
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

BRIEF COMMUNICATION: Weight management considerations prior to mating to control litter size in Inverdale ewes

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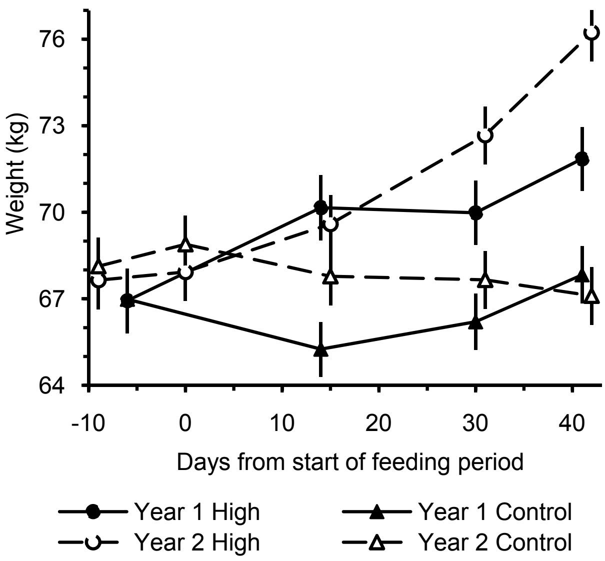
Keywords: Inverdale; flushing; sheep; litter size

Introduction

Nutritional flushing of ewes prior to mating is a routine component of many commercial farming operations to maximise profitability by increasing the number of lambs born per ewe. In the 1990s, the Inverdale mutation (*Fec X*^{I}) was identified and introduced into the New Zealand sheep industry as a way of increasing litter size in heterozygous carriers (I+) without the need for flushing (Davis 2005). The incorporation of *Fec X*^{I} into flocks gave farmers an opportunity to increase profitability without specific grazing management prior to mating (Amer et al. 1998). This enabled feed that would have been used for flushing to be carried through for later utilisation in the breeding season or over the winter months. However, autumn pasture growth is subject to considerable variation, potentially leading to variable intake if grazing management is not controlled prior to breeding. It was unclear what effect variable pasture intake before mating would have on litter size of I+ ewes, as there is a dearth of published information available on the effects of nutritional flushing highly prolific ewes like the Inverdale. Obtaining this information is therefore important for establishing and maintaining a cost effective and efficient flock of Inverdale sheep in New Zealand.

This study aimed to compare changes in live weight prior to mating following nutritional flushing or provision of a maintenance pasture allowance on consequent litter size in ewes that were heterozygous carriers (I+) or non-carriers (++) of the Inverdale mutation.

Figure 1 Mean un-fasted live weight ± standard error of the mean over a six-week feeding period prior to joining ewes that were heterozygous carriers of the Inverdale mutation (I+) and wild type (++) offered either a High (3.5 kg dry matter (DM)/ewe/d) or Control (maintenance) (1.25 kg/DM/ewe/d) feeding allowance in Year 1 or Year 2 of the trial.



Materials and methods

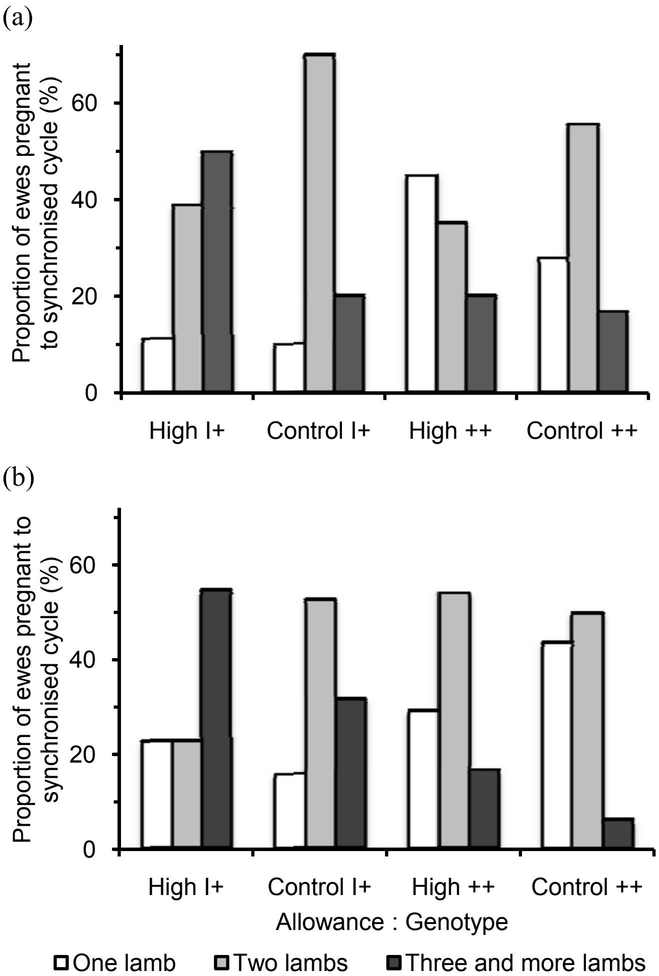
This study was conducted over two consecutive breeding seasons in 2008 and 2009 at the Invermay Agricultural Centre, Mosgiel, New Zealnd following prior approval of the Invermay Animal Ethics Committee.

Materials and methods for this trial have previously been described in detail in Demmers et al. (2011). Briefly the ewes were heterozygous carriers (I+) or their wild type (++) litter mates aged between 1.5 and 6.5 years, that were progeny of I+ Inverdale Romney ewes joined with wild-type Texel/Romney rams. Ewe genotypes were determined (Genomnz Laboratory, Mosgiel New Zealand) prior to the start of this experiment.

A total of 162 ewes were used in Year 1 (2008; 78 I+ and 84++) and 177 ewes in Year 2 (2009; 89 I+ and 88++). All animals were managed as a single flock according to normal farm practice on ryegrass/white clover pasture. Ewes had an average fasted live-weight of 63.4 ± 0.9 (standard error) kg in Year 1 and 63.9 ± 0.7 kg in Year 2. Each year they were assigned to two feeding groups, High or Control, balanced for live weight, genotype and age.

Ewes in the High group were given an *ad libitum* feed allowance of approximately 3.5 kg dry matter (DM) per ewe per day, and Control ewes were given a maintenance ration of approximately 1.25 kg/DM per ewe per day for a six week feeding period beginning 3 March 2008 and 26 February 2009 respectively each year. Pasture allowance for each group was calculated daily using a rising plate meter taking into account predicted growth rates and a residual DM of 500 kg per hectare, and was allocated in two to three day fenced sections. DM was confirmed on a regular basis using a cut quadrant system (Lile et al. 2001). At the end of the six week feeding period all ewes returned to a standard feeding programme.

Figure 2 Changes in litter size distribution in (a) Year 1 and (b) Year 2 associated with nutritional feed allocation prior to mating (High or Control) and the genotype of the ewe as carriers (I+) or non-carriers (++) of the Inverdale gene.



Live weight was recorded at the start and end of the six week feeding period in un-fasted ewes and again the next day following an overnight fast. Additional un-fasted weights were recorded fortnightly during the feeding period. The fasted weights were used for statistical analysis of liveweight change.

The oestrus cycle of all ewes was synchronised by the insertion of an intra-vaginal progesterone-releasing device (CIDR-G, Pfizer Animal Health, Auckland, New Zealand) for 12 days. Withdrawal coincided with the end of the feeding period. After CIDR removal the ewes were joined with harnessed Texel x Romney rams with mating marks recorded at the end of the synchronised cycle. Litter size was determined by close monitoring at lambing and was defined as the number of lambs born, alive or dead per ewe. Only lambs that were born to the synchronised cycle were included in the litter size analysis.

Change in fasted live weight and the effect on $\log_e$-transformed litter size was analysed by residual maximum likelihood (REML) using a mixed effects linear model (SAS 2004). Ewe was fitted as a random effect and feeding group, genotype, year of trial, mate ram and age of ewe were included as fixed effects. Non significant interactions ($P > 0.05$) were removed and the model was re-run.

Results and discussion

Ewes in the High group responded to the additional pasture allowance over both years by increasing in live weight (+ 5.84 ± 0.17 kg fasted weight; $P < 0.01$). In comparison, ewes in the Control group maintained or lost a small amount of weight over the feeding period in both years of the trial (-0.14 ± 0.17 kg; $P > 0.05$). Fig. 1 shows the change in un-fasted live weight measured fortnightly during the two feeding periods in both years of the trial.

The increased weight gain in the High group following flushing resulted in an 11.5% increase in litter size ($P = 0.06$) compared with Controls over both years, when both genotypes were analysed together. Although the litter size increase in the High group was small and non-significant in Year 1 compared to the Control group (4%; $P > 0.05$), litter size was 20% higher in ewes in the High group compared with the Control group in Year 2 ($P < 0.05$), following the greater liveweight gain recorded in that year. As expected, genotype affected litter size, being 41% higher in I+ (2.4 ± 1.10) than ++ ewes (1.7 ± 1.1; $P < 0.01$). An unexpected pattern was seen in ++ ewes in Year 1 with the Control group showing a higher average litter size of 1.89 compared with the High group at 1.75, whereas, in the second year, litter size in the ++ ewes increased with flushing (High 1.88, Controls). In contrast, flushing increased litter size in I+ ewes over both years (Year 1: High 2.72, Controls 2.20; Year 2 High 2.45, Controls 2.16). As the same calculated feeding allowance was provided over both years, the variable responses could possibly be associated with differences in pasture composition and associated nutritive value (Demmers et al. 2011).

The most obvious effect of differential feeding prior to mating was on the subsequent litter size distribution shown in Fig. 2. Increased weight gain following flushing resulted in 50% in Year 1 and 55% in Year 2 of the High I+ ewes producing three or more lambs compared with only 20% in Year 1 and 32% in Year 2 of the I+ Control ewes. Changes in litter size distribution were not as apparent in wild-type ewes, with only a small increase in ewes in the High group having triplets compared to Control ewes with 3% in Year 1 and 11% Year 2).

Conclusion

The proportion of multiple births in Inverdale ewes can be manipulated by controlling weight gain before mating. Increased feed allocation and subsequent weight gained by ewes in the *ad lib.* fed High group resulted in over half of the I+ ewes having triplets or higher, compared with only 20% to 32% of I+ ewes on a maintenance level of feeding.

Increasing the litter size to three or more may not be attractive for farmers, due to the negative effects reported in lambs from larger litters associated with decreased birth weight, subsequent growth rates and increased mortality (Everett-Hincks & Dodds 2008). Thus skewing litter size distribution towards large litter sizes can potentially have a negative impact on farm profitability and efficiency. Consequently, for ewes carrying the Inverdale mutation, care should be taken to avoid increases in nutrition prior to mating to avoid further stimulating the ewe to shed more eggs induced through flushing. An added benefit is that the feed that would have been used for 'flushing' can be kept for later in the season, possibly to assist with additional feeding for triplet-bearing ewes late in pregnancy.

Acknowledgements

The authors would like to thank Phil Farquhar, Daniel Olliver and Bruce Mathieson for assistance with feeding trials, and Dr Ken Dodds for assistance with statistical analyses.

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