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The effect of sward height during pregnancy on the wool follicle and fibre characteristics of twin- and triplet-born lambs

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ABSTRACT

Previous work estimating the impact of differential feeding of ewes during pregnancy, on lamb wool follicle development, has been done primarily with single- and twin-bearing ewes. The aim of this study was to compare the follicle development and fibre characteristics of twin- or triplet-born/reared lambs, born to ewes offered different sward height allowances during pregnancy and lactation. After pregnancy scanning, 186 twin- and triplet-bearing Romney ewes with 6 weeks wool growth, were randomly allocated to four different sward heights (2, 4, 6 and 8 cm). Within the first 24 hours of parturition ewes were transferred to one of two sward heights (4 and 8 cm). The wool and follicle characteristics of twin- (n = 65) and triplet-born (n = 63) ewe lambs were compared. Fleeces from triplet-born lambs were lighter (1.59 kg vs 1.82 kg, $P < 0.05$) and finer (32.7 µm vs 33.4 µm, $P < 0.05$) than those from their twin-born counterparts. Lambs born to ewes offered higher sward heights during pregnancy had increased loose wool bulk ($P < 0.01$). Although increasing sward height during pregnancy increased fibre diameter in twin-born lambs, there was no similar relationship for triplet-born lambs ($P < 0.05$). Sward height during pregnancy had no effect on secondary follicle number in twin-born lambs but, triplet-born lambs born to ewes grazed on the 4 cm sward tended to have significantly higher numbers of secondary follicles than those grazed on 6 cm (89.2 vs 66.0, $P < 0.05$). More work is necessary to determine whether this interaction has practical implications for breeding replacements. Nutritional treatments during lactation had no significant effects on lamb wool characteristics.

Keywords: feeding; nutrition; follicle development; wool bulk; wool characteristics.

INTRODUCTION

It is well accepted that the *in utero* nutrition of the fetus can affect the development of wool follicles (Schinkel & Short, 1961; Hutchison & Mellor, 1983; Kelly *et al.,* 1996), and that the follicle population will have a significant impact on the type of wool grown by lambs that become flock replacements (Turner, 1961; Butler, 1982; Moore *et al.,* 1998; Scobie & Young, 2000). The nutrition available to the developing fetus depends both on the level of nutrition available to the ewe as well as the number of lambs in the litter sharing those nutrients. Previous work has examined the effect of pregnancy feeding on wool follicle development (Doney & Smith, 1961; Cartwright & Thwaites, 1976; Hutchison & Mellor, 1983; Denney *et al.,* 1988; Kelly *et al.,* 1996; Williams & Henderson, 1971), the effect of litter size on wool follicle development (Lax & Brown, 1967; Butler, 1981; Aimone *et al.,* 1999), and some has looked at the combination of pregnancy feeding and litter size in single- and twin-born lambs (Kelly & Ralph, 1988). However, the authors are not aware of any previous experiments that have examined the effect of differential feeding of triplet-bearing ewes during pregnancy and lactation on the wool and follicle characteristics of the developing lambs.

With the increase in fecundity in the New Zealand sheep flock over the last decade, the incidence of lambs reared as triplets has increased and is likely to increase further. Although the impact of changes to the wool clip are likely to be minor in the current economic climate relative to the effects on lamb growth and survival (Morris *et al.,* 2003), the ability to characterise these changes helps create a complete picture of the farming enterprise and enables more informed decision making.

The aim of this study was therefore to compare the wool follicle development and fibre characteristics of twin- and triplet-born lambs born and reared by ewes offered different sward surface heights from mid pregnancy until weaning.

MATERIALS AND METHODS

Experimental design and animals

Sixty-four days after the mid-point of the mating period (P64), 186 Romney ewes (including 96 twin- and 90 triplet-bearing ewes) with 6 weeks wool growth, were randomly allocated to four different sward heights (2, 4, 6 and 8 cm). Each group was replicated twice and balanced for both ewe age (2-tooth vs mixed-age) and pregnancy rank. Within the first 24 hours of parturition, ewes were transferred to one of two sward heights (4 and 8 cm). Grazing management of the sward has been described previously (Morris *et al.,* 2003; Morris & Kenyon, 2004; Sherlock *et al.,* 2004). At approximately 5 months of age, mid-side wool and skin samples and fleece weights were collected from twin- (n = 65) and triplet-born (n = 63) and reared ewe lambs only. The numbers of dams represented at each litter size were 53 and 39 for the twins and triplets respectively. Samples were not collected from any lambs if one or more of their litter mates were not present at weaning. Lamb birth weight, growth rates and survival results have been described previously by Morris *et al.* (2003).

Wool samples were clipped from the mid-side patch using Oster clippers with a size 40 blade. Staple length was measured as the average length of ten staples from each mid-side sample. 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, Virginia, United States of America) according to SANZ (1984). The sample was then cored by hand using a 2 mm trocar and used to measure mean fibre diameter (MFD) using an optical fibre diameter analyser (IWTO, 1998).

The skin sample was taken from within the clipped mid-side area using a 10 mm trephine as previously described by Sherlock *et al.* (2002). The skin sample was immediately fixed in Bouins fluid. Skin samples were removed from the fixative within 12 hours and stored in 70% ethanol until histological processing. Skin samples were embedded in paraffin wax and sectioned at 6 µm 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.

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 a split plot design implemented via the Generalised Linear Model procedure of the statistical package 'SAS' (SAS, 2002). The main effects of litter size, sward height during pregnancy (SHP) and sward height during lactation and their interactions were fitted. The between-dam effect was used as the error term.

RESULTS

Triplet-born lambs had lighter fleeces than their twin-born counterparts (Table 1). Litter size had no effect on yield, staple length, colour or bulk. Neither increasing sward height during pregnancy (SHP) nor during lactation significantly affected lamb fleece weight.

The loose wool bulk of lambs wool increased with the height of swards offered to the ewe during late pregnancy such that lambs born to ewes offered 8 cm of herbage in late pregnancy had significantly bulkier wool than those born to ewes offered either 2 ($P < 0.01$) or 4 cm ($P < 0.05$) of herbage. SHP did not affect washing yield, wool colour or staple length. Sward height during lactation had no effect on any lamb fibre characteristics (Tables 1 and 2).

TABLE 1: The effect of litter size and sward height offered to the dam on lamb greasy fleece weight (GFW) and fibre characteristics (least-squares means ± SEM).

	(n)	GFW (kg)	(n)	Yield (%)	Staple length (mm)	Colour (Y-Z)	Bulk (cm^3/g)
Litter size							
twin	61	1.85 ±0.05	65	78 ±0.5	102 ±2.1	0.5 ±0.20	21.3 ±0.27
triplet	58	1.60 ±0.05	63	78 ±0.6	108 ±2.5	0.7 ±0.23	20.9 ±0.30
signif.		*		NS	NS	NS	NS
Sward height during pregnacy[1]							
2 cm	30	1.58 ±0.077	32	79 ±0.8	107 ±3.6	0.9 ±0.44	20.3 ±0.43
4 cm	32	1.71 ±0.067	32	78 ±0.7	104 ±3.2	0.7 ±0.38	20.7 ±0.38
6 cm	25	1.81 ±0.071	29	78 ±0.7	109 ±3.2	0.4 ±0.39	21.0 ±0.39
8 cm	32	1.79 ±0.068	35	78 ±0.7	101 ±3.1	0.4 ±0.37	22.3 ±0.37
signif.		NS		NS	NS	NS	**
Sward height during lactation[2]							
4 cm	50	1.72 ±0.055	55	78 ±0.6	105 ±2.6	0.6 ±0.24	20.9 ±0.31
8 cm	69	1.73 ±0.044	73	79 ±0.5	105 ±2.0	0.6 ±0.19	21.2 ±0.24
signif.		NS		NS	NS	NS	NS

[1]Sward height offered from pregnancy scanning to birth
[2]Sward height offered from birth to weaning

TABLE 2: The effect of litter size and sward height offered to the dam on lamb fibre and follicle characteristics (least-squares means ± SEM).

		n	Mean fibre diameter (μm)	n	Number of primary follicles	Number of secondary follicles	Ratio of secondary to primary follicles
Litter size (LS)							
Twin		65	33.4 ±0.32	57	16.5 ±0.73	77.7 ±2.22	4.9 ±0.21
Triplet		53	32.7 ±0.38	62	16.7 ±0.81	78.1 ±2.49	5.1 ±0.23
significance			*		NS	NS	NS
Sward height during pregnancy[1]							
2cm		32	33.1 ±0.54	29	17.8 ±1.21	81.2 ±3.67	4.8 ±0.34
4cm		32	32.5 ±0.48	31	17.6 ±1.06	83.5 ±3.23	5.1 ±0.30
6cm		29	33.4 ±0.49	27	15.3 ±1.07	72.6 ±3.25	5.2 ±0.30
8cm		35	33.0 ±0.47	32	15.8 ±1.05	74.4 ±3.19	4.9 ±0.29
significance			NS		NS	NS	NS
Sward height during lactation[2]							
4cm		55	33.2 ±0.39	55	15.9 ±0.84	77.0 ±2.56	5.2 ±0.24
8cm		73	32.8 ±0.31	66	17.3 ±0.71	78.9 ±2.16	4.8 ±0.20
significance			NS		NS	NS	NS
*SHP * LS*[3]							
2	twin	19	32.6 ±0.58	16	16.4 ±1.38	80.3 ±4.18	5.1 ±0.39
2	triplet	13	33.6 ±0.92	13	19.1 ±1.98	82.0 ±6.03	4.5 ±0.56
4	twin	19	33.3 ±0.58	18	17.2 ±1.26	77.8 ±3.82	5.0 ±0.35
4	triplet	13	31.8 ±0.75	11	18.0 ±1.71	89.2 ±5.21	5.2 ±0.48
6	twin	16	33.5 ±0.62	14	16.0 ±1.40	79.2 ±4.28	5.1 ±0.39
6	triplet	13	33.3 ±0.75	13	14.6 ±1.61	66.0 ±4.90	5.4 ±0.45
8	twin	11	34.1 ±0.78	9	16.5 ±1.76	73.6 ±5.35	4.7 ±0.49
8	triplet	24	31.9 ±0.52	23	15.2 ±1.14	75.3 ±3.40	5.2 ±0.32
significance			*		NS	P = 0.06	NS

[1]Sward height offered from pregnancy scanning to birth
[2]Sward height offered from birth to weaning
[3]Each of the means shown represents the lambs from a minimum of seven dams

SHP had no effect on primary follicle number or secondary to primary ratio (Table 2). There was a significant interaction between SHP and litter size for mean fibre diameter such that, for lambs born to ewes grazed on 4, 6 or 8 cm sward heights, twin lambs tended to have larger diameter fibres than their triplet-born counterparts. However this relationship was reversed for those born to ewes grazed on 2 cm swards. There was also a tendency (P = 0.06) for an interaction between SHP and litter size for secondary follicle number such that, in twin-born lambs sward height had no effect on secondary follicle number, but in triplet-born lambs those born to ewes grazed on the 4 cm sward had significantly ($P < 0.05$) higher numbers of secondary follicle numbers than those grazed on 6 cm.

DISCUSSION

The key questions of interest for this study were; will increasing the number of flock replacements that were born and reared as triplets affect the wool clip and can the wool quality and production of these triplet replacements be affected by feeding during gestation or lactation?

The fleeces harvested from triplet-born lambs were lighter than those from their twin-born counterparts by 0.15 kg and finer by 0.7 μm. In comparison, Butler (1982) found that fleeces from twin-born Corriedale lambs were 0.22 kg lighter and 2.34 μm finer than those from single-born lambs. Gonzalez *et al.* (1986) also found that twin-born Corriedale lambs produced less wool than singles (1.8%), but showed that this difference decreased with age. The lighter fleeces from triplet lambs observed in this study were probably a consequence of both their lower body weights (Morris *et al.,* 2003) and finer fleeces, decreasing fibre number and fibre volume respectively. The triplet lambs are likely to also have lower mature body weights and therefore lower lifetime fleece weights (Gonzalez *et al.,* 1986). Given that follicle numbers were not different for twins and triplets, it is likely that the differences in fibre diameter are due to the effect of poorer nutrition on fibre growth rather than follicle development, and should therefore not persist into adulthood.

The interactions between pregnancy sward height and litter size for MFD and secondary follicle number suggest that follicle development and fibre diameter of twin-born lambs are more stable in response to changes in SHP than those of triplet-born lambs. Twin-born lambs tended to maintain a MFD of around 33.7 microns, except at the lowest level of pregnancy sward-height where MFD dropped to 32.6 microns. In contrast, although there were significant differences in the MFDs of triplet-born lambs at different levels of SHP, there was no identifiable relationship with increasing SHP. Similar patterns for secondary follicle number were observed, whereby the parameter was relatively insensitive to SHP changes in twin-born lambs but varied significantly, although not consistently, with SHP in triplet-born lambs.

The study suggests that increasing feeding allowances for pregnant Romney ewes will increase the loose wool bulk of their progeny by up to 2 cm^3/g. However this response is not likely to be economic given the high allowances required to achieve it and the absence of other benefits at those same high allowances. Previous studies have shown that wool bulk is a highly heritable trait (Stobart & Sumner, 1991) that responds well to genetic selection in breeds that exhibit substantial genetic variation for the trait (Sumner *et al.,* 1991). However, the Romney sheep breed used in this study has been shown to have low levels of genetic variability for bulk (Carnaby & Elliott, 1980). It would be interesting to compare the response observed to pregnancy feeding in this study with those of other breeds with higher levels of natural variation in wool bulk.

CONCLUSION

There is no evidence from this study to suggest that increasing allowance during pregnancy above 4 cm would significantly improve wool production in triplet-born replacements. The current study suggests that both the development of secondary follicles and the mean fibre diameter of triplet-born lambs are more susceptible to differences in sward height, offered to their dams during pregnancy, than those of their twin-born counterparts.

Increasing the number of triplet-born lambs as flock replacements can result in smaller ewes that are likely to have lower levels of individual wool production. The lamb clip is likely to be finer but this will probably not persist through adulthood. It is possible that increasing the pasture allowance to ewe flocks during mid to late pregnancy, may also increase the loose wool bulk of potential flock replacements.

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