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Does mid-pregnancy shearing affect lamb fleece characteristics?

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ABSTRACT

Mid-pregnancy shearing has been promoted as a technique to increase both lamb birth weight and survival in multiple-born lambs. Mid-pregnancy shearing has also been shown to increase dam wool quantity and quality and, in some instances, increase lamb growth rates until weaning. It has also been suggested that shearing of the dam during pregnancy results in a change in the lamb's fleece characteristics. The aim of this study was to further investigate the effect of dam shearing treatment on lamb fleece characteristics. Thirty-one singleton and 29 twin-born lambs were born to either mid-pregnancy shorn or unshorn Romney ewes. At 6 months of age the lambs were midside sampled (to allow measurement of staple length (SL), washing yield, loose wool bulk, colour and mean fibre diameter (MFD)). A skin biopsy was taken from the midside to measure the ratio of secondary to primary follicles. The lambs were shorn three weeks later and a fleeceweight was obtained. Lambs born to shorn dams had a higher MFD (32.9 vs. 31.3μm, $P<0.05$) and had slightly whiter wool (0.1 vs. 0.3, $P=0.07$) than their counterparts born to unshorn ewes but did not differ for yield, SL or bulk. The higher MFD found in the lambs born to shorn ewes was associated with a decrease in the number of secondary follicles ($P<0.05$) without a significant decrease in the number of primary fibres. There was a significant interaction ($P=0.05$) between birth rank and shearing treatment on fleeceweight such that twin-born lambs born to shorn dams tended to have heavier fleeces (by 170g) than those born to unshorn dams, this relationship was not observed in singleton lambs. This study suggests that for singleton lambs, mid-pregnancy shearing of the dam will have no appreciable effect on wool value. However in twin-born lambs an increase in fleece weight may offset any decreased value due to higher MFD.

Keywords: mid-pregnancy shearing; micron; follicle development.

INTRODUCTION

Mid-pregnancy shearing has been promoted as a technique that can increase lamb birth weight and therefore increase the survival rates of otherwise lightweight lambs. However, if farmers are to implement any new management option the possible consequences on production need to be addressed, as they affect the overall profitability of any new system. Mid-pregnancy shearing has indeed been shown to increase lamb birthweight and has tended to increase survival rates to weaning (Morris *et al*., 1999). Additionally, it has on some occasions been found to increase lamb growth rates to weaning and dam annual fleece weights (Morris *et al*., 1999; Smeaton *et al*., 2000; Kenyon, 2002). Revell *et al*. (2002) reported that late pregnancy fetuses from mid-pregnancy shorn dams had both higher secondary follicle densities and secondary-to-primary-follicle ratios than their counterparts from unshorn dams. The differences in lamb birth weight are thought to be due to differences in fetal nutrition during the second half of gestation (Morris & McCutcheon, 1997). It has also been shown that it is possible to affect *in utero* follicle development though dam nutrition (Cartwright & Thwaites, 1976; Hutchison & Mellor, 1983). It is, therefore, possible that mid-pregnancy shearing results in changes in fetal nutrition that have positive or negative consequences on follicle development.

Differences in wool fibre diameter between sheep have been shown to be due to wool follicle density (Scobie & Young, 2000). Follicle density in turn is determined by the density of secondary follicles (Hocking-Edwards *et al*., 1996). Thus, mid-pregnancy shearing may result in lambs that have finer, higher-value fleeces throughout their lifetime.

The aim of this study was to examine the effect of mid-pregnancy shearing on the follicle population and fleece characteristics of six-month-old Romney ewe lambs born to either mid-pregnancy shorn or unshorn ewes.

MATERIALS AND METHODS

Ewe lamb source

The ewe lambs in this study were born to either mid-pregnancy-shorn or unshorn (with approximately six months wool growth) Romney ewes. All ewes conceived to a Romney ram during a 17-day mating period. Ewes were managed under commercial conditions as one flock during pregnancy, except for a period of six days in which unshorn and shorn ewes were offered similar allowances but grazed in adjacent paddocks (shorn ewes being grazed in a more sheltered paddock) after mid-pregnancy shearing. In late pregnancy, ewes were set-stocked within pregnancy rank, with equal numbers of shorn and unshorn ewes in each paddock. The ewe lambs in the trial were randomly selected from the resulting 202 singletons and 893 twin-born lambs. Only one lamb from each twin pair was selected.

Wool and skin measurements

Mid-side wool samples and fleece weights were collected from singleton and twin-born ewe lambs at approximately six months of age. After collection, all wool samples were conditioned at 65% relative humidity until (and during) fibre testing. Additionally, each ewe lamb had a skin biopsy taken from within the clipped mid-side area. The exposed skin patch was sterilized (with iodine) and a local anaesthetic (2ml Lopaine (Lignocaine), Ethical Agents, New Zealand Ltd) was injected subcutaneously into the center of the sterilized patch. This was left for three minutes, to allow the anaesthetic to take effect, before a skin biopsy was taken adjacent to the site using a 10mm biopsy trephine. The skin sample was immediately fixed in Bouins fluid. The biopsied area was then retreated with iodine. All lambs received an intra-muscular dose of long-acting antibiotic (10mg/kg Engemycin (oxytetracyline), Chemavet.Div. Pharmaco NZ Ltd). Skin samples were removed from the fixative within 12h and stored in 70% ethanol until histological processing.

Skin samples were embedded in paraffin wax and sectioned at 6μm thickness transverse to the plane of the follicle and stained using Haematoxylin and Eosin (Auber, 1952; Ryder & Stephenson, 1968). Sections containing primary (P) and secondary (S) follicles were selected at the level of the sebaceous gland in the skin, and were examined using a light microscope. Wool follicles were counted in a minimum of six fields of view for each skin sample. Primary (P) and secondary (S) follicles were counted and the ratio of S to P follicles (S:P) was calculated.

Staple length was measured as the average length of ten staples. Samples were aqueous scoured in a four-bowl mini scour to obtain a washing yield. The sample was then carded in preparation for the measurement of loose wool bulk using a WRONZ Loose-Wool Bulkometer (Bedford *et al*., 1977). Clean wool colour was measured on a Hunterlab spectrophotometer (Hunterlab, Colour Quest 45°/0° LAV, Hunter Assoc Laboratory VA, USA) according to SANZ (1984). The sample was then cored by hand using a 2mm trocar and used to measure mean fibre diameter (MFD), the coefficient of variation of fibre diameter (cvMFD) and fibre curvature using an Optical Fibre Diameter Analyser (OFDA), (IWTO, 1998).

The trial was undertaken with the approval of the Massey University Animal Ethics committee.

Data Analysis

Comparative least-squares means between groups were estimated for measured follicle and wool parameters using the Generalised Linear Model procedure of the statistical package 'MINITAB' (Minitab, 1998). The main effects of shearing treatment, birth/rearing rank and their interaction were fitted. The interaction between the main effects was only significant for greasy fleece weight and was, therefore, not included when analysing the other parameters. Lamb and ewe live weights at weaning were also tested for use as a covariate but were not included due to lack of significance. The raw S:P data were more normally distributed than the data following log-transformation and were therefore analysed in their raw state.

RESULTS

Of the 29 twin-born lambs selected for the study, six were subsequently reared as singles and, therefore, omitted from the data set because their nutritional environment was substantially different from their twin-reared contemporaries. An intermittent fault in the scales used for weighing fleeces resulted in some anomalous values (n=6) that were omitted from the data set.

Lambs born to unshorn dams tended to have more secondary follicles than lambs whose dams were shorn (Table 1; $P<0.05$). This trend was diluted by a slightly higher but non-significant difference in the number of primary follicles so that there was no difference in the S:P ratio.

TABLE 1: Effect of rearing rank (single *v*. twin) and dam shearing treatment (unshorn *v*. shorn at day 70 of pregnancy) on the wool follicle populations of 6-month-old lambs. Data are least-squares means.

	(n)	Number of Primary Follicles	Number of Secondary Follicles	Ratio of Secondary to Primary Follicles
Rearing rank				
Single	27	6.3	48.9	9.7
Twin	23	6.0	50.0	9.9
signif.				
Shearing treatment				
Unshorn	25	6.5	52.4	9.8
Shorn	25	5.8	46.5	9.7
signif.			*	
PSE		0.3	1.9	0.6

Twin-born lambs had significantly lower MFD ($P<0.05$) with a higher cvMFD ($P<0.05$) than their single-born counterparts. Lambs born to unshorn dams grew finer wool ($P<0.05$) and tended to have a higher cvMFD ($P=0.09$) than those born to shorn dams (Table 2).

TABLE 2: Effect of rearing rank (single *v*. twin) and dam shearing treatment (unshorn *v*. shorn at day 70 of pregnancy) on the fibre diameter of 6-month-old lambs. Data are least-squares means.

	(n)	Mean Fibre Diameter (MFD) (μm)	Coefficient of variation of MFD (%)
Rearing rank			
Single	31	32.9	25.7
Twin	23	31.3	26.8
signif.		*	*
Shearing treatment			
Unshorn	27	31.3	26.7
Shorn	27	32.9	25.8
signif.		*	P=0.09
PSE		0.5	0.3

There was a significant interaction ($P<0.05$) between rearing rank and shearing treatment for greasy fleece weight (GFW) such that while dam shearing treatment had little effect on the GFW of single-born lambs, it caused an increase in the GFW of twin-born lambs (Table 3).

Both rearing rank and shearing treatments had a small but significant effect on colour, such that twin lambs had significantly poorer colour wool than their single-born counterparts (Table 4; $P<0.05$) and lambs born to shorn dams had better colour wool than those born to unshorn dams ($P=0.07$).

Singleton lambs grew wool that was 0.9 cm^3/g bulkier than that of twin-born lambs (Table 4; $P<0.05$). There were no significant effects for either treatment on fibre curvature, staple length or washing yield (Table 4).

TABLE 3: Effect of rearing rank (single *v.* twin) and dam shearing treatment (unshorn *v.* shorn at day 70 of pregnancy) on the greasy fleece weight (GFW) of 6-month-old lambs. Data are least-squares means.

	(n)	**GFW**(kg)
Rearing rank ✕ Shearing trtmt		
Single ✕ Unshorn	15	1.45^{b}
Single ✕ Shorn	14	1.40^{b}
Twin ✕ Unshorn	7	1.15^{a}
Twin ✕ Shorn	12	1.32^{ab}
signif.		*
PSE		0.05

$^{a,\,b}$ Values with no superscripts in common are different at P<0.05

TABLE 4: Effect of rearing rank (single *v.* twin) and dam shearing treatment (unshorn *v.* shorn at day 70 of pregnancy) on the wool characteristics of 6-month-old lambs. Data are least-squares means.

	(n)	**Colour** (Y-Z)	**Bulk** (cm^3/g)	**Fibre Curvature** (deg./mm)	**Staple Length** (mm)	**Yield** (%)
Rearing rank						
Single	31	0.0	21.4	49.4	73	84
Twin	23	0.4	20.5	50.8	74	84
signif.		*	*			
Shearing treatment						
Unshorn	27	0.3	20.8	50.7	73	84
Shorn	27	0.1	21.1	49.5	75	84
signif.		P=0.07				
PSE		0.1	0.3	1.1	2	1

DISCUSSION

Evidence from previous trials has suggested that mid-pregnancy shearing may increase the number of secondary wool follicles that develop in lambs born and decrease the fibre diameter of their fleeces (Revell *et al.*, 2002). In contrast, the current study found that mid-pregnancy shearing caused a decrease in the number of secondary follicles and a resultant increase in the fibre diameter as expected (Meikle *et al*., 1988; Scobie & Young, 2000).

Secondary follicles generally develop between days 90 and 110 of pregnancy. Their development is, therefore, likely to be affected by any changes in the maternal environment caused by shearing at day 70 of pregnancy. Severe undernutrition of Merino dams during late pregnancy has previously been shown to decrease the number of secondary follicles that develop in the lamb (Cartwright & Thwaites, 1976; Hutchison & Mellor, 1983), however given that the lamb birth weights (not shown) within rearing rank were higher for lambs born to shorn dams than for those born to unshorn dams there is no evidence the fetuses in this study were undernourished. Revell *et al*. (2002) proposed that an increase in thyroid hormone levels due to cold stress might cause an increase in secondary follicle density. This could suggest that the unshorn ewes may have been stressed by cold during the six days they were grazing in the less-sheltered paddock, however, this seems unlikely given their fleece cover of six months' wool. The differences in secondary follicle development may also be attributable to lamb breed. Although the sire breed was not recorded in the paper by Revell *et al*. (2002), ewes were mated to a Suffolk ram (Revell, *pers comm*.) compared to a Romney ram in the current study.

Revell *et al*. (2002) found a significant decrease in fleece weight in singleton lambs born to shorn dams compared to those born to unshorn dams while those from twin-born lambs tended to increase. The same increase in fleece weight was found in the current study for the twin lambs born to shorn dams, however, there was no decrease in the single-born lambs. The increase in fleece weight may be a short-term response to increased nutrition during early life rather than a permanent effect. Future fleece weights measured from these animals will resolve this question.

Of the other wool characteristics measured, only yellowness showed a difference due to shearing treatment. It is difficult to understand why this might be the case, but low Y-Z coincided with high MFD and low cvMFD (correlations of –0.34 and 0.27 respectively) suggesting, in contrast to the results of Bray & Smith (1999), that coarser, more even fleeces may be less conducive to bacterial growth. The size of this difference was not commercially important, but may indicate a lower propensity for lambs born to shorn dams to yellow given the right conditions.

A one-micron increase in lifetime mean fibre diameter is unlikely to be commercially significant in strong-wool sheep and is likely to be outweighed by the possible increase in fleece weight as well as any lamb survival benefits from mid-pregnancy shearing. If the same fibre diameter increase was found in Merinos there may be implications for the practice of pre-lamb shearing in Merinos.

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