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BRIEF COMMUNICATION: Impacts of live weight of ewe lambs at mating on their reproductive performance

E Haslin*, RA Corner-Thomas, PR Kenyon, ST Morris, EJ Pettigrew, RE Hickson and HT Blair

School of Agriculture and Environment, Massey University, Palmerston North, New Zealand

**Corresponding author*. Email: E.Haslin@massey.ac.nz

Abstract

This experiment investigated the impacts of heavier live weight of twin-born ewe lambs at mating on reproductive performance. Romney ewe lambs (n=270) were allocated to one of two groups: 'Heavy' (48.0±3.8 kg), had been preferentially fed from weaning to breeding, or 'Control' (44.8±3.5 kg). Both groups were exposed to crayon-harnessed vasectomised rams for 68 days before breeding, and then were bred to entire Romney rams for 34 days. Crayon marks were recorded every 17 days. Heavy ewe lambs were more likely to be mated in the first 17 days of breeding (69.9% *vs.* 54.8%, P<0.05), mated in the entire breeding period (85.1% *vs.* 69.4%, P<0.01) and had a greater litter size (0.99 *vs.* 0.65; P<0.01) than did Control ewe lambs. Heavier live weight at mating improved reproductive performance of ewe lambs. These results emphasise the importance of an adequate live weight at breeding for reproductive success in ewe lambs.

Keywords: ewe lamb; breeding performance; live weight; litter size; body condition score

Introduction

Breeding ewe lambs at 8 to 9 months old can potentially improve their lifetime productivity, increase the number of lambs born per farm per year and, thus, increase the farm income (Kenyon et al. 2014). The attainment of a minimum live weight (50-70% of expected mature weight) is the main determinant for achieving puberty and successfully breeding ewe lambs (Rosales Nieto et al. 2013, Kenyon et al. 2014). There is a positive relationship between ewe lamb live weight at mating and the probability of being bred early in the breeding period (Kenyon et al. 2005), and litter size (Brown et al. 2015). Current minimum target live weight of ewe lambs is 40 kg at breeding (Kenyon et al. 2014). It is unknown if breeding ewe lambs at heavier weights may have any negative impacts on reproductive performance. This experiment investigated the impacts of a heavier live weight at mating on ewe lamb reproductive performance.

Materials and methods

Experimental design

The experiment and all handling procedures were approved by the Massey University Animal Ethics Committee (MUAEC17/16), New Zealand. The experiment was conducted at the Massey Riverside farm, 10 km north of Masterton, New Zealand. Twin-born Romney ewe lambs (n=270) were allocated to one of two groups at weaning with a similar weaning weight (mean±sd; Heavy=28.6±2.4 and Control=28.7±2.7): the 'Heavy' group (n=135) was preferentially fed until breeding to achieve an average of 48.0 kg (range 41.0 to 60.2), and the 'Control' group (n=135) was fed separately from 51 days before breeding to the start of breeding to achieve an average of 44.8 kg (range 39.1 to 57.6) at breeding. Both groups were grazed on lucerne from weaning until 27 days (Control) and 22 days (Heavy) before breeding, and then were grazed on rye grass/white clover pastures until the end of the experiment. They were supplemented with approximately 200 g/ewe lamb/day of grain-mix from weaning until 51 days before breeding. The Heavy group was then supplemented with 200 to 300 g/ewe lamb/day of grain mix until breeding.

All ewe lambs were exposed to vasectomised rams fitted with mating harnesses with crayons for 68 days before breeding. Every 17 days after vasectomised-ram introduction, the crayon colour was changed and the crayon marks were recorded. On the 10th May, both groups were merged, and vasectomised rams were replaced by crayon-harnessed entire Romney rams (ratio 1:40) for 34 days. Ewe lambs were then identified to mating categories: mated in the first 17-day period only (first crayon colour only on their rump), mated in the second 17-day period only (second crayon colour only), mated in both 17-day periods (both crayon colours) or not mated (no crayon colour). Litter size was diagnosed 50 days after ram removal by trans-abdominal ultrasound.

Unfasted live weights were recorded every 17 days from the introduction of vasectomised rams until to the end of the breeding period. Body condition scores (BCS; Jefferies 1961) of ewe lambs were recorded at the start of the breeding period.

Statistical analysis

All statistical analyses were conducted using SAS v9.4 (SAS Institute Inc, Cary, NC, USA). The proportion of ewe lambs within each mating category was analysed using generalised linear models with binomial distributions and logit transformations. The models included group, the sex of the co-twin, BCS and their two-way interactions with a Tukey adjustment to allow for multiple comparisons. This model was run with and without breeding live weight and liveweight change before breeding as covariates to determine their effects on the mating categories. Due to the low number of animals with BCS 2.0 and 4.0, the BCS were divided into three categories: ≤2.5 (n=144), 3.0 (n=86) and ≥3.5 (n=40).

Litter size was analysed using a generalised linear model with a Poisson distribution and a logit transformation, which included group, BCS, and sex of the co-twin as fixed effects and their two-way interactions. This model was run with and without breeding live weight and liveweight change between weaning and breeding.

Two linear models were used to determine the differences in live weight at breeding depending on 1) the mating categories or 2) litter size. The first model included group, sex of the co-twin, mating categories and their interactions. The second model included group, litter size and their interaction.

A logistic regression model was constructed for the proportion of ewe lambs mated during breeding with group, breeding live weight and their interaction as fixed effects.

All non-significant interactions were removed from the final models.

Results and discussion

Heavy ewe lambs were heavier before and during the breeding periods than Control ewe lambs ($P<0.0001$). Only, 1.5% of the Heavy group and 2.2% of the Control group were marked before breeding, indicating an expression of oestrus behaviour.

Mating categories

Heavy ewe lambs were more likely to be mated during the 34-day breeding period than Control ewe lambs ($P<0.05$). BCS had no effect on the proportion of ewe lambs mated. The covariate liveweight change before breeding did not change the results, however the inclusion of breeding live weight resulted in the group effect becoming with a tendency ($P<0.10$), indicating that the group effect was in part driven by breeding live weight. The probability of being mated increased in the Heavy group by 3% for each additional kilogram at mating up to 45 kg, and 2% from 46 to 50 kg with little apparent benefit above 50 kg (Fig. 1). In the Control group, the probability of being mated increased by 4% up to 45 kg, 3% from 46 to 50 kg and 2% from 51 to 55 kg with little apparent benefit above 55 kg (Fig. 1). It is unknown why the lines differed, therefore further work is needed to determine this.

These results are consistent with the literature and show a positive association between breeding live weight (i.e. a static effect) and mating performance (Kenyon et al. 2004, 2005). The association between breeding live weight and the probability of being mated appeared to plateau above 50 kg for Heavy and 55 kg for Control. This plateau in live weight was previously reported in ewe lambs (Rosales Nieto et al. 2013, Corner-Thomas et al. 2015), but was lower compared with this experiment. The different

Figure 1 The probability of being mated during the 34-day breeding period of the Heavy (n=135; solid line) and Control (n=135; dotted line) groups in relation to their live weight at breeding (logit predictions shown).

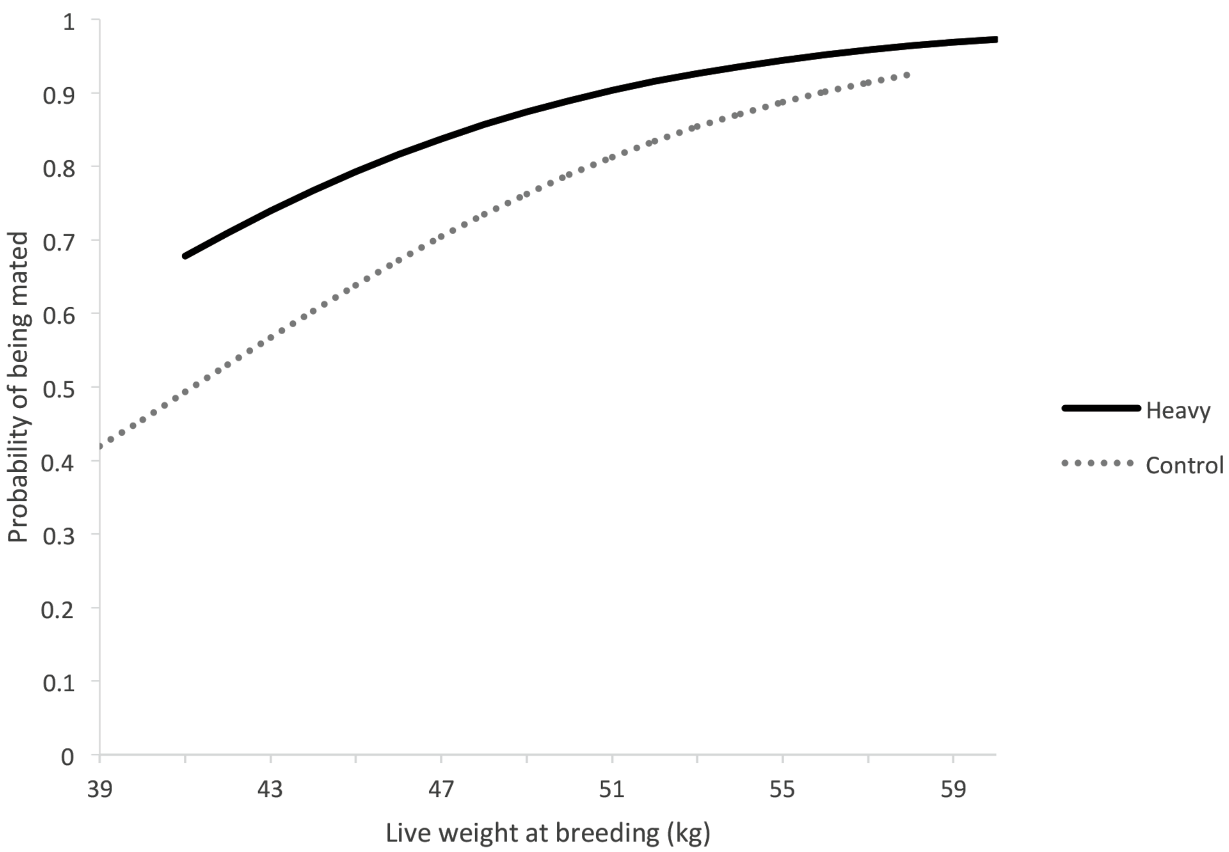

Table 1 Effect of ewe lambs treatment group (Control vs. Heavy) and BCS at breeding (≤2.5 vs. 3.0 vs. ≥3.5) on the percentage (95% confidence limits) of ewe lambs that were identified with ram mating harness crayon marks in each breeding period[1]. Least square means ± SEM of live weight at breeding and BCS at breeding per treatment group in the different mating categories.

	n	Mated first 17-day period only	n	Mated second 17-day period only	n	Mated both 17-day periods	n	Not mated
Group								
Control	67	54.8 (43.8 – 65.3)[a]	7	3.5 (1.3 – 9.0)	10	9.5 (4.7 – 18.3)	51	30.6 (21.0 – 42.0)[a]
Heavy	93	69.9 (61.3 – 77.3)[b]	11	7.5 (3.9 – 13.7)	10	6.2 (3.2 – 11.8)	21	14.9 (9.6 – 22.3)[b]
BCS								
≤2.5	76	56.1 (47.4 – 64.5)	11	8.2 (4.6 – 14.4)	6	3.7 (1.6 – 8.4)[a]	51	30.7 (23.1 – 39.5)
3.0	54	60.4 (49.3 – 70.5)	5	4.7 (1.8 – 11.7)	11	13.3 (7.5 – 22.7)[b]	16	20.1 (12.7 – 30.5)
≥3.5	30	70.7 (53.4 – 83.6)	2	3.4 (0.7 – 13.8)	3	8.9 (2.8 – 24.8)[a, b]	5	16.1 (6.8 – 33.4)
Live weight at breeding (kg)								
Control	67	45.4 ± 0.4	7	45.1 ± 1.3	10	45.8 ± 1.1	51	43.7 ± 0.5
Heavy	93	48.3 ± 0.4	11	47.6 ± 1.1	10	48.3 ± 1.1	21	46.6 ± 0.8
BCS at breeding								
Control	67	2.6 ± 0.2	7	2.6 ± 0.6	10	2.9 ± 0.5	51	2.5 ± 0.2
Heavy	93	3.0 ± 0.2	11	2.9 ± 0.5	10	3.0 ± 0.5	21	2.9 ± 0.4

[1] Means between rows and within columns with differing superscripts are different ($P<0.05$).

genotypes may explain this difference as may differences in breeding live weight (Rosales Nieto et al. 2013, Corner-Thomas et al. 2015).

A greater percentage of Heavy ewe lambs were mated in the first 17-day period only than Control ewe lambs (Table 1). The addition of breeding live weight as covariate resulted in the group effect becoming non-significant ($P>0.10$), indicating that the group effect was driven by breeding live weight. Ewe lambs mated in the first 17-day period only were heavier at breeding than those not mated (46.9±0.28 vs. 45.1±0.42; $P<0.01$). No other group differed in live weight at breeding. These results are consistent with previous studies that showed that heavier ewe lambs at breeding were more likely to be mated in the first 17 days of breeding than those that were lighter (Kenyon et al. 2004, 2005).

The proportion of ewe lambs mated in the first 17-day period did not differ by BCS. Ewe lambs with a BCS of 3.0 were more likely to be mated in both 17-day periods than were those with BCS≤2.5 ($P<0.05$; Table 1). BCS had no effect on the probability of being mated in the first or second periods, whereas previous studies reported a positive relationship between BCS at breeding and mating pattern in ewe lambs (Kenyon et al. 2010). Corner-Thomas et al. (2015) reported that ewe lamb performance was impaired when BCS<2.5, but in this experiment, the lowest category is BCS≤2.5, which may limit the identification of any effect.

Litter size

Heavy ewe lambs had greater litter size than Control ewe lambs (mean (95% confidence interval); 0.99 (0.84–1.18) vs. 0.65 (0.50–0.84)). Ewe lambs carrying twins were heavier at breeding than those carrying singles or being non-pregnant (48.5±0.54 vs. 46.7±0.31 and 45.1±0.35; $P<0.001$). On average, each extra kilogram at breeding was associated with a 6.3% increase in litter size. There was no effect ($P>0.05$) of BCS on litter size (data not shown). These results support previous findings and show a positive association between litter size and ewe lamb live weight at breeding (Paganoni et al. 2014, Corner-Thomas et al. 2015).

In conclusion, heavier live weight at breeding improved litter size and breeding performance of ewe lambs, but performance plateaued above 50 kg. These results emphasise the importance of an adequate live weight for breeding ewe lambs to achieve high reproductive performance. It is unknown why the relationship between the probability of being mated and live weight differ between groups. Further work is needed to determine this.

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