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Diagnosis of foetal number in prolific sheep

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ABSTRACT

Techniques of real time ultra sound (ADR 2130, Toshiba Sonolayer-L SAL 22A) and radiography (DSIR X-ray) were assessed to determine the accuracy of identifying ewes carrying 3 or more lambs. Ewes were scanned between 62 and 75 days of gestation with ultra-sound and between 110 and 124 days with X-ray. There were 94.2% (ultra-sound) and 96.2% (X-ray) of ewes predicted to be carrying 3 or more lambs that actually lambed with 3 or more lambs. However, 21.1% (ultra-sound) and 8.4% (X-ray) of ewes which lambed with 3 or more lambs were predicted to lamb with <3 lambs. Because ultra-sonic diagnosis is carried out at an earlier stage of gestation it gives greater flexibility to apply nutritional management to ewes carrying 3 or more lambs in order to sustain foetal growth in these high litter sizes.

Keywords Sheep prolificacy; litter size diagnosis; Booroola; pregnancy.

INTRODUCTION

The technology of radiography and ultra-sound for pregnancy detection in sheep has developed rapidly over the last decade (Richardson, 1972; Rizzoli *et al.*, 1976 and Thwaites, 1981). However, with increased emphasis on the use of prolific sheep, diagnosis has now moved from the assessment of pregnancy status in the ewe (i.e., pregnant or non-pregnant) to the identification of actual litter size. If ewes carrying 3 or more lambs can be identified during pregnancy, differential feeding to meet their higher nutritional requirements can be attempted in order to sustain foetal growth (Owens, 1984) and hence influence birth weight and survival (Hinch *et al.*, 1983).

The techniques of real time ultra-sound and radiography were assessed to determine the accuracy of litter size identification in prolific ewes, particularly those carrying 3 or more lambs.

MATERIALS AND METHODS

In 1983, (i) DSIR mobile X-ray equipment and (ii) ADR 2130 (Advanced Diagnostic Research, Temple, Arizona) and Toshiba Sonolayer-L (Model Sal-22A, Toshiba, Japan) real time ultra-sonic equipment, were used to scan 377 prolific sheep with the Booroola gene in order to assess the number of foetuses each carried. Ewes were of 2 breed types and were from 2 locations: 107 ½ Merino ½ Romney (MR) from Invermay Agricultural Research Centre and 270 Merino (M) from Tara Hills High Country Research Station. Dates of joining and scanning are shown in Table 1. X-rays could only be used after 100 days of gestation as prior to that time the diagnostic quality of radiographs is poor because of the lack of ossification of foetal bone.

TABLE 1 Breed (Merino Romney MR; Merino M), joining date, scanning date and mean gestational age at scanning of ewes scanned by ultra-sound and X-ray.

	No. ewes	Joining date	Date of scanning Ultra-sound	X-ray	Mean day of gestation (range) Ultra-sound	X-ray
MR	107	25/4	19/7	6/9	75 (52-85)	124 (101-134)
M	270	10/5	21-22/7	7/9	62 (48-72)	110 (86-120)

Real time ultra-sonic scanning can determine litter size as early as 47 days of gestation and up to 100 days (Wilkins and Fowler, 1982) with high levels of accuracy. Within this period, stage of gestation does not appear to influence accuracy (Fowler and Wilkins, 1984). Times of scanning in the present observations were therefore chosen within these limitations and the same ewes at each location were diagnosed by both methods. Both flocks were intensively shepherded at lambing to record litter size for each ewe.

RESULTS

As litter size increased, both techniques became increasingly inaccurate in determining correct litter size (Table 2). Ultra-sound and X-ray were (% ± SE) 89.4% ± 4.5% and 87.2% ± 4.9% accurate respectively, in diagnosing ewes that lambed with singles. In comparison, the techniques correctly diagnosed only 41.8% ± 6.6% and 56.4% ± 6.7% respectively, of ewes that lambed with quadruplets.

Both techniques were more accurate ($P<0.01$) in determining overall correct litter sizes when performed in M ewes (83.3% ± 2.3% ultra-sound; 89.6% ± 1.9% X-ray) than in MR ewes (61.7% ± 4.5% ultra-sound; 69.2% ± 4.5% X-ray).

TABLE 2 Accuracy of litter size diagnosis (%) using real time ultra-sound and X-ray.

Litter size at birth	Diagnosed litter size 0	1	2	3	4	No. ewes in each litter size
Ultra-sound						
0	**97.6**	2.4	-	-	-	83
1	-	**89.4**	8.5	2.1	-	47
2	-	7.4	**84.0**	7.4	1.2	81
3	-	2.8	21.5	**72.0**	3.7	107
4	-	-	16.4	41.8	**41.8**	55
5	-	-	-	25.0	75.0	4
X-ray						
0	**100.0**	-	-	-	-	83
1	2.1	**87.2**	10.6	-	-	47
2	-	1.2	**90.1**	8.6	-	81
3	-	1.0	12.1	**82.2**	4.7	107
4	-	-	-	43.6	**56.4**	55
5	-	-	-	25.0	75.0	4

The practical use of litter size identification during gestation for differential feeding would be to distinguish those carrying 3 or more lambs from those carrying 2 or 1 and those that were not pregnant. Accuracy of predicting these litter sizes can be viewed in 2 ways:

(a) accuracy of those predicted with a particular litter size which actually lambed with that litter size:

or

(b) accuracy of those ewes that lambed with a particular litter size which had been diagnosed to have that litter size.

Flock differences were due to a lower accuracy ($P<0.01$) of predicting ewes either non-pregnant or carrying 1 or 2 lambs in MR ewes (65.9% ± 7.1% ultra-sound, 77.5% ± 6.6% X-ray) compared with M ewes (89.7% ± 2.2% ultra-sound, 97.2% ± 1.2% X-ray).

For both breeds 94.2% ± 2.0% (ultra-sound) and 95.6% ± 1.6% (X-ray) of ewes predicted to be carrying 3 or more lambs during gestation actually lambed with 3 or more lambs. Of all the ewes predicted during gestation to be either non-pregnant or carrying 1 or 2 lambs, 85.3% ± 2.3% (ultra-sound) and 93.6% ± 1.7% (X-ray) were actually non-pregnant or lambed with 1 or 2 lambs.

Of those ewes that lambed with 3 or more lambs, 78.9% ± 3.2% and 91.6% ± 2.2% were correctly diagnosed by ultra-sound and X-ray respectively, leaving 21.1% ± 3.2% and 8.4% ± 2.2% incorrectly diagnosed as carrying less than 3 lambs. For ewes that were non-pregnant or lambed with 1 or 2 lambs, 96.2% ± 1.3% and 96.7% ± 1.2% were actually diagnosed by ultra-sound and X-ray to be non-pregnant or carrying 1 or 2 lambs during gestation.

DISCUSSION

The results show that X-ray examination at 100 to 130 days is usually more accurate than real time ultra-sound at 50 to 85 days in determining litter size and that accuracy for both techniques decreases as litter size increases. In a flock where these techniques are used to identify litter size in order to differentially feed ewes bearing 3 or more lambs, the diagnostic errors are such that 21.1% (ultra-sound) or 8.4% (X-ray) of the ewes carrying 3 or more lambs would be managed as single or twin bearers and consequently underfed. Also, 3.8% (ultra-sound) or 3.3% (X-ray) of ewes carrying singles or twins would be managed as ewes carrying 3 or more lambs and therefore overfed.

Ultra-sound tended to underestimate litter size, e.g. 21.5% and 16.4% of ewes having triplets and quadruplets were diagnosed as having twins. Another source of error is foetal loss from 40 days to term as Wilkins *et al.*, (1982; 1984) have suggested that in Merinos carrying the Booroola gene about 30% of reproductive loss occurs as foetal loss after 40 days.

Flock differences in overall accuracy are difficult to interpret and are most likely to be associated with differences in breed anatomical characteristics. Fowler and Wilkins (1984) observed an 18% higher accuracy for diagnosing twins with ultra-sound in Dorset x Merinos compared with Merino ewes.

Despite the higher accuracy of X-ray, ultra-sound would give greater flexibility to apply nutritional management to ewes carrying 3 or more lambs because diagnosis is at a much earlier stage of gestation. In reviewing the data of Robinson (1983), Owens (1984) has suggested that mulitple bearing ewes should be in good condition at joining and not lose condition over the first 3 months of pregnancy, thus avoiding detrimental effects on twin or triplet foetal growth and hence birth weight. As low birth weight can affect lamb survival (Hinch *et al.*, 1983), determining litter size and differentially feeding ewes carrying 3 or more lambs from early pregnancy might facilitate increased survival of lambs from large litters and enhance ewe lactational performance. Management would be further improved by the segregation of these ewes from single and twin-bearing ewes for intensive lambing management and earlier identification of non-pregnant animals for restricted winter feeding or culling.

Because the X-ray technique is effective only in late pregnancy the main benefit would be separating ewes carrying 3 or more lambs for intensive shepherding at lambing. The identification of these ewes in late pregnancy may help avoid ewe health problems but effects of the level of late pregnancy feeding on birth weights of lambs in high litter sizes are equivocal.

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