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Effect of season of steroid immunisation and Booroola genotype on the level and duration of response in ovulation rate of ewes

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ABSTRACT

In April and May 1983 60 Merino x Romney ewes of known Booroola genotype (30 F+ , 30+ +) were immunised against androstenedione. An equal number of contemporary ewes of the same breed type and Booroola genotype were run together as an untreated control. Ewes were joined with vasectomised rams and ovulation rates were measured 4 weeks after the booster injection and thereafter at 3 successive 17-day intervals. The immunised F+ ewes showed an initial ovulation rate response of 1.62 compared with F+ controls and the response had decreased to 0.17 at the fourth observation 51 days later. The immunised + + ewes showed an initial response in ovulation rate of 0.29 which increased to 0.61 at the second observation and decreased to 0.12 at the fourth observation.

The experiment was repeated with the same sheep in 1984. Half of the ewes immunised in 1983 were given a booster injection in December 1983 (early group) and the other half were boosted in May 1984 (late group). Control ewes remained untreated. The early F+ immunised ewes had an ovulation rate response of 1.93 in February and 6 months later in August the response was still 0.90. The early + + immunised had an initial response of 0.33 which increased to 0.40 at the second observation and decreased to 0.9 in August. Late F+ and + + immunised ewes had initial responses of 0.71 and 0.38 which declined to 0.52 and 0.05 respectively 51 days later.

These results all show a consistently higher response to immunisation in F+ ewes. The F+ ewes immunised in December before the onset of the breeding season showed the highest initial response and 8 months after the booster vaccination a significant response was still evident. F+ ewes immunised during the breeding season (booster injection in May) showed a lower initial response and a lower subsequent response than F+ ewes immunised before the breeding season. The duration of the response could not be determined in these ewes because of the short period from boosting until the end of the season.

INTRODUCTION

Ewes with one copy of the Booroola gene (F+) have mean ovulation rates about 1.5 higher than non carriers (+ +) (Davis *et al*., 1984). This enables ovulation rate responses to steroid immunisation to be studied in flocks of widely differing prolificacy.

EXPERIMENTAL

On 18 April 1983 60 2½- and 3½-year-old Merino x Rommey ewes of known genotype (30 F+ , 30+ +) were immunised against androstenedione with a commercial immunogen (Fecundin®, Glaxo Australia Pty Limited). A booster injection was administered 22 days later. An equal number of similar ewes constituted an untreated control. All animals in the trial were run as a single mob. The flock was synchronised with progesterone impregnated sponges inserted 16 May and removed 30 May. Vasectomised rams fitted with mating harnesses for oestrus detection were joined at the time of sponge removal and all ewes were laparoscoped to measure ovulation rate on 7 June and at 3 successive oestrous cycles on 24 June, 11 July and 28 July. Mating marks and live weights were recorded at the time of laparoscopy.

The experiment was repeated with the same sheep in 1984. Half of the ewes immunised in 1983 were given a booster injection on 21 December 1983 (early group) and the other half on 4 May 1984 (late group). The control ewes remained untreated. Ovulation rates were recorded throughout the breeding season (February to August) for both the early group and controls. The late group was recorded from 5 June until the end of the breeding season.

Responses to immunisation were assessed by analysis of variance in conjunction with randomisation tests (Edgington, 1980). The latter technique was particularly useful in comparing responses over time, as data were basically ovulation measurements taken from the same animals across successive laparoscopies and hence were serially correlated.

RESULTS

Within the Booroola genotype there were no significant live-weight differences between immunisation treatments. On 7 June 1983, 27 February 1984 and 5 June 1984 the F+ ewes weighed 45.2, 52.4 and 54.5 kg respectively. Corresponding weights for the + + ewes were 47.4, 54.8 and 56.6 kg.

The mean ovulation rates recorded in 1983 are shown in Table 1. The F+ group showed an initial ovulation rate response to immunisation (± SE) of 1.62 ± 0.44, with a consistent decline to 0.17 ± 0.22 after 51 days. A similar but less pronounced response pattern was apparent for the + + group with immunised ewes showing significantly higher ovulation rates at the first 2 observations only (0.29 ± 0.12, and 0.61 ± 0.17 respectively).

Table 2 shows the mean ovulation rates in 1984 of the ewes given a booster injection during the non breeding season (December). The immunised F+ ewes had significantly higher ovulation rates than the non immunised F+ ewes throughout the entire breeding season (February until August), with an initial response of 1.93 ± 0.38 and subsequent responses ranging from 0.67 ± 0.31 to 1.48 ± 0.36. The mean response was 1.14 ± 0.19. By comparison, the response in immunised + + ewes averaged 0.21 ± 0.09 throughout the breeding season, with the highest response of 0.40 ± 0.19 being recorded at the second and third observations.

The F+ ewes given a booster late in the 1984 breeding season (May) had a mean ovulation rate response of 0.48 ± 0.19. The highest response (0.71 ± 0.32) was recorded at the first observation after boosting (Table 3). The + + ewes boosted late in the breeding season again showed a smaller ovulation rate response than the F+ ewes, the mean being 0.18 ± 0.10.

TABLE 1 Ovulation rates of non immunised F+ and + + ewes, and the corresponding ovulation rate responses of ewes immunised in April 1983.

	7 June	24 June	11 July	28 July
F+ Non immunised	2.73	2.33	2.27	2.21
Response	1.62	1.30	0.54	0.17
SE of response	0.44	0.27	0.19	0.22
+ + Non immunised	1.79	1.39	1.21	1.12
Response	0.29	0.61	0.21	0.14
SE of response	0.12	0.17	0.12	0.12

TABLE 3 Ovulation rates of non immunised F+ and + + ewes, and the corresponding ovulation rate responses of ewes immunised on 4 May 1984.

	5 Jun	22 Jun	9 Jul	26 Jul	13 Aug
F+ Non immunised	2.44	2.62	2.11	2.25	2.24
Response	0.71	0.53	0.47	0.52	0.18
SE of response	0.32	0.31	0.30	0.30	0.27
+ + Non immunised	1.41	1.44	1.41	1.31	1.09
Response	0.38	0.10	0.05	0.05	0.33
SE of response	0.19	0.18	0.18	0.17	0.15

During the period 5 June to 13 August 1984, when early and late boosted ewes were laparoscoped on the same days, the mean ovulation rate of the ewes boosted in December was 0.47 ± 0.28 higher than the later boosted ewes (3.28 *v* 2.81) for the F+ group. On the other hand, no such difference was evident in the + + ewes (1.48 *v* 1.51; SED = 0.13).

The effect of immunisation during the breeding season on oestrous behaviour was similar for both Booroola genotypes. All non immunised ewes showed oestrus between 20 and 27 days after 10 May 1983, and between 26 and 31 days after 4 May 1984. Such was not the case with immunised ewes, where the percentage showing oestrus during these periods dropped to 72.7 and 26.1 respectively. Fewer ewes boosted in the non-breeding season were in oestrus 51 to 68 days later compared with non-immunised, but the difference was not significant (22.6% *v* 43.9% $\chi_1^2 = 3.06$).

TABLE 2 Ovulation rates during 1984 of non immunised F+ and + + ewes, and the corresponding ovulation rate responses of ewes immunised in December 1983.

		27 Feb	15 Mar	2 Apr	19 Apr	7 May	5 Jun	22 Jun	9 Jul	26 Jul	13 Aug
F+	Non immunised	2.67	2.59	2.57	3.00	2.55	2.44	2.62	2.11	2.25	2.24
	Response	1.93	1.48	1.16	0.67	1.38	1.03	1.05	0.96	0.82	0.90
	SE of response	0.38	0.36	0.35	0.31	0.35	0.30	0.39	0.25	0.26	0.28
+ +	Non immunised	1.54	1.54	1.67	1.77	1.68	1.41	1.44	1.41	1.31	1.09
	Response	0.33	0.40	0.40	0.10	0.13	0.26	0.19	0.03	0.19	0.08
	SE of response	0.20	0.19	0.19	0.16	0.16	0.16	0.17	0.18	0.15	0.10

DISCUSSION

These experiments all showed a consistently higher response to immunisation in F+ ewes than in + + ewes. The 2 genotypes represent widely different levels of prolificacy and the results suggest that a lower ovulation rate response might be expected from flocks which have lower natural ovulation rates. The mechanism by which the Booroola gene influences ovulation rate is not well understood and the responses observed in this study may not be the same as would occur between breeds or strains where differences in prolificacy are due to multigenic effects. The findings are nevertheless consistent with the breed effect reported by Quirke and Gosling (1980) where the prolific Finnish Landrace breed showed an ovulation rate response to steroid immunisation of 1.60 (3.50 *v* 5.10) compared with only 0.26 (1.41 *v* 1.67) from the less prolific Galway breed. Responses of 1.71 (Finnish Landrace) and 0.99 (Galway) were recorded from the same sheep given a booster injection in the subsequent year (Quirke and Hanrahan, 1981).

The persistence of a high ovulation rate response in F+ ewes immunised during the non breeding season (Table 2) was unexpected. Immunised F+ ewes had a mean ovulation rate 0.90 higher than non immunised ewes on 13 August which was 34 weeks after boosting. It is not possible to establish from this experiment whether this was a seasonal effect or the result of this group being reboosted 32 weeks after the previous booster. The + + ewes reboosted in the non breeding season also showed a continued response although the magnitude was much less than in F+ ewes. A result similar to that of the + + group has been observed in Coopworth ewes reboosted at a 12-month interval in the non breeding season (J.F. Smith, unpublished).

If the result is a seasonal effect it has a practical implication for the commercial use of immunisation as it implies that ewes can be successfully boosted prior to the breeding season. This could be combined with other activities such as shearing or weaning and thus avoid the need for special mustering. However, Cox (1984) considered it an advantage to have steroid antibody titres declining to low levels at lambing, thus ensuring minimal transfer in colostrum and milk to lambs in eary life. The high ovulation rate response still evident in August could indicate persistently high antibody titres in ewes at lambing where boosting has been in the non-breeding season.

The effects of immunisation during the breeding season on oestrous behaviour in the present study suggest that fewer immunised ewes would conceive at the time of the first ovulation after boosting. Delaying joining by a further 17 days would overcome the problem of anoestrus in immunised ewes. This may result in a smaller increase in litter size because (with one exception, + + 1983) the ovulation rate response was greatest at the first laparoscopy.

CONCLUSION

These experiments have shown that the ovulation rate response to immunisation is magnified by the large effect of the Booroola gene, and supports the recommendation that Booroola sheep should not be immunised unless very high levels of prolificacy are desired. The suggestion of a seasonal effect in immunisation response has important implications and should be the topic of further research.

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