Small Ruminant Research 145 (2016) 130–135

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Short communication

The effect of liveweight and body condition score on the ability of ewe lambs to successfully rear their offspring

K.J. Griffiths[a,*], A.L. Ridler[a], C. Heuer[b], R.A. Corner-Thomas[a], P.R. Kenyon[a]

[a] International Sheep Research Centre, Institute of Veterinary, Animal and Biomedical Sciences, Palmerston North, New Zealand
[b] Epicentre, Institute of Veterinary, Animal and Biomedical Sciences, Palmerston North, New Zealand

ARTICLE INFO

Article history:
Received 30 May 2016
Received in revised form 1 November 2016
Accepted 3 November 2016
Available online 5 November 2016

Keywords:
Ewe lamb
Reproduction
Liveweight
Body condition score
Lamb survival

ABSTRACT

Ewe lamb breeding is a means for farmers to further increase the number of lambs available for sale each year while concurrently increasing the ewe lamb's lifetime productivity. This study included 7666 replacement ewe lambs from two commercial New Zealand sheep farms that were presented for breeding during their first breeding season (aged 7–8 months) and were subsequently identified as pregnant. Ewe lambs were weighed and body condition scored (BCS) immediately pre-breeding, at pregnancy diagnosis (PD) and immediately prior to lambing (set-stocking). Logistic regression models were developed to assess the effect of liveweight and liveweight changes (both conceptus adjusted and non-adjusted) and BCS at breeding, PD and set-stocking on the risk of failure to rear a lamb (dry) to tail removal and castration (docking) where lambs are three to six weeks of age. There was no effect ($p > 0.05$) of breeding weight on the risk of being dry. There was an effect ($p < 0.001$) of conceptus adjusted liveweight at PD, and at set-stocking, such that ewe lambs with heavier conceptus adjusted liveweights were less likely to be dry. There was also an effect ($p < 0.001$) of weight change between PD and set-stocking on the risk of being dry, such that the more ewe lambs gained in conceptus adjusted liveweight the less likely there were to be dry. The above relationships were also observed with non- adjusted (actual) liveweights. There was an effect ($p < 0.05$) of BCS at PD and of BCS at set-stocking, such that ewe lambs that were of greater BCS were less likely to be dry. These findings enable commercial farmers to identify ewe lambs within a flock that are at increased risk of failing to successfully rear a lamb(s) to docking. Farmers are then able to plan management prior to breeding and throughout pregnancy to ensure ewe lamb weight and BCS targets are monitored, met and achieved.

1. Introduction

Currently in New Zealand the sale of lamb in cross bred flocks is a greater contributor to sheep farm income than wool (Anonymous, 2015). Ewe lamb breeding (7–9 months of age at breeding) is a means to further increase the number of lambs available for sale each year while concurrently increasing the ewe lamb's lifetime productivity (Corner et al., 2013; Kenyon et al., 2011, 2014b). However, less than 40% of New Zealand farmers choose to breed their ewe lambs (Kenyon et al., 2014b) indicating that there must be limiting factors which are restricting the uptake of this management option.

Management practices required to maximise the likelihood of a ewe lamb becoming pregnant are well documented (see review Kenyon et al., 2014b). However, farmer and veterinary evidence suggest losses between pregnancy diagnosis and marking (docking), when lambs are approximately three to six weeks of age, continue to be an issue on commercial New Zealand farms (Kenyon et al., 2014b; Ridler et al., 2015). Lower survival rates of lambs born to ewe lambs compared with those born to mature ewes have been reported, although few studies have directly compared this (Corner et al., 2013; Kenyon et al., 2014b). Corner et al. (2013) reported lamb survival to weaning of 69–89% for offspring born to ewe lambs, compared with 83–96% with mature ewes.

The development of ultrasound pregnancy diagnosis in sheep has enabled farmers to identify and cull their non-pregnant ewe lambs, while palpation of udders at docking enables actively lactating (wet) ewe lambs and not actively lactating (dry) ewe lambs to be identified. Those that are identified as dry at docking are assumed to have lost their lambs(s) between pregnancy diagnosis and docking. The aim of this study was to investigate the effects of liveweight and body condition score (BCS) at breeding, pregnancy diagnosis and at set-stocking on the ability of ewe lambs to rear their offspring to docking, on commercial New Zealand farms.

* Corresponding author.
E-mail address: K.J.Griffiths@massey.ac.nz (K.J. Griffiths).

http://dx.doi.org/10.1016/j.smallrumres.2016.11.001
0921-4488/

2. Materials and methods

2.1. Farms and animals

The study included 7666 replacement ewe lambs from two commercial New Zealand sheep farms (Farm A, 2010-born and 2011-born, and Farm B, 2011-born) that were presented for breeding during their first breeding season (at the age of 7–8 months) and were subsequently identified as pregnant. Farm A was located in the Waikato, New Zealand, and consisted of a semi-stabilised composite breed consisting of Coopworth and East Friesian genetics. Two cohorts of ewes from Farm A were included in this study: 2010-born (n = 3054) and 2011-born (n = 3078). Farm B was located in the Wairarapa, New Zealand, with Romney ewe lambs that were 2011-born (n = 1534).

2.1.1. Animal management

All ewe lambs were grazed under commercial conditions on permanent ryegrass and white clover based pasture. At approximately five months of age all ewe lambs were individually identified using electronic identification tags (EID; Allflex, Palmerston North, New Zealand). Prior to breeding ewe lambs were vaccinated with a sensitiser dose of a killed Clostridial vaccine conferring protection against *Cl. perfringens* type D, *Cl. tetani, Cl. chauvoei, Cl. septicum* and *Cl. novyi* type B (Ultravac 5 in 1®, Zoetis New Zealand), a live attenuated vaccine against *Toxoplama gondii* (Toxovax®, MSD Animal Health) and a sensitiser dose of a killed vaccine against *Campylobacter fetus fetus* and *Campylobacter jejuni* (Campyvax4®, MSD Animal Health). Four weeks later they received booster vaccinations with both the Clostridial and Campylobacter vaccine.

2.1.2. Reproductive management

On Farm A, all ewe lambs were joined with rams regardless of premating live weight (range 27 kg to 66.5 kg; mean 42 kg). On Farm B, only selected ewe lambs (approximately 38 kg and above) were joined with rams. On both farms ewe lambs were exposed to vasectomised rams at a ratio of 1:200-1:300 for 17 days prior to the planned start of breeding. All ewe lambs were then joined with entire rams at a ratio of 1:75; Farm A 2010 born = 34 days, Farm A 2011-born = 34 days, Farm B = 26 days.

Pregnancy diagnosis (PD) was undertaken by *trans*-abdominal ultrasound scanning; Farm A 2010-born = 59 days, Farm A 2011-born = 68 days, Farm B = 80 days, after the end of the breeding period. At PD ewe lambs were defined as either non-pregnant (no fetus), single (one fetus) or multiple (two or more foetuses). Non-pregnant ewe lambs were removed from the study cohort on each farm. Single and multiple-bearing ewe lambs were split into separate management groups and managed such that the plane of nutrition for the multiple-bearing was greater than for the single-bearing ewe lambs. As these were commercial farms no pasture measurements were taken.

Five to 28 days before the planned start of lambing the ewe lambs on all farms were given a Clostridial booster vaccination and placed in lambing paddocks. Ewe lambs were placed into individual paddocks (set-stocking) at a rate of approximately seven to twelve ewes per hectare. During lambing on Farm A, ewe lambs were observed from a distance every two to three days and on Farm B they were observed from a distance daily. If observed, any obvious problems such as dystocia, vaginal prolapse or cast ewes were resolved but no attempt was made to revive weak lambs or to mother-on or artificially rear orphaned lambs. Live and dead lambs were not identified or counted during the lambing period.

2.1.3. Data collection

All ewe lambs were weighed (to nearest 0.5 kg) and body condition scored (BCS) immediately prior to breeding, at pregnancy diagnosis (PD), and at set-stocking. Body condition score was undertaken by assessing the soft tissue over the lumbar region using a 1–5 scale (1 = thin, 5 = obese) with sheep assessed to the nearest 0.5 of a BCS (Jefferies 1961; Kenyon et al., 2014a). For consistency the same operator assessed BCS for all sheep at all time points on both farms.

Three to six weeks post-parturition ewe lambs and their offspring were gathered into handling facilities for ear marking, tail removal and castration of male offspring (docking). At this time the udder of each ewe lamb was palpated by the experienced flock manager and an assessment was made as to whether they were actively lactating (wet) or not (dry). Those that were deemed not to be actively lactating (dry) were assumed to have either had a mid to late-gestation pregnancy loss, abortion, or their offspring had died during the perinatal period. Those that were deemed to be still lactating were assumed to still have at least one live offspring.

2.1.4. Data analysis

A total of 7666 ewe lambs which were identified as pregnant at PD and were subsequently deemed to be wet (n = 5987) or dry (n = 1679) at docking were included in the analysis. All statistical analyses were conducted using SAS (SAS Institute Inc., Cary, NC, USA; Version 9.3).

2.1.5. Calculation of conceptus adjusted liveweights

In order to eliminate the potential influence of conceptus weight on ewe lamb liveweight during pregnancy, predicted conceptus adjusted liveweights of the ewe lambs were used in the analyses. Ewe lamb conceptus adjusted liveweights at PD and set-stocking were calculated by subtracting the estimated weight of the conceptus. The predicted weight of the conceptus was calculated using the GRAZPLAN model (Freer et al., 1997). This model requires data on stage of pregnancy and lamb birth weight. To estimate 'days pregnant' it was assumed all ewe lambs conceived nine days after the start of mating. Lamb birth weights were estimated using average birth weights from a number of New Zealand studies which included Romney or Composite ewe lambs (Schreurs et al., 2010), 4.46 kg for single and 3.42 kg for multiple born (assumed to be twin-born) lambs. It was assumed all pregnancies were 150 days in length.

Predicted conceptus weight = total birth weight x 1.43 x EXP (3.38 x (1-EXP (0.91 x (1–days pregnant/150)))) (Freer et al., 1997).

Three logistic regression models were developed, one for liveweight at breeding and adjusted liveweight at PD and set-stocking, one for changes in adjusted liveweight from breeding to PD and from PD to set-stocking, and one for BCS at breeding, PD and set-stocking, as predictor variables of interest. All models used wet vs. dry as the output variable, the above mentioned predictor variables of interest and additional covariates of farm-year (Farm A 2010-born and 2011-born, Farm B 2011-born). The models also included the number of foetuses at PD (single or multiple bearing).

Equation for model 1 (adjusted liveweight (ALW)): $\text{logit}(P) = \alpha + \beta_i{*}ALW_i + \beta_k{*}FY_k + \beta_{ik}{*}ALW_i{*}FY_k + \varepsilon$

Where P is the probability of a dry ewe lamb, α is the intercept representing a reference category for farm-year A2010 and measuring time 1, β with subscripts are regression coefficients, subscripts i are ALW measuring times 1–3 with 1 = mating, 2 = PD, 3 = Set Stocking, and k are farm years (FY) A2010, A2011 and B2011, and ε is a binomially distributed error term.

Data are presented as back transformed logit means and their 95% confidence interval as calculated in SAS (SAS Institute Inc., Cary, NC, USA; Version 9.3). Inferences were based on scatter plots with Loess smoothing trend lines of predicted probabilities of interest stratified by farm-year. Significance was inferred when $p < 0.05$. Interaction between adjusted liveweight and farm-year or BCS and farm-year were not significant in any of the models. Model fit