ANALYSES OF BIRTH WEIGHT OF CROSSBRED LAMBS AT MENIFO, PAPUA NEW GUINEA

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ABSTRACT

Birth weight of lambs from Priangan x Corriedale F1, Priangan x Perendale F1 and F1 x F1 (or Halfbred) ewes born between 1994 and 1998 at the Menifo Sheep Research Station in the Eastern Highland Province of Papua New Guinea were analyzed. The fixed effects linear model used included ewe genotype, sex, birth type, years and year by birth type interaction. All effects in the model contributed significantly to variation in birth weight of lambs. Least squares mean birth weight of lambs from Halfbred, Corriedale and Perendale ewes were 3.32 ± 0.04 kg, 3.18 ± 0.05 kg and 2.79 ± 0.07 kg respectively. The significantly higher birth weight of lambs from Halfbred (F1) ewes suggests maternal heterosis may be an important factor affecting birth weight of lambs.

Key words. *Crossbreeding, growth, sheep, breeds, Papua New Guinea, Corriedale, Perendale, Highlands Halbred.*

INTRODUCTION

The sheep crossbreeding programme at Menifo in the Eastern Highlands Province of Papua New Guinea, started in 1982, came to an end in the late 1990s but the data gathered during the period still provides useful information for studying various aspects of sheep production in Papua New Guinea. Crossbreeding of locally adapted sheep breeds to genetically improved temperate breeds has often been proposed as a tool for faster genetic improvement of sheep in the tropics. The purpose of such crossbreeding programs is usually to produce an intermediate breed, which can survive, exhibit heterosis for the economically important traits and also express desirable characteristics of both breeds, that is, breed complementarity. The Menifo sheep research station concentrated on producing the Highlands Halfbreds (HHF) by mating crossbred rams and ewes which result from crossing Priangan (PR) rams with purebred Corriedale (CORR) and Perendale (PER) ewes imported from New Zealand. The halfbreds produced from these types of mating were subsequently distributed as breeders to smallholder farmers.

PR is a locally adapted coarse-woolled sheep, which is recognized as a prolific breed (Mason 1980). CORR is a dual-purpose breed (wool and mutton) originating from New Zealand (Maijala 1997). PER also originated from New Zealand where it is used for meat and medium wool production in difficult hill country (Mason 1996).

Since the inception of the crossbreeding program at Menifo some reports have been published on different aspects of productivity of the F1s and halfbreds, using parts of the data collected. Manua and Malik (1988) found that overall lambing and weaning percentages were 71% and 37% respectively in 1984 compared to 87% and 65% respectively in 1985 and attributed the difference to influences such as rainfall, forage availability, change in mating systems and flock management. However no comprehensive studies have been conducted to compare the performance of the different crossbred genotypes with respect to birth weights of lambs at the station. Birth weight of lambs is an important trait, which, especially in severe environments, affects lamb survival (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. Lamb birth weight is influenced by a number of factors including ewe and ram genotype, ewe nutrition, season of birth, sex of lamb, and litter size (Martin *et al.* 1980).

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The main objective of this report is therefore to estimate and compare the birth weight of lambs of the different ewe genotypes born between 1994 and 1998 and estimate phenotypic trends in this trait over the period, taking into account sex and birth type of lambs.

MATERIALS AND METHODS

Menifo sheep research station is located 6° 15'S, 145° 30' E and 1405 metres above sea level, about 15km from Goroka, capital of the Eastern Highlands Province of Papua New Guinea. The area experiences a humid tropical type climate with average annual rainfall of 1285 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 (Sivasupiramaniam *et al.* 1986).

All classes of animals at 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 (e.g. *Stylosanthes spp.*, *Macroptilium spp*, *Desmodium spp.*, *Trifolium repens* Haifa, *Neonotonia wightii* Copper, *Pennisetum clandestinum* and *Setaria spp*). Mineralized salt licks and water were provided at all times. Seasonal mating once a year was practiced using PR rams on CORR and PER ewes and HHB rams on HHB ewes. During the breeding season a ratio of 15 to 20 rams to about 500 ewes was maintained. After six weeks rams were withdrawn and both groups kept together until the next mating season. Ewes were culled against ease of lambing, old age and ailments such as chronic foot scald problems. HHB ram lambs and replacement ewes were selected from ewes with multiple births and on weaning weight basis. Sheep of all ages were identified by ear tags and were drenched to control gastrointestinal parasites regularly. Tail docking of lambs was practiced at 3 weeks of age followed by weaning at 3 months of age. Birth weight, dam number, date of birth, sex, and birth type were recorded on all lambs born at the station between 1994 and 1998 and were used in this study.

Least squares analysis of variance was carried out on 1108 lamb birth weight records in this study. The fitted fixed effects linear model, in statistical notation was:

$$Y_{ijkl} = G_i + B_j + S_k + T_l + BT_{jl} + e_{ijkl}$$

Where: Y_{ijkl} was a birth weight observation;

G_i was ewe genotype (i = 1, ,3 i.e. HHF, CORR and PER)

B_j was the lamb birth type (j = 1,2 i.e. single and twins)

S_k was the sex of the lamb (k = 1,2 i.e. males and female)

T_l was year of birth of lamb (l = 1, ,5 i.e. 1994 - 1998)

BT_{jl} was birth type by year interaction.

e_{ijkl} was a random residual term assumed normally and independently distributed with zero mean and unit variance. The analysis was run in the GLM procedures of SAS (2001). Preliminary runs included season of birth of lambs, parity and other two-way interactions between the main factors but these did not contribute significantly to variation in birth weight and were therefore removed from the final model. Less than 1% of births were triplets. This subclass created a very unbalanced design, which affected estimates of least squares means and was therefore also removed from the final analysis.

RESULTS AND DISCUSSION

Table 1 shows the results of the analysis of variance of birth weight of the crossbred lambs.

Table 1. Least squares analysis of variance of birth weight of crossbred lambs.

Source	Degrees of freedom	Sum of Squares	F value	Pr > F
Model	12	78.50	15.21	<0.0001
Error	1095	471.07		
Corrected total	1107	549.57		
Birth type	1	33.34	77.51	<0.0001
Sex	1	2.06	4.78	0.0290
Ewe genotype	2	19.97	22.76	<0.0001
Year	4	18.97	11.03	<0.0001
Birth type by Year	4	10.98	6.38	<0.0001

The model fitted to birth weight observations was highly significant (P<0.0001).

Least squares Mean birth weights of the different categories of lambs are shown in Table 2. Ewe genotype significantly contributed to variation in birth weight of lambs at the station (P<0.0001). The mean birth weight of lambs born to HHF, CORR and PER ewes were 3.29 kg, 3.11 kg and 2.73 kg respectively.

The differences in lamb birth weight for these three categories of lambs were significant. The higher birth weight of lambs of HHB ewes may be partly attributed to the ewe's better adaptation to the less favourable pasture and health conditions that prevailed in most part of the study period as described later. Another possible reason for the higher birth weights of lambs from HHF ewes could be that they were relatively younger due to regular replacement policy compared to CORR and PER ewes which were imported and not replaced by younger ewes. The higher birth weight of lambs of HHB ewes also suggests that maternal heterosis for birthweight may be important.

Maternal effects are known to significantly influence preweaning traits in lambs (Maria et. al. 1993; Nasholm and Danell 1994). The mature weight of CORR is higher than that of PER therefore, given the same ram breed (i.e. PR), birth weight of their lambs would be expected to follow the same trend as their mature weight as was observed in this data. Even though birth weights are known to affect lamb survival (Alexander 1984), it is not possible to quantitatively estimate this effect in this study due to lack of appropriate data.

Other environmental factors, which contributed significantly to variation in birth weight of lambs on the station were birth type (P<0.0001), sex of lamb (P<0.029) and year of birth (P<0.0001) (Table 1). The mean birth weight of single and twin born lambs were 3.32 kg and 2.77 kg respectively (Table 2). Donald and Russell (1970) estimated the mean birth weight of twins to be 80% of that of single born lambs which is close to the 83% estimated in this data. The lower birth weight of twins is often attributed to competition for maternal resources in the prenatal period (Alexander 1984).

Table 2. Mean birth weight of crossbred lambs.

Factor	Subclass	Number of Observations	Means ± standard error (kg)
Birth type	Single	917	3.32 ± 0.03
	Twin	191	2.77 ± 0.06
Sex	Male	532	3.09 ± 0.04
	Female	576	2.99 ± 0.04
Ewe genotype	Crossbred	663	3.29 ± 0.04
	Corriedale	318	3.11 ± 0.05
	Perendale	127	2.73 ±0.07
Year	1994	72	3.59 ± 0.09
	1995	203	2.95 ± 0.08
	1996	266	2.99 ± 0.08
	1997	355	2.88 ± 0.06
	1998	212	2.80 ± 0.06
Birth type by year interaction	Single, 1994	46	3.78 ± 0.10
	Single, 1995	183	3.53 ± 0.05
	Single, 1996	244	3.26 ± 0.05
	Single, 1997	306	3.06 ± 0.04
	Single, 1998	138	2.94 ± 0.07
	Twins, 1994	26	3.40 ± 0.14
	Twins, 1995	20	2.36 ± 0.15
	Twins, 1996	22	2.73 ± 0.15
	Twins, 1997	49	2.70 ± 0.10
	Twins, 1998	74	2.66 ±0.09

The mean birth weight of males and females were 3.09 kg and 2.99 kg respectively. Male lambs are usually 5% to 12% heavier than female lambs at birth (Alexander 1984; Robinson *et al.* 1977).

Mean birth weights of lambs generally declined over the years from 1994 to 1998 but the mean birth weight in 1994 is larger in comparison to those of the later years. According to Low and Low (2000) critical external funding for the project was stopped in 1996. Pasture conditions (quantity and quality) declined from 1995 onwards as paddocks were not slashed or fertilized as in the past due to funding constraints. For the same reason ewes were not treated for gastro-intestinal parasites regularly from 1995 as compared with the past, the average age of breeding ewes increased due to irregular replacement and law and order problems accounted for loss of some productive breeding stock. These factors could therefore possibly account for the generally decreasing birth weights of lambs starting from 1995.

Mean birth weights for the year by birth type interaction categories show that birth weight of lambs born either as single or twin appear to follow the same trends over the years as overall birth weights for each year. The yearly trend in birth weight for single and twin-born lambs could therefore also be explained by the same factors mentioned above which affected overall yearly trends in mean birth weight of lambs.

ACKNOWLEDGEMENTS

The authors wish to thank staff at the Menifo sheep research station including Mr. Kewage Teka who painstakingly recorded the data used in this study. Special thanks also go to DAL for allowing the use of this data.

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