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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 ewe's 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 an 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 ewe’s 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).  

<table>
<thead>
<tr>
<th>Ewes Birth Rank</th>
<th>n</th>
<th>Total number of lambs born</th>
<th>Total number of lambs weaned</th>
<th>Total weight weaned (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,082</td>
<td>6.18 ± 0.177</td>
<td>5.65 ± 0.158</td>
<td>135.7 ± 3.37</td>
</tr>
<tr>
<td>2</td>
<td>15,360</td>
<td>6.66 ± 0.171</td>
<td>6.01 ± 0.153</td>
<td>143.2 ± 3.26</td>
</tr>
<tr>
<td>3+1</td>
<td>1,750</td>
<td>7.06 ± 0.187</td>
<td>6.37 ± 0.167</td>
<td>151.3 ± 3.57</td>
</tr>
</tbody>
</table>

1 Included both triplet and quadruplet born ewes
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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).

<table>
<thead>
<tr>
<th>Twin sibling relationship</th>
<th>n</th>
<th>Survival to weaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female/Female</td>
<td>35,198</td>
<td>0.880 ± 0.0046</td>
</tr>
<tr>
<td>Mixed-set</td>
<td>34,200</td>
<td>0.866 ± 0.0046</td>
</tr>
<tr>
<td>Male/Male</td>
<td>34,914</td>
<td>0.850 ± 0.0048</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Twin sets</th>
<th>n</th>
<th>Total number of lambs born</th>
<th>Total number of lambs weaned</th>
<th>Total weight weaned (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female-Female</td>
<td>11,600</td>
<td>6.61 ± 0.142</td>
<td>6.02 ± 0.127</td>
<td>144.7 ± 2.76</td>
</tr>
<tr>
<td>Female-Male</td>
<td>10,739</td>
<td>6.63 ± 0.144</td>
<td>6.06 ± 0.129</td>
<td>145.5 ± 2.80</td>
</tr>
</tbody>
</table>

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.

**ACKNOWLEDGEMENTS**

The authors wish to thank Landcorp Farming Limited and specifically the staff working with the Waihora Romney flock. We also acknowledge the National Research Centre for Growth and Development, a Centre of Research Excellence and Massey University for funding the study.

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