EFFECT OF GENOTYPE AND YEAR ON BIRTHWEIGHT OF CROSSBRED LAMBS IN PAPUA NEW GUINEA

G. Danbaro1 and P.F. Arthur2

1 Department of Agriculture, Papua New Guinea University of Technology, PMB, Lae, Papua New Guinea
2 NSW Agriculture, Agricultural Research Centre, Trangie, NSW 2823, Australia

INTRODUCTION
Crossbreeding is often proposed as a relatively faster method for genetic improvement of livestock breeds in most tropical environments. The aim in crossbreeding is usually to produce an intermediate genotype which expresses heterosis and breed complementarity for the economically important traits. To this end a sheep crossbreeding programme was started at the Menifo sheep research station in the highlands of Papua New Guinea in 1994. This involved the local Priangan (PR) ewes which were mated to Corriedale (CORR) and Perendale (PER) rams, imported from New Zealand, to produce the Highlands halfbreds (HHF). The HHF were further inter se mated and finally distributed to subsistence farmers.

Birthweight affects lamb survival especially in severe environments (Alexander, 1984) and has positive medium to high genetic correlations with other growth traits such as weight at weaning and at older ages (Fogarty, 1995) which, in turn, affect profitability of meat sheep operations. Analyses of birthweights of lambs could give a better understanding of the contributory factors to performance. Similarly estimates of yearly average birthweights of crossbred lambs could suggest problem areas and indicate overall success or failure of such crossbreeding programmes. The main objective of this report was therefore to compare the birthweight of the different crossbred lamb genotypes born during the five year crossbreeding programme and estimate phenotypic trends in overall performance with respect to this trait.

MATERIALS AND METHODS.
Menifo sheep research station is located in a humid tropical area 1 405 m above sea level in the Eastern Highlands Province of Papua New Guinea. Average annual rainfall is 1 285 mm with most of it falling between October and April. Mean annual temperature and relative humidity range between 19.6 °C to 27.3 °C and 65 % to 81 % respectively.

All classes of animals on the station were rotationally grazed but lactating ewes, weaners and hoggets were separated from the breeding group. Pastures consisted of both native species (e.g. Imperata cylindrica, Themeda australis and Panicum maximum) and introduced improved species (Stylosanthes spp., Macroptilium spp, Desmodium spp., Trifolium repens Haifa, Neonotonia wightii Copper, Pennisetum clandestinum and Setaria spp). Mineralized salt licks and water were freely available to all animals at all times. All breeding animals (CORR, PER, PR and crossbreds) were run together. There was limited selection of ewes for reproductive characters such as litter size, ease of lambing and mothering ability and ram lambs not required for breeding were castrated. Sheep of all ages were identified by ear tags and were dewormed regularly. Tail docking of lambs was practiced at 3 weeks of age followed by weaning at 3
months of age. Birthweights of lambs born at the station between 1994 and 1998 were used in this study.

**Statistical analyses.** Least squares analysis of variance was carried out on 1 108 lamb birthweight records. The linear model fitted to observations in statistical notation was:

\[ Y_{ijkl} = \mu + G_i + B_j + S_k + T_l + BT_{il} + e_{ijkl} \]

Where:
- \( Y_{ijkl} \) was a birthweight observation;
- \( \mu \) was a general mean birthweight;
- \( G_i \) was lamb genotype \( (i = 1, 3 \text{ i.e. HHF, CORR and PER}) \);
- \( B_j \) was the lamb birth type \( (j = 1, 2 \text{ i.e. single and twins}) \);
- \( S_k \) was the sex of the lamb \( (k = 1, 2 \text{ i.e. males and female}) \);
- \( T_l \) was year of birth of lamb \( (l = 1, 5 \text{ i.e. 1994 - 1998}) \);
- \( BT_{il} \) was birth type by year interaction and
- \( e_{ijkl} \) was a random residual term.

The analysis was run in the GLM procedures of SAS (2001)

**RESULTS AND DISCUSSION**
Table 1 shows the results of the analysis of variance of birthweight of the crossbred lambs. Least squares means of the different categories of lamb birthweights are shown in table 2.

<table>
<thead>
<tr>
<th>Source</th>
<th>D.f.</th>
<th>Sum of squares</th>
<th>F value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>12</td>
<td>78.50</td>
<td>15.21</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>1095</td>
<td>471.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected total</td>
<td>1107</td>
<td>549.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewe genotype</td>
<td>2</td>
<td>19.97</td>
<td>22.76</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Year</td>
<td>4</td>
<td>10.98</td>
<td>6.38</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

^\text{^A}\) degrees of freedom

Ewe genotype significantly contributed to variation in birthweight of lambs at the station (\( P < 0.0001 \)). The least squares mean birthweight of HHF, CORR and PER lambs were 3.29 kg, 3.11 kg and 2.73 kg respectively. The differences in birthweight for these three categories of lambs were significant. These estimates were also higher than those of purebred PR reported elsewhere in the literature. The higher birthweight of lambs of Highland halfbred ewes therefore suggests that maternal heterosis for birthweight may be important. Maternal effects are known to significantly influence pre-weaning traits in lambs (Maria et al., 1993 ; Nasholm and Danell, 1994). The mature weight of CORR is higher than the PER therefore, when mated to the same ram breed (PR), their lamb birthweight would be expected to follow the same trend as observed in this analysis.

Session 02. Breeding ruminants for meat production Communication No 02-45
Table 2. Least squares mean birthweights of crossbred lambs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Subclass</th>
<th>n</th>
<th>Means ± standard error (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewe Breed</td>
<td>Halbred</td>
<td>663</td>
<td>3.29 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>Corriedale</td>
<td>318</td>
<td>3.11 ± 0.05</td>
</tr>
<tr>
<td></td>
<td>Perendale</td>
<td>127</td>
<td>2.73 ± 0.07</td>
</tr>
<tr>
<td>Year</td>
<td>1994</td>
<td>72</td>
<td>3.59 ± 0.09</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>203</td>
<td>2.95 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>266</td>
<td>2.99 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>355</td>
<td>2.88 ± 0.06</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>212</td>
<td>2.80 ± 0.06</td>
</tr>
</tbody>
</table>

B: Number of observations

Mean birthweights of lambs generally declined over the years from 1994 to 1998 (table 2). The year effects estimate phenotypic trends in birthweights of lambs taking into account the other factors specified in the model. These trends may be due to such influences as rainfall, forage availability, change in mating systems and flock management. According to David and Sue (2000) the breeding program was beset with problems such as diseases, poor pastures and management which accumulated over the years thereby contributing significantly to the decline in birthweight of lambs born on the station during the period.

ACKNOWLEDGEMENTS
The authors wish to thank Mr. Anton Benjamin and management of the Menifo sheep research station for allowing the use of this data and also Ms Jacob Peninah and Mr. Jack Stanley for data entry.

REFERENCES