BLOODLINE DIFFERENCES AND CHANGES IN HOGGET MERINO WOOL QUALITY TRAITS DURING BLOODLINE SUBSTITUTION

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SUMMARY
The wool quality traits of staple length, definition and thickness, crimp definition and frequency and dust penetration were measured from midside samples representing purebred, first cross and backcross combinations of eight Merino bloodlines. It is known that fibre diameter during bloodline substitution can be predicted from the parental means. It is not known if other wool quality traits behave in an additive way when bloodlines are crossed. Some of these wool characteristics have a small influence on processing performance. It is shown that there is little or no heterosis for these traits. A commercial breeder can predict the outcome of substituting a bloodline on these traits as the weighted average of the two bloodlines. There was a trend from fine to strong bloodlines of greater staple length and lower crimp frequency while staple and crimp definition were in general better defined for the medium-wool Peppin and strong-wool strains.

Keywords: Merino, sheep, crossing, wool quality.

INTRODUCTION
There are many bloodlines available to commercial wool producers which may be used to improve flock profitability. In an economic evaluation of bloodlines compared in analyses of NSW and Victorian wether comparisons, Coelli et al. (1996) have shown that there are large differences between Merino bloodlines in gross margin per dry sheep equivalent. Under the market conditions of relatively low (6%) and high (12%) micron premiums studied, wool quality traits (such as style, length, colour and strength) accounted for less than 2 - 3 % of the total variation between bloodlines as against the 88 - 93 % of the total variation accounted for by fleece weight and fibre diameter.

However, such wool quality traits may have a greater influence on the choice of bloodline used by the commercial producer than fleece weight and fibre diameter. In some instances, wool quality attributes may exclude from use possible alternative bloodlines identified by comparisons of performance in production traits. For example, well-defined crimp, long staples, and white soft handling wool ranked as being more important than clean fleece weight to many Victorian wool growers (Love et al. 1987). In a survey of NSW Merino ram breeders wool quality was identified as a breeding goal by 86% of participating studs after fleece weight, fibre diameter, body weight and reproductive rate. Also 70% of the studs used both visual assessment and objective measurement to select for fibre diameter, and 32% of these emphasised visual assessment above objective measurements (Casey and Hygate 1990). Certain wool quality attributes have been
shown also to enhance processing performance. Improved crimp definition and low crimp frequency decrease carding waste, noil and increase hauteur (Stevens and Crowe 1994).

Once an alternative bloodline has been identified for use, another concern may be the prediction of performance in wool quality traits of the first cross and backcross progeny generated during bloodline substitution. In this preliminary report, bloodline differences in staple definition, staple length, staple thickness, crimp definition, crimp frequency and dust penetration are recorded. The effect of bloodline substitution on hogget performance in these wool quality traits is reported. Data of the Merino bloodline crossing project, conducted at Trangie, were used for these analyses.

MATERIALS AND METHODS
The Merino bloodline crossing project, conducted by NSW Agriculture at the Agricultural Research Centre, Trangie, is fully described by Mortimer et al. (1994). For this study, data were recorded on purebred, first cross and back cross progeny born in 1993 and 1994 within the crossing project. In brief, these animals were derived from two contemporaneous types of matings. For the first mating type, fine-wool (two bloodlines, F1 and F2), medium-wool non-Peppin (two bloodlines, MNP1 and MNP2), medium-wool Peppin (three bloodlines, MP1, MP2 and MP3) and strong-wool (one bloodline, S) bloodlines were mated in a complete diallel design to produce purebred and first cross progeny. For the second mating type, the purebred and crossbred ewes produced by the diallel matings were mated to purebred and a restricted range of crossbred ram genotypes.

Midside samples from a total of 642 hogget (15 months) ewes and rams were recorded for staple length, staple thickness, staple definition, crimp frequency, crimp definition and dust penetration. Staple definition, staple thickness and crimp definition were assessed visually on a score from one to five, with the staple tips facing down on a black cloth, according to Crook et al. (1994). A score of one indicated very distinct and even crimp and pencil-thin staples that were well defined and free-growing (ie. few cross-fibres). A score of five indicated very thick and indistinct staples with little visible crimp. Crimp frequency was measured using a crimp wheel on three different staples (crimps/25mm). Staple length was measured using a ruler on ten staples sub-sampled for strength testing. Dust penetration was measured on the same ten staples and the depth of the staple penetrated by dust was expressed as a percentage of the staple length.

For each wool quality trait, least squares methods (REG, Gilmour 1993) were used to fit effects for bloodline and mating type (purebred versus first cross versus backcross mating types) as well as the fixed effects of sex, birthdate, age of dam, birth-rearing type and year.

RESULTS
There were significant (P<0.01) differences between bloodlines due to additive effects for all the traits reported (Table 1). The staple length ranged from 77.3 to 100.4 mm and variation between bloodlines was low (8%CV). The F1 and F2 bloodlines had the shortest staple length while the bloodlines of the other strains were much longer. The bloodlines within the non-Peppin and
Peppin strains were significantly different from each other but some bloodlines between these strains did not differ significantly (e.g. MNPl and MP1). There was considerable variation between the bloodlines in staple definition (17%CV) and values ranged from 1.4 to 2.3. The best staple definition was in the MP1, MP2 and S bloodlines, while the F1, F2 and MNPl bloodlines had the highest scores. The MNPl and MP3 bloodlines were intermediate. Overall the fine-wool and medium-wool non-Peppin strains had poorer staple definition, and the medium-wool Peppin and strong-wool strains had better staple definition. Staple thickness ranged from 3.0 to 3.8 and variation between bloodlines was similar to staple length (7%CV). Crimp definition ranged from 1.3 to 2.3 and varied greatly between bloodlines (18%CV). The S, MP1, and MP2 bloodlines had the better defined crimp, while the F1, MNPl and MP3 bloodlines had the poorest defined crimp. Between these groups were the F2 and MNPl bloodlines. Crimp frequency ranged from 8.4 to 15.4 crimps per 25mm and variation between bloodlines was high (23%CV). The MP2 and MP3 bloodlines had the lowest crimp frequency. However all bloodlines except the F1 and F2 had low values. The dust penetration ranged from 47.32% to 51.97% and variation between bloodlines was low (3%CV). The MP3 and MNPl bloodlines had lower dust penetration than the other bloodlines.

Table 1. Bloodline and mating type least square means and standard errors and heterosis estimates for wool quality characteristics

<table>
<thead>
<tr>
<th>Bloodline effect</th>
<th>Staple definition(^A) (1 to 5)</th>
<th>Staple thickness(^A) (1 to 5)</th>
<th>Staple length(^A) (mm)</th>
<th>Crimp definition(^A) (1 to 5)</th>
<th>Crimp frequency(^A) (crimps/25mm)</th>
<th>Dust penetration(^A) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>2.3 (0.1)(^a)</td>
<td>3.3 (0.1)(^a)</td>
<td>78.7 (1.3)(^a)</td>
<td>2.3 (0.1)(^a)</td>
<td>15.4 (0.2)(^a)</td>
<td>52.0 (0.9)(^a)</td>
</tr>
<tr>
<td>F2</td>
<td>2.0 (0.1)(^abc)</td>
<td>3.0 (0.1)(^a)</td>
<td>77.3 (1.4)(^a)</td>
<td>1.7 (0.1)(^bc)</td>
<td>13.9 (0.3)(^b)</td>
<td>49.5 (1.0)(^abc)</td>
</tr>
<tr>
<td>MNPl</td>
<td>2.2 (0.1)(^abc)</td>
<td>3.8 (0.1)(^b)</td>
<td>90.7 (1.2)(^bc)</td>
<td>2.1 (0.1)(^ad)</td>
<td>10.1 (0.2)(^e)</td>
<td>50.3 (0.9)(^ab)</td>
</tr>
<tr>
<td>MNPl2</td>
<td>1.8 (0.1)(^cd)</td>
<td>3.2 (0.1)(^a)</td>
<td>95.4 (1.1)(^d)</td>
<td>1.9 (0.1)(^bd)</td>
<td>9.5 (0.2)(^d)</td>
<td>47.7 (0.8)(^c)</td>
</tr>
<tr>
<td>MP1</td>
<td>1.4 (0.1)(^e)</td>
<td>3.2 (0.1)(^a)</td>
<td>89.1 (1.1)(^b)</td>
<td>1.4 (0.1)(^c)</td>
<td>10.1 (0.2)(^c)</td>
<td>49.0 (0.8)(^bc)</td>
</tr>
<tr>
<td>MP2</td>
<td>1.5 (0.1)(^de)</td>
<td>3.3 (0.1)(^a)</td>
<td>100.4 (1.2)(^e)</td>
<td>1.4 (0.1)(^c)</td>
<td>8.4 (0.2)(^e)</td>
<td>50.2 (0.9)(^ab)</td>
</tr>
<tr>
<td>MP3</td>
<td>2.0 (0.1)(^bc)</td>
<td>3.7 (0.1)(^b)</td>
<td>93.4 (1.1)(^cd)</td>
<td>2.0 (0.1)(^abc)</td>
<td>8.5 (0.2)(^e)</td>
<td>47.3 (0.8)(^c)</td>
</tr>
<tr>
<td>S</td>
<td>1.5</td>
<td>3.2</td>
<td>92.4</td>
<td>1.3</td>
<td>9.0</td>
<td>50.8</td>
</tr>
<tr>
<td>Mating type effect</td>
<td></td>
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<tr>
<td>Purebred</td>
<td>1.84 (0.05)(^a)</td>
<td>3.31 (0.05)(^a)</td>
<td>90.03 (0.61)(^a)</td>
<td>1.68 (0.06)(^a)</td>
<td>10.52 (0.12)(^a)</td>
<td>49.98 (0.45)(^a)</td>
</tr>
<tr>
<td>First cross</td>
<td>1.80 (0.05)(^ab)</td>
<td>3.32 (0.06)(^ab)</td>
<td>89.62 (0.61)(^ab)</td>
<td>1.79 (0.06)(^ab)</td>
<td>10.60 (0.12)(^ab)</td>
<td>49.05 (0.45)(^ab)</td>
</tr>
<tr>
<td>Backcross</td>
<td>1.86 (0.04)(^ab)</td>
<td>3.36 (0.05)(^ab)</td>
<td>89.33 (0.50)(^ab)</td>
<td>1.79 (0.05)(^ab)</td>
<td>10.67 (0.10)(^ab)</td>
<td>49.76 (0.37)(^ab)</td>
</tr>
<tr>
<td>Heterosis (%)(^\text{b})</td>
<td>-2.2</td>
<td>0.3</td>
<td>-0.4</td>
<td>6.5</td>
<td>0.8</td>
<td>-1.9</td>
</tr>
</tbody>
</table>

\(^A\) Means followed by different superscripts differ significantly (p<0.05)

\(^\text{b}\) The superiority of the first cross over the mean of the parental bloodlines.
The mating type differences were not significant and apparent heterosis was not significant for these traits. The means of the parental bloodlines and the first cross and backcross combinations and estimates of heterosis are reported in Table 1. Estimates calculated from the backcross exceeded or equalled that of the estimates calculated from the first cross except for dust penetration.

**DISCUSSION**

The multiple-bloodline project at Trangie has compared eight bloodlines in the one environment. Some of the strain differences are expected. The fine-wool bloodlines had staples that were shorter and more highly crimped than the other bloodlines. The results for staple length agree with Mortimer and Atkins (1989) and the results for staple length and crimp frequency agree with the unadjusted means reported by Rogan (1984). In this report the wool quality traits of crimp definition, staple definition and dust penetration, which can constitute components of style grade score, did not reflect the style grades in Mortimer et al. (1994) where the fine-wool bloodlines, together with the MNPl, tended to have a higher proportion of fleeces graded as best topmakers in style.

Bloodline substitution offers one method to change the commercial flock in order to meet future market demands (Atkins 1995). Given the importance of wool quality traits to ram breeders and commercial wool growers (Love et al. 1987; Casey and Hygate 1990), the outcome of bloodline substitution on these traits warrants attention. For the wool quality traits in this study it is shown that the effects of bloodline substitution are additive and can be predicted from the weighted means of the parental bloodlines. The first and second lamb drops will be the average of the bloodlines and continued introduction of the new bloodline will result in the change becoming progressively smaller.

Finally it should be noted that the traits in this study were assessed off the animal, using midside wool samples. These traits show varying degrees of variability both within midside samples and across the fleece (Jackson and Rottenbury 1994). In fact the evenness or uniformity of the fleece with respect to crimp definition and frequency, for example, is given consideration by some sheep classifiers. The impact of bloodline substitution on fleece variability is not known for these traits. However, Pietsch et al. (1997) showed that the impact on diameter variation within mid-side wool samples was additive and could be predicted from the means of the parental bloodlines.

**ACKNOWLEDGMENTS**

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REFERENCES