large variation was found in down production indicating the possibility of rapid genetic gain through selection.

Goats produce down fibres which grow from the secondary follicles as an undercoat to the coarse hairs from primary follicles. Cashmere is down with a fibre diameter within a range of 8 to 25 μm and a mean of 15.5 μm. Cashmere-producing goats have been kept for centuries in Himalayan countries and China, Iran, Turkey and Russia. Numerous goat types including Angora and those bearing down arrived in Australia at the time of European settlement but documented arrivals are scarce (e.g. Wilson, 1873). Descendants of these goats survived in the wild. During the 1960's feral goats were harvested and the meat exported. Smith, Clarke and Turner (1973) reported on the down production of six feral goats captured in New South Wales.

Since then, cashmere societies have been formed in Australia and the world's largest cashmere processor, J. Dawson International, has been promoting the development of an Australian cashmere industry. Japanese, Italian and American manufacturers are also showing interest. Current prices provide an incentive to produce 15 to 16 μm white down with discounts for coarser coloured fibre.

Russian crossbreeding studies with indigenous down-bearing and Angora goats obtained male goats (bucks) producing 1100 g of 26 μm down and females (does) producing 920 g of 22 to 23 μm down. The mean down production of the Volgograd Region Collective Farm rose from 560 g (1966 to 1970) to 650 g (1971 to 1979), with the nucleus of 2 200 does averaging 715 g (Zaporozhtsev, 1979). In the pastoral areas of Inner Mongolia white goats produce a mean of 125 g of down and black goats from the same flocks produce 175 to 200 g (Epstein, 1965).

Australian Angora x feral goats produce a white down ‘Cashgora’ which has a fibre diameter acceptable to some cashmere processors and can be economically harvested (R. C. Couchman and B. A. McGregor, unpublished results). To establish baseline production data for Australian down-bearing goats, including those with an Angora influence, both research and objective measurement is required.

A herd of 20 000 feral goats in central western New South Wales was inspected (approximately two-thirds were bucks) and 600 down-bearing does were selected. These
does were run on natural and improved pastures in southern Victoria. This area is 244 m above sea level and has 480 mm rainfall, mean summer temperatures of 25-9°C maximum, and mean winter temperatures of 13-4°C maximum and 5°C minimum. The does were mated to ‘Cashmere’-type bucks. Two successive generations have been mated with selected bucks to give F₁ and F₂ generations. Ninety-three goats were randomly selected over the range of ages, sexes and generations for study. Each animal was visually assessed for down production on the basis of down length and density 1 week prior to shearing and the mean value recorded. Feral does were rated 1, 2 or 3; as F₁ and F₂ animals appeared to have better down production, they were rated similarly on each of three midline sections of the body, namely, neck (midway between the angle of the mandible and the head of the humerus), midside and hindquarter (over the tibia and femur joint), to give a final score range of 3 to 9. The selected bucks had a more even distribution of down over the whole body and were scored 1 to 5. No account was taken of body size in this visual assessment.

Animals were shorn early in August 1981 and fleece weights recorded. For each animal, samples were taken from the 3 sites described and bulked. Two laboratories undertook analysis of fibre diameter (determined by projection microscope examination of 100 fibres), grease and moisture content and down yields determined using laboratory dehairing machines. In the textile trade, yield is normally given in percentage units, and expressed as weight of down × 100 / total weight of greasy fibre; for this publication the data is presented in decimal form. To test the accuracy of the three site-sampling technique, the remainder of each fleece from nine animals was also subjected to testing.

Following shearing, skin surface areas were estimated on 107 goats covering the complete range in body size encountered in the herd (24 to 86 kg live weight) using the girth measurement method of Burns (1954) and treating the body as a cylinder of variable circumference. Data have been analysed by regression analysis and where appropriate by Student’s ‘t’ test.

Down yield tests conducted at the two laboratories produced significantly different results. Forty-five samples dehaired in laboratory A yielded 0.45 ± 0.11 down and in laboratory B the same samples only yielded 0.35 ± 0.10 down, a difference of 29.8% (P > 0.005). As the techniques used in laboratory A are those used for processing and quality control in industry, it is apparent that suitable correction factors need to be developed if the dehairing techniques of laboratory B are to become standard for fleece-testing programmes. Results presented in the Tables have not been corrected for laboratory effect.

In the evaluation of the composite sampling at three sites as compared with full fleece testing, full fleeces were tested at laboratory A and midline samples at laboratory B. The mean proportional yields of down were 0.34 ± 0.15 and 0.27 ± 0.16 (P > 0.005), and the mean fibre diameter was 15.47 ± 0.94 μm and 15.34 ± 1.11 μm (NS) in laboratory A and B respectively. If allowance is made for the difference in estimation of down yield between the laboratories (as shown above), then the results of testing midline samples compare favourably with those of full fleece testing (within 0.01), and offer a practical alternative.

Fleece characteristics and production of down from goats of different ages, sexes, and generations are shown in Table 1. Total fleece production averaged 700 g for older bucks, 370 to 400 g for adult does and 330 g for yearling does. The mean proportional yield of down was 0.40 to 0.48 for most groups but was 0.57 for F₁ yearling does. The mean weight of greasy down was 140 to 200 g for most groups with older bucks producing 330 g and a range of 110 to 650 g at fibre diameters of 18.9 μm and 19.8 μm respectively. There were no significant differences in total fibre,
total down production, grease, moisture or down yield between generations. However, bucks produced significantly more down than does \((P > 0.005)\). Adult buck down was significantly coarser, by 2 \(\mu m\) \((P > 0.005)\), than yearling buck or doe down. Moisture content of down samples ranged from 0.12 to 0.13. As Epstein (1965) reported higher total down production in coloured animals, data from \(F_1\) and \(F_2\) yearlings have been separated into coat colour groups (Table 2). Coloured animals tended to produce more down than white animals, but differences were not significant. There were no differences in fibre diameter.

Visual score gave reasonable predictions of total down production. The best prediction was with adult bucks, the highest down-producing group \((r = 0.84)\). Lower values were obtained for feral does \((r = 0.56)\), yearlings, coloured and white animals \((r\ \text{ranging from 0.61 to 0.77})\). These results indicate that visual selection could be 60% to 80% as efficient as objective measurement. It would seem practical to cull up to four-fifths of bucks visually and objectively measure the rest. Visual classing of yearling does would enable the best animals to be retained as replacements.

The regression relating estimated skin area \((A, \ m^2)\) to live weight \((W, \ kg)\) was \(A = 536.1\ W^{0.703} \ (R^2 = 0.98)\). Regressions relating visual score to down \((g/cm^2)\) were calculated, but were poor predictors of total down production. Further work needs to be done to assess the value of skin area used in conjunction with down length, eye assessment of density and total down production as an index of secondary follicle density. This may be an on-farm alternative to undertaking expensive skin biopsies to aid in selection.

Phenotypic correlations of down weight with various fleece characteristics for \(F_1\) and \(F_2\) yearling bucks are presented in Table 3. The correlations are as expected, in line with the differences in down production between the two groups of animals.

Results indicate that, whilst down production of unselected and \(F_1\) and \(F_2\) does is low compared to Russian animals, it is similar to those of Inner Mongolian goats, and fibre diameter is within the cashmere
TABLE 2

Fleece characteristics and production of white and coloured F₁ and F₂ yearling bucks and does

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>Total wt fibre (g)</th>
<th>Yield</th>
<th>Total wt of down (g)</th>
<th>Fibre diameter (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloured ♂†</td>
<td>9</td>
<td>356</td>
<td>45-6</td>
<td>165</td>
<td>10-7</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td>110</td>
<td>11-5</td>
<td>71</td>
<td>1-67</td>
</tr>
<tr>
<td>White ♂</td>
<td>18</td>
<td>341</td>
<td>46-1</td>
<td>153</td>
<td>16-1</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td>89</td>
<td>9-7</td>
<td>59</td>
<td>1-21</td>
</tr>
<tr>
<td>Coloured ♀</td>
<td>12</td>
<td>317</td>
<td>40-7</td>
<td>131</td>
<td>15-8</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td>68</td>
<td>11-8</td>
<td>58</td>
<td>1-27</td>
</tr>
<tr>
<td>White ♀</td>
<td>7</td>
<td>339</td>
<td>31-0</td>
<td>117</td>
<td>16-3</td>
</tr>
<tr>
<td>s.d.</td>
<td></td>
<td>125</td>
<td>9-5</td>
<td>62</td>
<td>1-66</td>
</tr>
</tbody>
</table>

† Bucks tested in Laboratory A and does tested in Laboratory B (see text).

TABLE 3

Phenotypic correlations for some fleece characteristics in F₁ and F₂ yearling bucks

<table>
<thead>
<tr>
<th>Generation</th>
<th>No.</th>
<th>Total fibre</th>
<th>Fibre diameter</th>
<th>Down weight ×</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Down yield</td>
</tr>
<tr>
<td>F₁ ♂</td>
<td>17</td>
<td>0-92</td>
<td>0-62</td>
<td>0-68</td>
</tr>
<tr>
<td>F₂ ♂</td>
<td>10</td>
<td>0-63</td>
<td>-0-50</td>
<td>0-85</td>
</tr>
</tbody>
</table>

† Density expressed as g down per cm² skin area.

range. F₂ yearling bucks and does had lower down production than similarly managed F₁ animals although differences are not significant (Table 1). This is the result of minimal objective selection for down production, while animal numbers were increased and genetic diversity maintained. Bucks produce significantly greater amounts of coarser down than does and the range in buck down production offers hope for selective breeding and improvement. Visual scoring for down production may be a reliable screening technique in selecting the most productive bucks from which herd sires could be selected following objective testing. Scoring may be improved by combining this with an estimation of skin area or body weight measurements.

Economic returns at current levels of down production are not sufficient to ensure the development of a cashmere industry in Australia. In the long term the breeding of high-producing goats using heavy selection pressure could enhance the viability of cashmere production.

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REFERENCES


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