The Effect of Non-genetic Factors on Birth Weight and Weaning Weight in Three Sheep Breeds of Zimbabwe

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ABSTRACT : Sheep production is affected by genetic and non-genetic factors. A knowledge of these factors is essential for efficient management and for the accurate estimation of breeding values. The objective of this study was to establish the non-genetic factors which affect birth weight and weaning weight in Dorper, Mutton Merino and indigenous Sabi sheep breeds. A total of 2,625 birth and weaning weight records from Grasslands Research Station collected from 1991 through 1993, were used. The records were collected from indigenous Sabi (939), Dorper (807) and Mutton Merino (898) sheep. A mixed classification model containing the fixed effects of year, birth status and sex was used for identification of non-genetic factors. Sire within breed was included as a random effect. Two factor interactions and three factor interactions were important in indigenous Sabi, Mutton Merino and Dorper sheep. The mean birth weights were 4.37±0.04 kg, 4.62±0.04 kg and 3.29±0.04 kg for Mutton Merino, Dorper and Sabi sheep, respectively. Sire had significant effects ($p<0.05$) on birth weight in Mutton Merino and indigenous Sabi sheep. Year of lambing had significant effects ($p<0.05$) on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep. The effect of birth status was non significant in Dorper and Mutton Merino sheep while effect of birth status was significant on birth weight in indigenous Sabi sheep. In Indigenous Sabi sheep lambs born as singles (3.30±0.05 kg) were 0.23 kg heavier than twins (3.07±0.05 kg), in Mutton Merino lambs born as singles (3.99±0.08 kg) were 0.07 kg heavier than twins (3.92±0.08 kg) and in Dorper lambs born as singles (4.41±0.04 kg) were 0.02 kg heavier than twins (4.39±0.04 kg). On average males were heavier than females ($p<0.05$) weighing (3.32±0.04 kg vs. 3.05±0.07 kg) in indigenous Sabi, 4.73±0.03 kg vs. 4.08±0.05 in Dorper and 4.26±0.07 kg vs. 3.66±0.09 kg in Mutton Merino sheep. Two way factor interactions of sire*year, year*sex and sex*birth status had significant effects ($p<0.05$) on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep while the effect of year*birth status was non significant on birth weight in Indigenous Sabi sheep. The three way factor interaction of year*sex*birth status had a significant effect ($p<0.01$) on birth weight in indigenous Sabi and Mutton Merino. Tupping weight fitted as a covariate had significant effects ($p<0.001$) on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep. The mean weaning weights were 17.94±0.31 kg, 18.19±0.28 kg and 14.39±0.28 kg for Mutton Merino, Dorper and Indigenous Sabi sheep, respectively. Effects of sire and sire*year were non significant on weaning weight in Dorper and Mutton Merino while year, sex and sex*year interaction had significant effects ($p<0.001$) on weaning weight. On average males were heavier than females ($p<0.001$) at weaning. The respective weaning weights were 18.05±0.46 kg, 18.68±0.19 kg, 14.14±0.15 kg for males and 16.64±0.60 kg, 16.41±0.31 kg, 12.64±0.32 kg for females in Mutton Merino, Dorper and Indigenous Sabi sheep. Lambs born as singles were significantly heavier at weaning than twins, 0.05 kg, 0.06 kg and 0.78 kg for Mutton Merino, Dorper and Indigenous Sabi sheep, respectively. Effect of tupping weight was highly significant on weaning weight. The three way factor interaction year*sex*birth status had a significant effect ($p<0.01$) on weaning weight. Correction for environmental effects is necessary to increase accuracy of direct selection for birth weight and weaning weight. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 2 : 151-157)***

Key Words : Non-genetic Factors, Birth Weight, Weaning Weight, Sheep, Zimbabwe

INTRODUCTION

Sheep are principally kept as meat animals in Zimbabwe. There are about 350,000 sheep in Zimbabwe with the smallholder sector having about 80% of the population (CSO, 1990). The sheep breeds reared in Zimbabwe can be divided into exotic, indigenous breeds and crosses between exotic and indigenous sheep breeds. Lamb production varies a great deal under different conditions and with different breeds (Donkin, 1973). The great diversity in performance among Zimbabwean sheep breeds provides an opportunity for choice of breeds best suited to various production objectives, environments and management systems.

Birth weight as an early measurable trait is of great interest because of its positive genetic correlation with further live weights. Weaning weight is the most important economic traits determining economic returns from sheep in commercial flocks and both provide examples of traits subject to environmental variation. Mutton Merino is one of the exotic dominant meat breeds in commercial use in Zimbabwe representing 13% of the national commercial flock. (Buitendag, 1986). The Dorper sheep is the most improved exotic mutton breeds on commercial farms and the Sabi sheep is the most common indigenous sheep breed in Zimbabwe.

There has been scarcity of research work on non-genetic

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factors in sheep breeds in Zimbabwe. This study focused specifically on the influence of non-genetic factors on birth weight and weaning weight of Dorper, Mutton Merino and the indigenous Sabi sheep of Zimbabwe, which are Dorper, Mutton Merino and the indigenous Sabi sheep.

MATERIALS AND METHODS

Location

The study was done using records from Grassland Research Station in Marondera 70 km East of Harare Zimbabwe. The Research Station is situated 18° 11' South of the equator at an altitude of approximately 1,600 m above sea-level on acidic granite -derived sandy soils of inherent low fertility with a pH 4.5. The dominant feature of the climate is the fluctuation in rainfall. Both within and between seasons, which brings about corresponding fluctuations in herbage production from year to year. The quality and quantity of herbage are seasonal and follow rainfall distribution. The wet season is from November to April. The average mean rainfall over the period of study was 900 mm (range 423-1,641 mm) of which 87% of the rainfall fell between November and March. Temperatures vary from average mean minimum and mean maximum of 11 and 23°C in June and October, respectively. Ground frost are prevalent in May to August. The dominant vegetation type is Savannah with various Acacia species mostly referred to as sour veld dominated by Hyparrhenia grass species. A detailed description of the environment has been published (Kennan, 1979).

Flock management

The indigenous Sabi, Mutton Merino and Dorper were run separately, although their management was relatively uniform and consistent over the three years (1991-1993) of the study. The ewes plus their progeny were grazed on an extensively managed dryland veld during the day from 0800 h to 1500 h and were penned at night. The major grass species in these pastures are *Hyparrhenia spp.*, *Andropogon spp*., *Pennisetum purpur* and *Brachiaria mutica*. Depending on availability of food and severity of dry season. varying quantities of energy (maize stover) and protein (cotton seed cake) supplements were given when ewes grazed standing hay or cut and stacked hay. The ewes were fed 0.3 kg and lambs 0.2 kg of cottonseed cake meal each per day from the end of May each year until the onset of the rainy season. The nutrients composition of cotton seed cake was 930 g/kg DM, 730 g/kg TDN, 390-450 g/kg Protein, 300-360 g/kg DP and ME value 10.9 MJ/kg. Water was constantly available. Mineral licks were often *ad libitum* in the dry season. Prophylaxis deworming and de-ticking in a plung dip were regularly carried out using organophosphates. All animals were vaccinated against Pulpy Kidney and Rift Valley Fever.

Ewes were assigned within breeds into mating flocks each year but mating of close relatives was avoided. Ewes of all age categories were represented in each single ram mating group. The breeding season was between May and June. Single sire flocks comprised of one ram to 30 ewes. Females were introduced to the breeding flock for mating when they attained one and half years of age and rams were not used for service until they were over one and half years old. Initial ram selection was based on birth weights with males singles of over 3 kg and twins over 2.5 kg weight being retained entire, while the rest of the males were castrated using rubber ring.

The selection criteria used for subsequent retention in the flock were: firstly ewes giving birth to twins and rearing them to weaning; ewes giving birth to singles and rearing them to weaning; ewes giving birth to twins and rearing one to weaning; dry (i.e. non-pregnant) ewes, and lastly ewes which gave birth but did not wean a lamb depending on the number of replacement ewes required. Once the ewe lock stabilized at about 300-400 ewes from 1993 then all dry ewes and those ewes not rearing lambs were usually culled. Older ewes were culled mainly on their reproductive performance, with ewes not having lambed or weaned a lamb in two consecutive seasons being culled. Culling was also on age and dentition status from 6 years of age and older.

Most lambs were born between late October and early November which is the start of the rainy season. Lambs were weighed using an electronic scale and ear tagged soon after birth and left to suckle their dams during grazing until weaning at approximately 3 months of age. Lambs were separated by sex at weaning into different weaner flocks. The records taken on lambs included birth weights and weaning weights.

Data and statistical analysis

Data on birth weight and weaning weight were obtained from grasslands Research Station, Marondera, Zimbabwe. A total of 2,625 birth and weaning weight records from 1991 through 1993, were used. The records were collected from Sabi (939), Dorper (807) and Mutton Merino (898) sheep. The data was edited to remove outliers and incorrect data. Outliers were determined by plotting frequency graphs using General Linear Model (GLM) procedure of the Statistical Analysis System (SAS) (1996). Records were deleted if missing sire and dam identification or duplication of pedigree. A mixed model classification model containing the fixed effects of year, birth type and sex was used for identification of non-genetic factors. Sire within breed was included as a random effect. Two factor and three factor interactions were also considered. Tupping weight was fitted as a covariate. Both birth weight and weaning weight

Table 1. Effect of sire, year, birth status, sex, tupping weight and, the two and three factor interactions on birth weight in indigenous Sabi sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	5.23	0.0099
Year	2	6.21	0.0192
Sex	1	0.59	0.3865
Birth status	1	13.43	0.0001
Year×sex	2	4.10	0.0415
Year×birth status	2	0.96	0.5422
Sex×birth status	1	4.23	0.0202
Sire×year	2	6.44	0.0166
Year×sex×birth status	2	10.94	0.0010
Tupping weight	1	20.14	0.0001

Table 2. Effect of sire, year, birth status, sex, tupping weight and, the two and three factor interactions on weaning weight in indigenous Sabi sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	171.33	0.0190
Year	2	2.85	0.9551
Sex	1	19.89	0.4237
Birth status	1	254.93	0.0043
Year×sex	2	68.17	0.3339
Year×birth status	2	3.71	0.9420
Sex×birth status	1	26.54	0.3554
Sire×year	2	283.32	0.0107
Year×sex×birth status	2	292.56	0.0092
Tupping weight	1	862.40	0.0001

data were analyzed for indigenous Sabi, Dorper and Mutton Merino using the General Linear Model (GLM) procedure of the Statistical Analysis System (SAS) (1996) to establish the significance of the non-genetic factors and their interactions with the following mathematical model:

$$Y_{ijklm} = u+G_i+Y_j+S_k+B_l+(GY)_{ij}+(YS)_{jk}+(SB)_{kl}+(YB)_{jl} +(YSB)_{jkl}+b(P_{ijklm})+e_{ijklm}$$

where;

Y_{ijklm} = traits analyzed (birth weight, weaning weight)

u = overall mean (constant);

G_i = random effect of i^{th} sire NID $(0,\sigma^2_s)$;

Y_j = fixed effect of year of lambing; (j^{th} = 1991, 1992, 1993);

S_k = fixed effect of sex of lamb; k^{th} = male, female;

B_l = fixed effect of birth status; l^{th} = single, twins;

$(GY)_{ij}$ = random sire effect nested in year;

$(YS)_{jk}$ = interactions effects between year of birth and sex;

$(SB)_{kl}$= interactions effects between sex and birth status;

$(YB)_{jl}$ = interactions effects between year and birth status;

$(YSB)_{jkl}$ = three factor interaction effects of year of birth, sex and birth status;

Table 3. Effect of sire, year, birth status, sex, tupping weight and the two factor and three factor interactions on birth weight in Mutton Merino sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	32.12	0.0001
Year	2	8.01	0.0004
Sex	1	45.99	0.0001
Birth status	1	0.59	0.4444
Year×sex	2	12.69	0.0024
Year×birth status	2	18.17	0.0002
Sex×birth status	1	3.94	0.0523
Sire×year	2	43.96	0.0001
Year×sex×birth status	2	10.31	0.0074
Tupping weight	1	4.20	0.0451

Table 4. Effect of sire, year, birth status, sex, tupping weight and the two factor and three factor interactions on weaning weight in Mutton Merino sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	42.15	0.3466
Year	2	1,091.50	0.0001
Sex	1	265.57	0.0184
Birth status	1	0.35	0.9315
Year×sex	2	1,445.40	0.0001
Year×birth status	2	11.81	0.8921
Sex×birth status	1	16.77	0.5527
Sire×year	2	144.25	0.2231
Year×sex×birth status	2	72.15	0.4785
Tupping weight	1	61.53	0.2556

b = linear regression coefficient of tupping weight of ewe on birth weight and weaning weight in indigenous Sabi, Dorper and Mutton Merino sheep;

$e_{ijklmno}$ = is the error term, assumed to be randomly and independently distributed with a mean equal to 0 and variance equal to 0.

RESULTS

The results of analysis of variance for indigenous Sabi, Mutton Merino and Dorper sheep for birth weight and weaning weight are presented in Table 1, 2, 3, 4, 5 and 6. The mean birth weights were 3.29±0.04 kg, 4.37±0.04 kg, 4.62±0.04 kg for indigenous Sabi, Mutton Merino and Dorper sheep. Sire had a significant ($p<0.05$) effect on birth weight in Mutton Merino and indigenous Sabi sheep and was non-significant in Dorper sheep. The mean birth weights were 3.32±0.04 kg, 4.73±0.03 kg, 4.26±0.04 kg, for males and 3.05±0.07 kg, 4.08±0.05 kg, 3.66±0.09 kg, for females in indigenous Sabi sheep, Mutton Merino and Dorper sheep, respectively. The males were found to be 0.27, 0.65 and 0.60 kg heavier than females in indigenous Sabi sheep, Mutton Merino and Dorper sheep, respectively. Singles and twins were in a ratio of 92 and 8%, 45 and 55%, 60 and 40% in indigenous Sabi, Mutton Merino and Dorper, respectively. Mean birth weights were 3.30±0.05 kg, 4.26±

Table 5. Effect of sire, year, birth status, sex, tupping weight and the two factor and three factor interactions on birth weight in Dorper sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	0.10	0.7112
Year	2	6.72	0.0081
Sex	1	119.27	0.0001
Birth status	1	0.32	0.4954
Year×sex	2	5.96	0.0145
Year×birth status	2	10.65	0.0001
Sex×birth status	1	32.13	0.0001
Sire×year	2	3.90	0.0512
Year×sex×birth status	2	0.30	0.8134
Tupping weight	1	51.97	0.0001

Table 6. Effect of sire, year, birth status, sex, tupping weight and the two factor and three factor interactions on weaning weight in Dorper sheep in Zimbabwe

Source	Df	Type III SS	P-value
Sire	1	2.14	0.7688
Year	2	474.42	0.0001
Sex	1	1,444.22	0.0001
Birth status	1	1.12	0.8313
Year×sex	2	161.00	0.0389
Year×birth status	2	896.27	0.0001
Sex×birth status	1	186.68	0.0061
Sire×year	2	54.56	0.3345
Year×sex×birth status	2	373.67	0.0005
Tupping weight	1	188.59	0.0058

0.07 kg, 4.41±0.04, for singles and 3.07±0.05 kg, 3.66±0.09 kg, 4.39±0.04 kg for twins in indigenous Sabi, Mutton Merino and Dorper, respectively. The singles in exotic breeds of sheep Dorper and Mutton Merino were on average 1.04 kg heavier than indigenous Sabi sheep. Two factor interactions between year and sex, sex and birth status and, sire and year had a significant effect ($p<0.001$) on birth weight while effect between year and birth status and the three way interaction of year×sex×birth status were non significant on birth weight in indigenous Sabi and Dorper sheep, respectively. Tupping weight was fitted as covariate and had a significant ($p<0.01$) effect on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep (Tables 1, 3 and 6).

The results of analysis of variance for weaning weight in indigenous Sabi, Mutton Merino and Dorper are presented in Table 2, 4 and 6, respectively. Sire had a significant ($p<0.001$) effect on weaning weight in indigenous Sabi sheep (Table 2) and non significant in the exotic breeds. Sex and year had non-significant effects on weaning weight in indigenous Sabi sheep and had a significant effect in the exotic breeds (Tables 4 and 6). The mean weaning weights were 14.14±0.15, 18.05±0.46, 18.68±0.19 kg, for males and 12.64±0.32, 16.64±0.60, 16.41±0.31 kg for females in indigenous Sabi, Mutton Merino and Dorper sheep, respectively (Table). The males were found to be 1.5, 1.41 and 1.27 kg heavier than females in indigenous Sabi, Mutton Merino and Dorper sheep, respectively. Singles and twins in exotic sheep breeds were on average 3.70 and 4.44 kg heavier than singles and twins in indigenous Sabi sheep. Three factor interactions of sex×year×birth status were more important on weaning weight than two factor interaction in indigenous Sabi, Mutton Merino and Dorper sheep. Tupping weight was fitted as a covariate and had a significant ($p<0.001$) effect on weaning weight in indigenous Sabi, Mutton Merino and Dorper sheep.

DISCUSSION

Effect of sire on birth weight and weaning weight

The effect of sire was significant on birth weight (Table 5) in indigenous Sabi sheep and Mutton Merino (Tables 1 and 3) while had a non significant effect on birth weight in Dorper sheep. The significant effects of sire have been reported in literature for other traits in sheep (Cloete et. al., 1992). Olivier et al. (1987) found that the between sire variance terms were significant for birth weight and weaning weight in their study on Grootfontein Merino flock and similarly found variation between sires for type traits.

Sire effect had non significant effect on weaning weight in the exotic sheep breeds while highly significant in the indigenous Sabi sheep. This could have been due to the ram exchange program were new rams were occasionally introduced into the flock from surrounding farmers. This resulted into high phenotypic and genetic variability in the indigenous Sabi sheep. The high phenotypic and genetic variability in the indigenous Sabi flock could be exploited for genetic gain in birth weight and weaning weight through mass selection. The non significant effect of sire in the exotic sheep breeds could have been a result of inbreeding depression due to continued use of same rams in the flocks for a long time due to unavailability of rams of the exotic sheep breeds under the ram exchange program. The importance of the random effect of sires within breeds on birth weight and weaning weight suggest that selection of rams should be given a priority in any sheep production system making it useful in the improvement of overall economic efficiency. The significance of sire effect could also suggest that there is a possibility of generic variance for birth weight and weaning weight in sheep.

Two factor interaction of sire with year had a significant effect on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep (Tables 1, 3 and 5) this suggests that sire performance would depend on the year effect which encompasses factors such as management, climate, temperature and disease control. Sires perform differently from year to year or there is a change in ranking of sires from year to year which could be a function of rainfall, quality and quantity of feed and management on birth weight and weaning weight. In other words the main effects of sire and year are meaningless because the performance of the sire will depend on the year and vice versa. There was no confounding sires and years effects because there were overlaps of rams across years to ensure genetic links across time.

Effect of year of lambing on birth weight and weaning weight

The year of lambing had a significant effect on birth weight in indigenous Sabi, Mutton Merino and Dorper sheep. This was in agreement with what has been widely reported worldwide (Shrestha et al., 1974; Oslon et. al., 1976; Van Wyk et al., 1993). According to Sidwell and Miller (1971) differences in performance between years reflect variation in the environment, resulting primarily from differences in the amount of rainfall and the quantity and quality of herbage available. The effect of year of lambing could have been confounded with supplementation regimes which were given to the ewes as 1991/1992 was a drought year. Differences between years are normal phenomenon and are normally caused by fluctuations in environmental conditions that are difficult to control. The month within a year in which a lamb was born is very important. According to Mukandan et al. (1971), birth weights are affected by feeding conditions. Pasture availability follows a seasonal pattern, Nagpal (1984) reported that the year had a significant effect on birth weight which also agreed with the findings of (Khan and Sohani, 1983). The year effect encompasses factors which include feeding, management, climate, temperature, disease control and management ability of the person responsible for data collection. Year of birth has been found to have a significant influence on birth weight in cattle (Magnus and Brink, 1971). Large differences in rainfall lead to marked differences between years quality and quantity of forage available (Khombe, 1985) hence supplementation would remove the year effect.

The findings that effect of year of lambing and birth status were significant (Tables 4 and 6) for weaning weight in Dorper and Mutton Merino sheep is in agreement with results of others (Khombe, 1985). Van Wyk et al. (1990) reported that birth status, year-season, age of dam and sex had an effect on weaning weight in an Elsenburg Dorper sheep stud. Similar findings were also reported in the literature (Shrestha et al., 1974; Oslon et al., 1976). According to Sidwell and Miller (1971) differences in performance between years reflect variation in the environment resulting primarily from differences in the amount of rainfall and the quantity and quality of herbage available. Such differences have been reported in Zimbabwe (Asiedu, 1983; Khombe, 1985). Dickerson (1978) found season and year of lambing to have a significant effect on weaning weight. Difference between year of birth on birth weight may be expected especially in extensive farming conditions (Manyuchi et.al., 1990). The results also indicate that when the year is good in terms of forage availability ewes were able to find sufficient energy-rich grazing which account for the satisfactory birth weight gains within that particular year.

Effect of birth status on birth weight and weaning weight

Singles were significantly ($p<0.01$) heavier than twins in indigenous Sabi while had non significant effect in Mutton Merino and Dorper. Atkins (1980) reported similar findings that birth status had a significant effect on birth weight. The differences between the exotic and indigenous sheep breeds could be due to the fact that not many cases of multiple birth have been reported in the indigenous Sabi breed. Sabi sheep rarely produce twins under communal farming setup in Zimbabwe. The low birth weight and subsequent growth rate of twin born lambs can be attributed to competition for nutrients *in utero* (Galal et al., 1972). As litter size increases, there is decrease in birth mass of individual offspring (Donald and Russel, 1970; McDonald et al., 1981). The differences in foetal mass because of differences in litter size appear as early as the first month of pregnancy (Hulet et al., 1969; Dingwal et al., 1981). Low birth weight was found to be leading cause of reduced lamb viability (Wilson, 1986). Therefore particular nutritional attention should be given to ewes lambing twins. Nutritional stress limits the lambs from expressing their full genetic potential (Chang and Rae, 1972) for birth weight and weaning weight.

Birth status had also non significant effect ($p<0.05$) on weaning weight in exotic breeds (Mutton Merino and Dorper sheep) while had a significant effect ($p<0.05$) on weaning weight in indigenous Sabi sheep (Table 2). This entails that there is no carry over effect or singles do not maintain their birth status advantage from birth to weaning in Mutton Merino and Dorper. The importance of birth status in indigenous Sabi sheep is an indication of a constant maternal environmental effect and the singles tend to maintain their birth advantage to weaning. The indigenous Sabi sheep have a good mothering ability. The singles were found to have significantly ($p<0.01$) higher weaning weights in indigenous Sabi sheep than twins this is in agreement with literature findings (Manyuchi et al., 1990; Matika, 1995). The differences between singles and twins were 0.05, 0.06 and 0.78 kg for Mutton Merino, Dorper and the indigenous Sabi sheep. The birth weight differences in the exotic and indigenous sheep breeds reflect

Table 7. Least squares means and standard errors (LSM±SE) for birth weight and weaning weight in Dorper, Mutton Merino and the Indigenous Sabi sheep of Zimbabwe

	Birth weight			Weaning weight		
	Indigenous Sabi (939)	Dorper (807)	Mutton Merion (898)	Indigenous Sabi (939)	Dorper (807)	Mutton Merion (898)
Variable						
Year						
1991	3.03±0.07	4.49±0.06	4.39±0.09	12.08±0.29	16.49±0.35	16.46±0.60
1992	3.20±0.06	4.47±0.05	3.24±0.16	14.69±0.25	15.53±0.29	15.73±1.06
1993	3.31±0.06	4.24±0.07	4.25±0.08	13.40±0.24	19.61±0.42	19.85±0.51
Sex						
Male	3.32±0.04	4.73±0.03	4.26±0.07	14.14±0.15	18.68±0.19	18.05±0.46
Female	3.05±0.07	4.08±0.05	3.66±0.09	12.64±0.32	16.41±0.31	16.64±0.60
Birth status						
Single	3.30±0.05	4.41±0.04	3.99±0.08	13.78±0.22	17.58±0.24	17.37±0.52
Twins	3.07±0.05	4.39±0.04	3.92±0.08	13.00±00.23	17.52±0.26	17.32±0.54

the true biological phenomenon in terms of milk production and the high occurrence of multiple birth in exotic sheep breeds compared to indigenous sheep breeds which limit direct genetic expression of birth weight. The Dorper and Mutton Merino which are exotic breeds are high milk producers compared to the indigenous Sabi sheep. Its most likely that in Dorper and Mutton Merino twins may be supplied with sufficient milk by the dam for growth while insufficient milk may be supplied for growth in twins in the indigenous Sabi sheep, as a result birth weight differences between singles and twins in indigenous Sabi sheep is greater. The other possible reason for the greater birth weight difference between singles and twins in the indigenous Sabi sheep was due to sampling as the number of twins recorded were very few. The differences can be taken as values for permanent and common environmental dam effects which did not differ much between birth weight in exotic breeds, indicating that the exotic breeds offer possibly a similar maternal environment and/or behavior from birth to weaning. Buvanendran et al. (1992) reported similar findings that lambs born and reared as single were heavier at weaning than those born and reared as twins in Dorper sheep in Zimbabwe.

Sex effects on birth weight and weaning weight

The least squares means and standard errors for males and females are shown in Table 7. The results of statistical analysis revealed that sex had a non significant effect on birth weight in indigenous Sabi sheep. The results are in agreement with literature findings (Trail and Sacker, 1986). Khombe (1985) reported similar findings. Sex had a significant effect ($p<0.05$) on birth weight in Mutton Merino and Dorper sheep (Tables 2, 4 and 6). The males were significantly ($p<0.001$) heavier than females in Mutton Merino and Dorper sheep. The differences in the weaning mass between males and females were 1.5, 2.4 and 2.3 kg for indigenous Sabi, Mutton Merino and Dorper sheep. The weaning mass difference for males and females was nearly the same magnitude 2.4 and 2.3 kg in Mutton Merino and Dorper, respectively. The explanation is that the common selection objectives in the exotic breeds had been breeding for improved growth rates and higher slaughter weights in Zimbabwe.

The two factor interactions of sex with year and sex with birth status were important on birth weight and were unimportant for weaning weight in exotic breeds because the interactions only reached significance ($p<0.05$) on two occasion. The interactions cannot be explained readily since it may be related to sampling.

CONCLUSION

This study provides data on the importance of the effect of non-genetic factors on birth weight and weaning weight in indigenous Sabi, Mutton Merino and Dorper sheep of Zimbabwe. From the study can conclude that, to increase accuracy of selection for birth weight and weaning weight in sheep, it would be essential that correction be made for sex of lamb, year of lambing and birth status as environmental effects. Furthermore magnitude of effects of sex, year and birth status should be determined in future studies using large data sets so that comparison can be made within sheep breeds in Zimbabwe.

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