DOES DAM AGE, EWE BIRTH RANK AND SEX OF A CO-TWIN AFFECT A EWE'S LIFETIME PERFORMANCE?

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SUMMARY

A large sheep dataset including ewe and progeny records from 1982 through to 2006 was used in the present study. The data included the variables: sex of lamb, birth rank, weaning weight, year born and dam and sire. The aim was to firstly, determine if the age of the ewe's dam, or the birth rank of the ewe affected her lifetime performance and secondly, to determine in twin-born lambs if the sex of the co-twin affected survival to weaning and the lifetime performance of ewe. Age of the ewe's dam had no effect on her productive performance. The total number lambs born, weaned and total weight of lamb weaned per ewe increased with ewe birth rank. In twin-born sets of lambs, the sex of the co-twin had a small effect on survival to weaning. Sex of the co-twin did not affect the lifetime reproductive performance of ewes.

INTRODUCTION

Live weight, body condition, nutritional level, environmental conditions and genotype can all affect the physical characteristics of an animal. However, accounting for these factors does not explain all of the variation observed in animal performance. There is increasing evidence of a link between the uterine environment a foetus is exposed too and its potential survival, performance and health post-birth (Kenyon 2008, Gluckman *et al*. 2010, Greenwood *et al*. 2010). This has resulted in increased interest in potential intragenerational effects i.e. those observed in first generation offspring after that offspring was exposed to a given in-utero environment.

Factors that could potentially alter the foetal environment of a potential breeding ewe include: age of dam, birth rank and the sex of a co-twin within a set. These parameters have previously been examined individually but, those studies which have tended to utilise relatively small data sets. Age of the dam, often confounded with parity, has been shown to affect lamb live weight, carcass characteristics (Afolayan *et al*. 2007, Gardner *et al*. 2007, Gootwine *et al.* 2007) and metabolism (Pain *et al*. 2010) but little information is available for potential effects on reproductive parameters. Birth rank is known to affect lamb live weight to at least yearling age (Afolayan *et al*. 2007, Gardner *et al*. 2007, Gootwine *et al.* 2007, Safari *et al*. 2007a, Hopkins *et al*. 2007) although affects on live weight after yearling age are not always present (Corner *et al*. 2006, Kenyon *et al*. 2008). Studies also indicate that the reproductive performance of multiple born ewes is greater than that of single born ewes (Gonzalez *et al*. 1986, Safari *et al*. 2007a). Sex of the lamb is known to affect survival, with male lambs having lower survival than female lambs (Dalton *et al*. 1980). Although, Baharin and Beilharz (1977) reported that female lambs born with a male co-twin tended to have lower survival compared to its male co-twin and compared to females in a same-sexed pair.

Therefore the aim of the present paper was to use a large sheep data set to firstly, determine if the age of a ewe's dam or the birth rank of the ewe affected her lifetime performance and secondly, to determine in twin-born lambs if the sex of the co-twin affected survival to weaning and the lifetime performance of the ewe.

MATERIALS AND METHODS

The dataset was provided by Landcorp Farming Limited from their Waihora Romney stud flock which included ewe and progeny records from 1982 through to 2006. The data included the

variables: sex of lamb, birth rank, weaning weight, year born, dam and sire identity. The presence of a weaning weight in the data was taken as a measure of lamb survival to weaning. Lambs with an unknown birth rank or incomplete dam and sire data were removed from the data set. Quadruplets were pooled with triplet data due to their small number. Dams aged five and above were considered as a single group (5+). Number of lambs born, number of lambs weaned and total weight of lambs weaned per ewe were determined for each ewe over the years 1983-2000.

Analysis one – how does a ewes birth rank and her dam's age affect her lifetime performance? The variables; numbers of lambs born and weaned per ewe and total weaning weight of lambs per ewe lifetime were analysed using the MIXED model in SAS (SAS 2006) that included the fixed effects of ewe birth rank, year, flock, age of the ewe's dam and ewe status (still alive or no longer present). The status variable was needed to take into account ewes which were still within the flock in 2000. These ewes would likely produce more lambs during their lifetime but these records were not available. Ewes needed to have given birth at least once to be included in this model.

Analysis two – does the sex of the co-twin affect lamb survival? Only twin-born sets with known sex of lambs between 1983 and 2006 were used in this analysis. Survival was analysed using a MIXED model that included the fixed effects of twin sibling, sex, year, birth flock and dam age.

Analysis three – The effect of sex of co-twin on the lifetime performance of a ewe? Only ewes which were twin-born and who had lambed at least once were considered in this analysis. The variables: numbers of lambs born and weaned per ewe and total weaning weight of lambs per ewe lifetime were analysed using the MIXED model that included the fixed effects of sex of co-twin, year, flock, age of the ewe's dam at birth and status of the ewe (still alive or no longer present).

RESULTS

Analysis one. The total number of lambs born and weaned and the total weight of lambs weaned per ewe lifetime increased ($P<0.05$) with increasing dam birth rank (Table 1). Age of the ewe's dam had no ($P>0.05$) effect on lifetime production of the ewe (results not shown).

Analysis two. Same sex sets of female twins had higher ($P<0.05$) survival to weaning than mixed-set twins and male-male sets (Table 2). In addition mixed set twins, had higher survival ($P<0.05$) than male-male sets. Within a mixed-set, females had lower ($P<0.05$) survival than males (0.850 ± 0.0092 vs. 0.862 ± 0.0092).

Analysis three. There was no effect ($P>0.05$) of sex of co-sibling on the lifetime performance of ewes born as a twin (Table 3).

Table 1. Effect of a ewes birth rank on the total number of lambs born and weaned in her productive lifetime and the total weight of lamb weaned. Means within columns with differing superscripts are significantly different (P<0.05).

Ewes Birth Rank	n	Total number of lambs born	Total number of lambs weaned	Total weight weaned (kg)
1	5,082	$6.18^{a} \pm 0.177$	$5.65^{a} \pm 0.158$	$135.7^{a} \pm 3.37$
2	15,360	$6.66^{b} \pm 0.171$	$6.01^{b} \pm 0.153$	$143.2^{b} \pm 3.26$
3+[1]	1,750	$7.06^{c} \pm 0.187$	$6.37^{c} \pm 0.167$	$151.3^{c} \pm 3.57$

[1] Included both triplet and quadruplet born ewes

Table 2. Effect of sex of sibling on twin lamb survival to weaning. Means within columns with differing superscripts are significantly different (P<0.05).

Twin sibling relationship	n	Survival to weaning
Female/Female	35,198	$0.880^{a} \pm 0.0046$
Mixed-set	34,200	$0.866^{b} \pm 0.0046$
Male/Male	34,914	$0.850^{c} \pm 0.0048$

Table 3. The effect of sex of co-sibling on the total number of lambs born and weaned in her productive lifetime and the total weight of lamb weaned. Means within columns with differing superscripts are significantly (P<0.05) different.

Twin sets	n	Total number of lambs born	Total number of lambs weaned	Total weight weaned (kg)
Female-Female	11,600	6.61 ± 0.142	6.02 ± 0.127	144.7 ± 2.76
Female-Male	10,739	6.63 ± 0.144	6.06 ± 0.129	145.5 ± 2.80

DISCUSSION

In support of the findings of Safari *et al.* (2007a) age of the ewe's dam, did not affect the lifetime reproductive performance of the ewe. Therefore for reproductive traits the data suggest age of the ewe's dam does not need to be considered when selecting replacements. Somewhat in support of these findings, Kenyon *et al*. (2008) reported that the reproductive performance of two-year-old ewes was not affected by dam parity while Kenyon *et al*. (2009) reported that grand dam parity had no effect on lamb live weight or survival.

The present findings that ewe birth rank affected her reproductive performance supports the findings of Gonzalez *et al*. (1986) and Safari *et al*. (2007a) and indicate the potential importance of selection based on birth rank if the aim is to increase reproductive performance of the flock. Although, reproductive traits tend to have low heritability (Safari *et al.* 2007b). In commercial flocks where farmers often have little pedigree information, birth rank may be the only reproductive phenotype the have. In these situations using birth rank as a parameter when selecting ewe replacements would be worthwhile.

In the present study, complete male twin-sets of lambs had the lowest survival, followed by mixed sex pairs and within the mixed set, the female had the lowest survival rate. However, the relative size of the survival effects was not large. It is known that birth weights affects survival and it has also been suggested that relative birth weight affects the ability of a lamb to compete within a litter (Everett-Hincks and Dodds 2008, Morel *et al*. 2009). Korsten *et al*. (2009) found that the birth weight of female lambs within a mixed set was lighter than those in a female:female set. In contrast, males in a mixed set did not differ in birth weight compared to those in a male only twin set. Gardner *et al*. (2007) also reported that males in a mixed set did not differ in birth weight compared to those in a male only set but, did observe that males in a mixed set were 0.5 kg heavier than their female counterpart. However, Avdi and Driancourt (1997) found no effect of sex of lamb on twin lamb birth weight. Combined, these studies may suggest that the reduced survival of the female in the mixed sexed twin pair may be due its lower birth weight and reduced ability to compete with its sibling. Birth weights were not recorded in the present study.

The present findings support those of Avdi and Driancourt (1997) who reported that sex of the co-twin in utero had no effect on ovulation rate and litter size. Although, not significant, Uthlaut *et al.* (2010) reported that ewes co-twinned with a ram tended to produce 10% fewer lambs in their productive lifetime than those co-twinned with a ewe. Similarly, Korsten *et al.* (2009) noted that in Soay sheep, which average less than one lamb born per ewe lifetime, that those females which

had a male co-twin gave birth to less lambs than those with a female co-twin. They attributed this difference to reduced survival of the females, in their first year, supporting the lower survival to weaning of mixed paired lambs, specifically the female, in the present study. When this was considered, co-twin sex was no longer significant for number of lambs born per ewe lifetime (Korsten *et al*. 2009). Combined results suggest the sex of the co-twin does not need to be taken into account when selection on future potential reproductive performance is made.

CONCLUSION

The data suggest for reproductive traits that age of the ewe's dam does not need to be taken into account but birth rank of the ewe should be considered. Within twin-born ewes, sex of their co-twin does not need to be considered when selection for potential lifetime reproductive performance is being undertaken.

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