THE EFFECT OF SUBCUTANEOUS FAT, MUSCLE AND BODY WEIGHT DURING MATING ON FERTILITY IN MERINO AND BORDER LEICESTER X MERINO LAMBS

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SUMMARY

Mating ewes to produce their first lamb at 12 to 14 months of age is one strategy to improve reproduction efficiency. Over two years we compared the reproductive performance of Merino and Border Leicester x Merino cross ewe lambs mated at 7-8 months of age. We analysed their reproductive performance in relation to their liveweight, eye muscle depth and fat depth at the C site, a point between the 12th and 13th ribs, 45 mm from the midline. The Border Leicester x Merino ewes outperformed the Merino ewes and there were differences between those that produced a lamb and those that did not. In most cases ewes that produced a lamb were heavier at joining and had a higher muscle and fat depth than those that did not lamb. These differences provide opportunities to select for these indicator traits to enhance early fertility traits in ewe lambs.

INTRODUCTION

Several maternal breeds have a capacity to conceive at 7 – 8 months of age and to lamb when they are about one year old (Fogarty *et al*. 2007), but this is not a common practice for Merinos. If Merino ewes could be selected and bred to reliably rear lambs at about one year old there would be a range of benefits to the industry including, improved production efficiency, the breeding flock could be increased in size and the generation interval would be reduced (Fogarty *et al*. 2007).

Liveweight of ewe lambs at post-weaning age is likely to be an important driver of the reproductive success of joining ewe lambs. Davidson *et al*. (2005) found that rates of pregnancy in Merino lambs was correlated to liveweight at joining and lambs that were 40 kg or greater were more likely to conceive than ewes below that weight. Watson and Gamble (1961) found that growth rate was also implicated as faster growing lambs were both younger and heavier at their first puberty than lambs that grew more slowly.

Carcass traits may also be related to the reproductive success of ewe lambs. Ferguson *et al*. (2010) found that muscle influenced fecundity of adult Merino ewes and that genetically fatter ewes had higher fertility is some years but not others. If these traits have a role in the reproductive performance of mature ewes it is also likely that they will play a role in onset of puberty and the ability for early conception. In this paper we compared the fertility of Border Leicester x Merino (BLM) with Merino (MM) ewe lambs and investigated whether fertility in ewe lambs is influenced by subcutaneous fat, muscle and liveweight.

MATERIALS AND METHODS

This study used BLM and MM ewe lambs born in 2007 and 2008 at the Information Nucleus site in Katanning WA (van der Werf *et al*. 2010). In March 2008, 81 BLM and 123 Merino ewe lambs were mated when they were on average 213 days old to a syndicate of rams for five weeks. This was repeated in March 2009 when 78 BLM and 212 MM ewe lambs were mated when they were 241 days old.

The ewes were scanned by ultrasound to determine eye muscle depth (EMD) and fat depth (FAT) at the C site about six weeks prior to joining for the 2007 drop ewes, when they were about 5.5 months old, and about six weeks post joining for the 2008 drop ewes, when they were about 10.5 months old. About one week prior to the commencement of lambing the ewes were put onto one hectare lambing plots in groups of about 15 ewes. Lambing rounds were conducted twice daily. At birth the lambs were tagged and the mothers' identification determined.

Analysis. A generalised linear mixed model approach was used to analyse ewes that produced a lamb/s. Fertility was coded as 0 (not lambed) and 1 (lambed). A logistic model was fitted and breed and year of birth were fitted as fixed effects. Four measurements were included as covariates; joining weight, scanning weight, EMD and FAT. The interactions between breed and these traits were investigated. Differences in scanning weight, EMD and FAT between pregnant and non pregnant ewes within each breed were determined using a one tailed homoscedastic t test.

RESULTS

In both years the BLM ewes were heavier than the MM ewes at joining. The 2007 drop BLM ewes weighed 49.5 ± 0.69 kg and the Merinos 42.6 ± 0.53 kg. In 2008 BLM ewes were 42.4 ± 0.69 kg and the MM ewes 35.1 ± 0.35 kg. A significant breed effect was found with a greater proportion of BLM ewes producing a lamb than MM ewes in both years (86 vs 47 in 2008 and 45 vs. 9 lambs per 100 ewes joined in 2009 for BLM and MM, respectively ($P < 0.001$). There were also differences in the distribution of lambing in relation to time of joining (Figure 1).

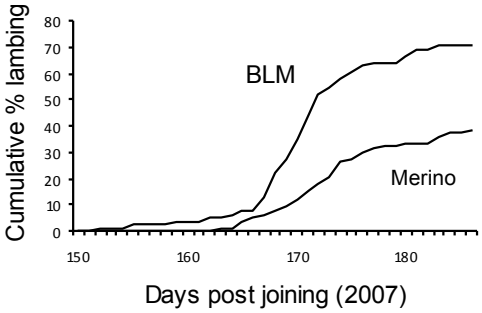

Figure 1a. The cumulative proportion of 2007 drop Border Leicester x Merino and Merino ewes that lambed in relation to days post joining.

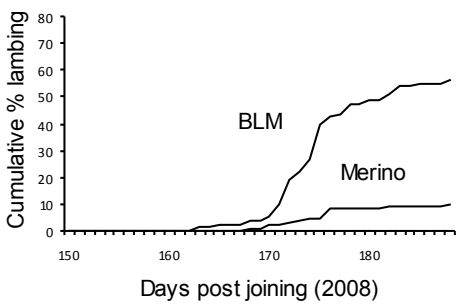

Figure 1b. The cumulative proportion of 2008 drop Border Leicester x Merino and Merino ewes that lambed in relation to days post joining.

Ewes that were heavier at joining or scanning were more likely to conceive than lighter ewes (Table 1). For the 2007 drop all three traits were associated with the success of establishing pregnancy for the MM ewes but were not significant for the BLM ewes. For the 2008 drop however these traits were significant for both breeds except for FAT in the MM ewes.

The effect of liveweight at scanning and joining, EMD and FAT on fertility are shown in Table 2 for each breed. There was a significant interaction between breed and weight at ultrasound scanning ($P < 0.01$) with the Merino having a higher slope (0.172 *vs* 0.159) than the BL. However,

this interaction was not apparent at joining. No significant interaction effects were found between breed and FAT and for breed and EMD (Table 2).

Table 1. The comparative mean values (± se) of liveweight at scanning, EMD and FAT for BLM and Merino ewes born in 2007 and 2008 for ewes that lambed and did not lambed.

			Lambed	Dry	Sig Level
2007	BLM	Scanning WT (kg)	38.12 ± 0.64	38.83 ± 1.25	ns
		EMD (mm)	23.57 ± 0.40	22.58 ± 0.72	ns
		FAT (mm)	3.63 ± 0.14	3.42 ± 0.19	ns
	Merino	Scanning WT (kg)	35.71 ± 0.64	32.90 ± 0.62	P < 0.01
		EMD (mm)	21.11 ± 0.30	19.09 ± 0.35	P < 0.0001
		FAT (mm)	2.99 ± 0.09	2.53 ± 0.07	P < 0.0001
2008	BLM	Scanning WT (kg)	47.73 ± 0.71	42.30 ± 0.81	P < 0.0001
		EMD (mm)	25.74 ± 0.45	23.53 ± 0.43	P < 0.001
		FAT (mm)	4.23 ± 0.14	3.50 ± 0.05	P < 0.0001
	Merino	Scanning WT (kg)	43.83 ± 1.61	36.74 ± 0..32	P < 0.0001
		EMD (mm)	21.26 ± 0.89	19.48 ± 0.19	P < 0.01
		FAT (mm)	2.68 ± 0.15	2.53 ± 0.05	ns

Table 2. Logistic regression coefficients (± se) of fertility on liveweight at scanning, eye muscle depth (EMD) and FAT at the C site of BLM and Merino ewe lambs adjusted for year of birth.

	BLM	Merino
Liveweight at joining	0.048 ± 0.043 [a]	0.048 ± 0.043 [a]
Liveweight at scanning	0.159 ± 0.058 [a]	0.172 ± 0.065 [b]
EMD	0.086 ± 0.083 [a]	0.098 ± 0.081 [a]
FAT	0.336 ± 0.306 [a]	-0.218 ± 0.309 [a]

[ab] Slopes with different superscripts in the same row differ significantly (P<0.05)

DISCUSSION

The fertility of BLM and MM ewes from the 2008 drop was less than the 2007 drop as the seasonal conditions restricted post-weaning growth of the 2008 drop. Subsequently they were much lighter at their first joining. Overall, BLM ewes performed far better than the MM ewes and this difference was greater under the harsher conditions faced by the 2008 drop ewes (56 vs. 10%) than those faced by the 2007 drop ewes (70 vs, 40%).

There were marked differences in time of lambing, and therefore time of conception in relation to introduction of rams between years and breeds. It may be that many of the 2008 drop ewes are mating and returning to service when the rams are first introduced or that there is a ram effect

when the ewes are introduced to rams. Kenyon *et al* (2008) provides some support for the latter proposition. They found that ewe lambs that were exposed vasectomised rams for 17 days prior to the introduction of rams had better conception rates than ewe lambs were exposed to entire rams for short periods (2 or 4 days) or ewe lambs that had not been teased at all. An alternate explanation may by offered by Mulvaney *et al*. (2010) who found that ewe lambs on maintenance level nutrition did not perform as well as ewe lambs on higher levels of nutrition and that performance increased with the plane of nutrition. If the former is the case it may be possible to improve early conception with the use of teaser wethers to initiate cycling. It would also seem reasonable that a high level of nutrition will improve performance. It is also possible that there could be an interactive effect of both nutrition and teasing prior to introducing rams. Further investigation would be required to determine the cause of the relatively poor initial conception rate.

It is interesting that liveweight at scanning, EMD and FAT were not different between 2007 drop pregnant and non pregnant BLM ewes (Table 1). However these factors became important to the nutritionally challenged 2008 drop BLM ewes. Liveweight and EMD were greater in the MM ewes that produced a lamb than those that did not. This suggests a genetic basis to early reproductive success, which supports Alkass *et al*. (1994) who showed a heritability estimate of 0.35 ± 0.06 for age at puberty and 0.26 ± 0.08 for weight at puberty. This may be explained by Ferguson *et al*. (2010) who reported that FAT became important in achieving pregnancy in mature MM ewes subject to low nutrition. It is then perhaps curious that FAT in the 2008 drop MM ewes was not significant in the challenged environment. It may be that FAT in MM ewe lambs cannot accumulate sufficient reserves in a challenged environment. The ewes also grew more slowly in that environment. It would seem intuitive that if growth is impaired fat reserves will not accumulate. This suggest that nutrition is the underlying problem. In turn that suggests that successful reproduction with Merino ewe lambs would only be a feasible proposition where nutrition is high prior to mating. More information is required under different environmental conditions to confirm these trends.

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