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The effect of steroid immunisation on the seasonal pattern of oestrus, ovulation and ovulation rate in Coopworth ewes

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ABSTRACT

Two hundred 5-year-old Coopworth ewes were allocated to 4 groups in December 1983. Two groups (1 of which had been given a booster treatment of Fecundin® on 21 December) were treated with progesterone impregnated intravaginal sponges and joined with vasectomised Southdown rams on 19 January 1984. Oestrous data were recorded daily and ovulation rate determined by laparoscopy at each cycle thereafter. The other 2 groups (1 of which received a booster on 5 May 1984) were also treated with progesterone impregnated intravaginal sponges and introduced to rams on 1 June 1984. Oestrous and ovulation data were recorded until mid-September.

Immunisation had no effect on the percentage of ewes exhibiting oestrus whereas season had a significant effect with an increase from 18% in January to a peak of 95% in April. This level of oestrous activity was maintained until the end of July after which there was a rapid decline. The proportion of ewes ovulating showed a similar pattern although peak values were attained early in February. Ovulation rate showed an increase up to March, plateauing until early July, and then declining. Values for immunised ewes were significantly higher than controls and persisted for at least 6 months in the early treatment group.

These data show that although immunisation does not adversely influence the pattern of oestrus and ovulation activity in ewes subjected to the ram effect, early treatment appears to prolong the ovulation rate response.

Keywords Immunisation; season; oestrus; ovulation rate; Coopworth.

INTRODUCTION

There are very limited data on the seasonal pattern of oestrus and ovulation in the Coopworth ewe (Kelly *et al.,* 1976) although slightly more data are available for the Romney breed (Goot, 1949; Averil, 1965; Quinlivan and Martin, 1971; Hight *et al.,* 1976; Kelly *et al.,* 1976; Knight *et al.,* 1983). Use of the ram effect to induce an earlier onset of the breeding season resulted in an earlier cessation in Romney ewes (Knight *et al.,* 1983). Immunisation of ewes against steroid hormones has been shown not to interfere with the ability of rams to induce ovulation in anoestrus ewes (Scaramuzzi *et al.,* 1981; Smith *et al.,* 1983). However Davis *et al.* (1985) observed a delay in the onset of oestrus in immunised Merino x Romney ewes of known Booroola genotypes. They also observed a prolonged interval (8 months) during which the immunised ewes of the F+ genotype had higher ovulation rates. This contrasts with the decline in ovulation rate following immunisation in Merino ewes reported by Cox *et al.* (1984).

The present trial was conducted to:

1. Provide further data on the pattern of oestrus and ovulation in Coopworth ewes.
2. Determine if a ram induced early onset to the breeding season influenced the time of cessation.
3. Examine the effect immunisation had on commencement of the breeding season.
4. Determine the effect of season on the duration of the increased ovulation rate response in immunised Coopworth ewes.

MATERIALS AND METHODS

In December 1983 following weaning and shearing 200 5-year-old Coopworth ewes were allocated to 4 groups of 50 on the basis of their previous history of Fecundin® treatment, live weight post-shearing, and reproductive performance in 1983.

One group of ewes that had previously been immunised with Fecundin® was given a booster injection on 21 December. These ewes and another non-immunised group were treated with intravaginal sponges containing 70 mg medroxprogesterone acetate on 5 January and joined with 10 vasectomised

Southdown rams at sponge removal on 19 January (early treatment).

Two other groups (1 which had been previously immunised and given a booster on 5 May) were treated with progesterone impregnated sponges on 18 May and joined with vasectomised rams on 1 June (late treatment). To facilitate the conduct of laparoscopy the early groups were also treated with progesterone impregnated sponges from 18 May to 1 June.

Daily oestrous observations were conducted from time of sponge removal in both early and late groups. The incidence of ovulation and ovulation rate were determined by laparoscopy 5 d after sponge removal and at each cycle thereafter. Observations on all groups ceased in mid-September 1984. Ewe live weight was recorded at each laparoscopy and a blood sample taken for determination of androstenedione antibody titre level.

The level of nutrition was adjusted during the trial to maintain the initial live weight.

RESULTS

A total of 8 ewes died during the trial. Five of these deaths were directly or indirectly attributable to the laparoscopic procedure. A further 20 ewes developed adhesions to 1 or both ovaries, sufficient to obscure ovulation sites and were subsequently culled. As the majority of these ewes (17) were in the early treated groups, data from these groups were analysed with and without the inclusion of the ewes with adhesions. As no major discrepancies were detected between the analyses data from the ewes with adhesions are not included in the presented data.

Incidence of Oestrus

There was no effect of either early or late immunisation on the proportion of ewes exhibiting oestrus prior to each laparoscopy (Table 1.)

There was a significant ($P<0.001$) seasonal change between 24 January and 14 February and between 9 and 27 April. This level of activity was maintained until the end of July, after which it declined during August and September in the early treated group. The late treated groups showed high initial activity in June and were not different from the early groups until the last observation in September when they maintained a higher level of activity.

There was no significant difference between immunised (I) and control (C) ewes in the day of first oestrus for the early (E) (IE = 49 ± 4; CE = 52 ± 4) and late (L) (IL = 155 ± 1; CL = 154 ± 1) treated groups. The precision of onset was better in the late group. There was a significant ($P<0.05$) difference between early and late treated groups in the day of last recorded oestrus (IE = 222 ± 3; CE = 222 ± 3; IL = 233 ± 2; CL = 228 ± 2).

Incidence of Ovulation

There was no effect of immunisation on the proportion of ewes ovulating at any time during the trial. A significant ($P<0.001$) seasonal pattern of ovulatory activity was observed (Table 1). The

TABLE 1 Proportion of ewes exhibiting oestrus and ovulation, ovulation rate and mean antibody titre levels at each laparoscopy.

Treatment		Date of laparoscopy Jan 24	Feb 14	Feb 28	March 20	April 9	April 27	May 14	June 8	June 21	July 11	July 31	Aug 17	Sept 6
Proportion of ewes exhibiting oestrus (%) (LSD = 16)														
Early	Immunized	23	58	69	77	77	92	100	81	100	100	92	77	35
	Control	13	61	65	74	77	97	97	84	97	100	97	61	29
Late	Immunized	—	—	—	—	—	—	—	89	92	89	97	78	57
	Control	—	—	—	—	—	—	—	93	98	98	95	83	48
Proportion of ewes ovulating (%) (LSD = 21)														
Early	Immunized	54	88	96	96	100	100	96	100	100	96	100	73	54
	Control	42	94	94	100	97	97	97	100	97	94	100	71	32
Late	Immunized	—	—	—	—	—	—	—	100	95	97	97	86	51
	Control	—	—	—	—	—	—	—	100	98	100	95	86	50
Ovulation rate (LSD = 0.21)														
Early	Immunized	1.64	1.85	1.72	2.12	1.92	2.04	1.96	1.92	1.77	1.88	1.73	1.42	1.29
	Control	1.31	1.48	1.52	2.06	1.67	1.73	1.90	1.42	1.53	1.66	1.55	1.27	1.20
Late	Immunized	—	—	—	—	—	—	—	2.16	1.89	1.89	1.64	1.59	1.37
	Control	—	—	—	—	—	—	—	1.55	1.66	1.55	1.45	1.17	1.05
Antibody titre ($\log_e$) (LSD = 0.51)														
Early		6.37	5.70	5.90	4.89	5.00	4.83	5.18	4.54	5.27	5.29	4.76	5.02	5.21
Late		—	—	—	—	—	—	—	4.93	5.52	5.43	4.53	4.79	4.62

percentage of ewes ovulating increased from 24 January to 14 February. This high level of activity persisted until the end of July and declined during August and September in all groups.

Ovulation Rate

The ovulation rate of ewes ovulating at each laproscopy (Table 1) showed an increase to 20 March, then a plateau until 11 July and a decrease thereafter in the early group. A similar pattern of decline was seen in the late groups. Values for the immunised ewes were significantly higher than for the controls on all except 2 occasions (20 March and 14 May) between 24 January and 11 July. The late treatment groups showed a similar effect of immunisation up to the last laparoscopy.

Antibody Titre Levels

The $\log_e$ mean values for antibody titre (Table 1) declined over the first 3 months in the early group and then appeared to stabilise. The late group did not achieve the same initial high levels and had titre values similar to the early group at the same date.

Ewe Live Weight

Mean ewe live weight was 56 kg at the commencement of the trial in December and did not differ either between groups or over time.

DISCUSSION

Following a ram-induced ovulation in mid-January, Coopworth ewes continue to ovulate regularly for a period of 7 months. Thereafter the proportion ovulating declined with over 40% still ovulating in September. Oestrus behaviour showed a more seasonal pattern with peak values being achieved during March and April. The early response to the ram effect recorded here confirms an earlier report for Coopworth ewes (Smith *et al.*, 1983) although the effect was slightly less effective in terms of the proportions of ewes ovulating and exhibiting oestrus.

These data indicate an earlier onset for the Coopworth (day 50) than that reported for the Romney (day 67) at similar latitude (38°S) (Knight *et al.*, 1983) after early ram introduction. Also while the unstimulated onset of oestrus in the late group was not recorded in this experiment other data were obtained on similar ewes. These ewes were joined with rams only after they had been observed to have ovulated with a mean oestrous onset of day 69. This is again earlier than that reported for either the Romney or the Coopworth at a more southern latitude (Kelly *et al.*, 1976). The cessation of oestrous activity was later than that recorded for the Romney (Knight *et al.*, 1983) and similar to that for Coopworths further south (Kelly *et al.*, 1976). As 40 to 50% of the ewes were still showing oestrus at the last observation in the present trial it would appear that Coopworth ewes have a longer breeding season than Romneys. The season is also longer at the more northern latitudes in New Zealand. The indication of an earlier cessation of the breeding season by the early treated group is partly in agreement with that recorded for Romneys by Knight *et al.* (1983). However the 7 d earlier cessation does not equate with the 17 d earlier onset (calculated using data from the supplementary group mentioned earlier) and thus use of the ram effect may have resulted in an increase in the duration of the breeding season. Steroid immunisation using Fecundin® in December, 4 weeks prior to ram introduction, had no effect on either the pattern of oestrus activity or on the incidence of ovulation. This differs from the report of Smith *et al.*, (1983) and Davis *et al.*, (1985) that immunisation produced a delay in the onset of oestrus. However in the case of Smith *et al.* (1983), the interval from booster to ram introduction was only 2 weeks compared to the 4 weeks in the present trial. Thus because of the effect of interval from booster to joining on oestrous response (Smith, 1985), the difference in interval could explain the difference in response.

The ovulation rate of ewes ovulating showed a distinct seasonal pattern with maximum values being obtained between March and June. As there were no changes in ewe live weight this pattern is most probably due to an effect of change in day length. Immunisation increased ovulation rate in both the early and late treated groups. Of particular interest is the prolonged response shown by the early treated group and the lesser response shown by the late group. This is in agreement with the results of Davis *et al.* (1985) with ewes carrying the Booroola fecundity (F) gene. However it contrasts with the decline in ovulation rate within 65 d of treatment in the breeding season reported by Cox *et al.* (1984).

The prolonged ovulation rate response in the present trial, despite the decline seen in antibody titre, suggests the possibility of using booster treatment of ewes at an earlier time in the season to reduce the handling costs involved. However, when this was attempted (McGowan and Smith, 1987) ewes boosted with Fecundin® in December and first joined with rams in April did not have a higher ovulation rate than non-immunised controls and antibody titres were lower. Thus the prolonged ovulating response recorded here and by Davis *et al.* (1985) may be related to the early induction of reproductive activity while antibody titres are elevated.

The lack of interference with the ram effect and the increased ovulation rate early in the season suggest that immunisation with Fecundin® could be a beneficial technique to employ in an early or out of season lambing programme.

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