Effect of ewe live weight on the level of response to steroid immunisation

J.F. SMITH, K.S. MACLEAN, L.T. MCGOWAN AND I.R. POTTS

Ruakura Animal Research Station
Ministry of Agriculture and Fisheries, Hamilton

ABSTRACT

A trial was conducted in 1984 to examine the effect of live weight on response to immunisation in 3 groups of 200 Coopworth ewes differentially fed from weaning in December to reach 3 live weights in March (40, 50 and 60 kg). Half the ewes in each group were immunised with Fecundin® and further subdivided into 2 levels of nutrition (1.5 v 3.4 kg DM/ewe/d) for 4 weeks prior to a synchronised mating. Ovulation rate (OR); percent ewes lambing to first cycle (CR); lambs born per ewe lambing (LB/EL); percentage ova wastage (PFMO); and lambs born per ewe joined (LB/EJ) were determined. Immunisation had a significant effect on all parameters (OR = +0.56; CR = −7.6%; LB/EL = +0.37, PFMO = +10.1%; LB/EJ = +0.25). Ewe mating weight significantly increased OR (+0.37), CR (+19.5%), LB/EL(+0.25) and LB/EJ (+0.34) but did not significantly influence ova wastage. Premating nutrition significantly increased OR (+0.23), LB/EL (+0.09) and PFMO (+8.9%), but not LB/EJ.

The regressions on mean group mating weight of OR and LB/EL in first cycle showed similar slopes for the immunised and control ewes. Nutritionally induced differences in ewe mating weight therefore did not influence these responses to immunisation.

The response in LB/EJ was greater in the heavier ewes and reflected the effects of live weight on conception rate and embyronic loss.

INTRODUCTION

Field trials with the androstenedione immunogen Fecundin® (Scaramuzzi *et al.*, 1983) showed an apparent effect of ewe live weight at mating on the level of response, measured as lambs born per ewe joined (LB/EJ). This effect has subsequently been reported in field trials both in New Zealand (Geldard, Scaramuzzi and Wilkins, 1983) and Australia (Geldard, Dow and Kieran, 1984), and suggests that heavier ewes responded to immunisation better than light ewes.

Scaramuzzi *et al.* (1983) reported that immunised ewes produced an additional 2.4% LB/EJ for each 1 kg increase in mating weight compared to an extra 1% per 1 kg increase from the control ewes. This differed from the previously reported additive responses of immunisation and plane of nutrition on ovulation rate (Smith *et al.*, 1981a; Smith and Cox, 1981), although there was a suggestion of an improved response in terms of LB/EJ for the ewes on highest level of feeding.

The field trial data covered a wide range in mating live weights but were confounded with possible effects of ewe breed, age, season, location, previous history, current nutrition and management. Therefore an experiment was designed specifically to examine the effect of ewe live weight on the response to immunisation.

MATERIALS AND METHODS

In a 3x2x2 factorial experiment (n = 50 N = 600) Coopworth ewes (4-tooth to 6-yr) were allocated to 12 groups on the basis of age, weaning live weight and lambing performance in the previous year. Four of these groups were assigned to each of 3 levels of feeding (high, medium and low) with the aim of producing groups of ewes with different mean live weights at mating. The ewes averaged 48 kg at weaning and target mean live weights for the beginning of March were heavy (60 kg), medium (50 kg) and light (40 kg).

Ewes from 2 groups in each of the 3 feeding levels were treated with Fecundin®, being injected 8 and 4 weeks prior to joining.

Four weeks prior to joining the groups were allocated to either a flushing (3.5 kg DM/ewe/d) or non-flushing (1.5 kg DM/ewe/d) level of nutrition. Intravaginal CIDR devices were used to synchronise oestrus and ewes were mated with 5% Suffolk rams at the second oestrus following CIDR removal. Ovulation rate was recorded by laparoscopy 10 days later.

RESULTS

Table 7 presents the mean live weights (after 24 h without feed and water) for all groups at the

commencement of flushing and at the time of laparoscopy. The reproduction data are presented in Table 8.

Ovulation Rate (OR)

There were effects ($P<0.001$) of immunisation (+0.56), flushing (+0.23) and live weight (heavy *v* light, +0.37) on ovulation rate. There were interactions between immunisation and flushing ($P<0.01$) on the proportion of ewes multiple ovulating (EOM) and on the proportion of EOM that had higher order (3+) multiple ovulations (EOHM). There was an interaction ($P<0.05$) between immunisation and live weight on the proportion of EOHM (Table 9).

Conception Rate at First Cycle (CR)

Immunisation reduced conception rate (−7.6%, $P<0.05$) while ewe live weight increased it (+19.5%, $P<0.001$).

TABLE 7 Ewe live weight (kg).

	Date			
	13/3	16/4	29/5	16/7
Treatment group[1]	FW[2]	LW[3]	50D[4]	100D[5]
LIN	41.8	43.7	50.1	49.9
LIF	41.3	49.3	51.1	50.6
LCN	42.0	44.2	49.6	49.5
LCF	41.7	49.2	50.8	51.1
MIN	48.0	47.7	52.2	51.8
MIF	48.5	53.7	53.6	53.9
MCN	49.3	48.3	52.8	52.5
MCF	49.8	54.4	54.7	53.8
HIN	57.4	55.3	57.6	56.9
HIF	57.8	60.5	59.5	58.2
HCN	58.5	56.3	58.7	57.7
HCF	58.6	60.7	59.2	58.3
Means				
Immunised	49.1	51.7	54.0	53.6
Control	49.9	52.2	54.3	53.8
Light	41.7	46.6	50.4	50.3
Medium	48.9	51.0	53.3	53.0
Heavy	58.1	58.2	58.8	57.8
Non flushed	49.5	49.3	53.5	53.1
Flushed	49.6	54.6	54.8	54.3

[1] L = Light, M = Medium, H = Heavy preflushing live weight, I = Immunised, C = Control, N = Non flushed, F = Flushed
[2] FW = Weight at start of flushing period
[3] LW = Weight at laparascopy (mating weight)
[4] 50D = Weight at day 50 of pregnancy (ewes conceiving to 1st cycle only)
[5] 100D = Weight at day 100 of pregnancy (ewes conceiving to 1st cycle only)

Lambs Born per Ewe Lambing in First Cycle (LB/EL)

There were effects of immunisation (+0.37; $P<0.001$) flushing (+0.09; $P<0.05$) and ewe live weight (H *v* L; +0.25; $P<0.01$) on LB/EL at the first cycle. There was an interaction ($P<0.05$) between flushing and immunisation with the immunised ewes showing a negative response to flushing (−0.05) in contrast to the positive response of the control ewes (+0.21). Similar patterns were seen in the data on LB/EL over the whole lambing period.

Embryo Loss

Partial failure of multiple ovulation (PFMO) was determined for those ewes conceiving to the first cycle as the percentage of ovulations not represented by lambs born. There were effects ($P<0.001$) of immunisation and flushing which increased PFMO by +10.1% and +8.9% respectively. There were no interactions and the effects of immunisation and flushing appeared additive.

Barren Ewes

The overall incidence of barrennes was 6.7% and whilst there were no significant treatment effects, the immunised ewes had more (+3.3%) than the controls and the heavy ewes less than the light (−6.2%).

Lambs Born per Ewe Joined (LB/EJ)

There were significant effects of immunisation (+0.25), and ewe live weight (H *v* L, +0.34) and interactions between immunisation and flushing and between immunisation and live weight where the response (LB/EJ) to immunisation was greater in the non flushed and in the heavy ewes (Table 10).

Relationship of Response with Ewe Live Weight

Simple linear regressions calculated for OR and LB/EJ with mean group live weight at laparoscopy (i.e., joining live weight) for the immunised and control ewes indicate no difference between immunised and control ewes in response to increasing live weight for OR and no significant difference in slopes for the response in terms of LB/EJ (Table 11). There was however a trend for the heavier ewes to show a greater response to immunisation in terms of LB/EJ. This reflects the differing effects of immunisation and live weight on conception rate and embryonic loss.

For the heavy ewes there was little difference between the immunised and control groups in terms of barren ewes or PFMO, while for the light ewes the immunised group had a higher incidence of barren ewes and a higher level of PFMO so that the advantage of the increased OR was partially dissipated.

TABLE 8 Reproductive performance

Treatment group (n = 50)	OR	CR[1] %	LB/EL[1]	PFMO[1] %	Barren %	LB/EJ	LM[2] %
LIN	1.72	60	1.50	16.7	14.6	1.28	10.0
LIF	1.92	56	1.53	25.9	8.3	1.31	3.2
LCN	1.18	68	1.12	5.0	8.2	1.06	9.6
LCF	1.42	74	1.38	5.6	4.2	1.27	8.2
MIN	2.00	76	1.67	16.9	14.6	1.43	9.0
MIF	2.12	70	1.60	28.2	6.3	1.51	9.9
MCN	1.33	76	1.16	13.7	10.2	1.13	1.9
MCF	1.71	69	1.44	16.9	4.3	1.38	10.8
HIN	2.10	74	1.92	10.1	2.3	1.86	12.2
HIF	2.40	82	1.80	26.0	4.0	1.70	10.6
HCN	1.44	92	1.35	6.1	0.0	1.33	4.6
HCF	1.79	84	1.51	15.1	4.0	1.40	7.1
Means							
Immunised	2.04	69.7	1.69	20.9	8.4	1.52	9.3
Control	1.48	77.3	1.32	10.8	5.1	1.26	7.1
Light	1.56	64.5	1.37	14.1	8.8	1.23	7.6
Medium	1.79	72.9	1.47	19.6	8.9	1.36	8.2
Heavy	1.93	83.0	1.62	15.4	2.6	1.57	8.9
Non flushed	1.63	74.3	1.45	11.7	8.4	1.35	8.2
Flushed	1.89	72.6	1.54	20.6	5.2	1.43	8.4

[1] First cycle only
[2] LM = Lamb mortality to weaning, including those born dead

TABLE 9 Interactions between immunisation and flushing or ewe live weight on percentage of ewes that had multiple ovulations (EOM) and higher order multiples (EOHM).

	Immunised	Control
EOM/EO		
Flushed	83.2	60.3
Non flushed	74.7	30.4
EOHM/EOM		
Flushed	33.1	5.7
Non flushed	25.0	4.4
EOHM/EOM		
Light	17.6	7.1
Medium	30.0	6.4
Heavy	37.5	3.4

TABLE 10 Interactions between immunisation and flushing or ewe live weight on LB/EJ.

	Immunised	Control
LB/EJ		
Flushed	1.51	1.35
Non flushed	1.52	1.17
LB/EJ		
Light	1.30	1.17
Medium	1.47	1.26
Heavy	1.78	1.37

TABLE 11 Regressions on ewe live weight at mating of ovulation rate, LB/EL at first cycle and LB/EJ for immunised and control ewes.

	Slope	Regression Intercept	r	Significance
Ovulation rate				
Immunised	0.036	0.16	0.96	**
Control	0.034	-0.28	0.88	*
LB/EL (1st cycle)				
Immunised	0.020	0.65	0.73	*
Control	0.021	0.24	0.85	*
LB/EJ				
Immunised	0.0309	-0.0840	0.82	*
Control	0.0210	0.1676	0.91	**

Lamb Birth Weight

The mean weight of the 792 lambs born was 5.03 kg. There was a significant effect of birth rank (singles = 5.81 kg, twins = 4.67 kg, triplets = 3.76 kg). Lambs of immunised ewes were lighter than those of control ewes (4.79 *v* 5.32 kg) primarily because of the different proportions in birth ranks. Ewe mating live weight had no effect on lamb birth weight.

Lamb Mortality

The overall lamb mortality was 8.3% and there were no significant treatment effects.