Do melatonin implants influence the breeding season in Coopworth ewes?

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ABSTRACT

Implants of melatonin can improve reproductive performance in sheep but timing of joining is important. In this study, 531 Coopworth ewes were used in a 2x4 factorial design to investigate the effects on reproductive performance of Regulin (melatonin) implants and time of joining. Implanted ewes were treated about 1 month prior to joining on either 1 December, 15 December, 29 December or 12 January. Control ewes were untreated. Matings with Poll Dorset rams were recorded fortnightly until the rams were removed on 5 February.

About 10% of the implanted and control ewes joined on 1 December mated by 29 December. None of the ewes joined on 15 December had mated by 29 December. By the end of joining, over 90% of these early joined ewes had mated. Melatonin treatment had no effect on mating pattern in these 2 joining groups. By contrast, melatonin treatment improved the total number of ewes mated when joined on 29 December (100% *v* 58% $P<0.001$). About 50% of the treated and control ewes joined on 12 January had mated by the end of joining. Time of joining, but not melatonin treatment affected return to service rates.

Melatonin treatment reduced the pregnancy rate in ewes joined on 1 December and 15 December (69% *v* 83% $P<0.01$). In contrast, melatonin treatment increased the pregnancy rate for 29 December joinings (72% *v* 41% $P<0.001$) but not 12 January joinings (49% *v* 46%). The incidence of multiple pregnancies was increased by melatonin treatment (40% *v* 30% $P<0.05$).

The melatonin treatment trend was for fewer lambs per ewe joined for early joining times to more lambs per ewe joined for later joining times.

These results demonstrate that reproduction responses to melatonin implants are very sensitive to time of joining. With a late December to mid January joining time and an early February end of joining, between 20 and 40 more lambs per ewe joined was achieved in this study. The onset to the breeding season in these Coopworth ewes is about 2 months earlier than expected. The use of Poll Dorset rams may be an important factor in this early onset.

Keywords Melatonin; Regulin; implants; breeding season; Coopworth; Poll Dorset; early lambing; seasonality of reproduction

INTRODUCTION

Melatonin is believed to be the hormone which enables seasonally breeding sheep to time reproduction. Melatonin implants (Regulin) have been developed which release physiological doses of melatonin for several weeks. When used in breeds of sheep with a poorly defined non-breeding season, for example Merinos, melatonin implants have resulted in reproductive performance rates from summer matings that are more characteristic of performance levels from autumn matings. The response of breeds of sheep with clearly defined breeding seasons has yet to be defined. To this end, a flock of Coopworth ewes which has consistently displayed an early onset to the breeding season was used to investigate the effect of melatonin on reproductive performance.

MATERIALS AND METHODS

Five hundred and thirty one mixed age Coopworth ewes were allocated at random into 8 groups according to a 2x4 factorial design. Half of the ewes received an ear implant of melatonin (18 mg, Regulin Ltd) approximately 28d prior to joining with harnessed Poll Dorset rams on one of either 4 dates (1 December, 15 December, 29 December and 12 January). Matings were recorded fortnightly from the start of joining until the end of

joining on 5 February. All ewes were run as one mob during joining. Ewes were ultrasonically scanned to determine number of foetuses present. The data were analysed using logit analysis.

RESULTS

Mating

There was an interaction between melatonin treatment and time of joining. Joining on 1 December compared to 12 December resulted in more ewes mating by 29 December (11% *v* 1% $P<0.001$) and by 12 January (65% *v* 22% $P<0.001$) (Fig. 1). Thereafter, there was little difference in the incidence of mating between these 2 groups with 95% of the ewes mated. Melatonin treatment had no effect.

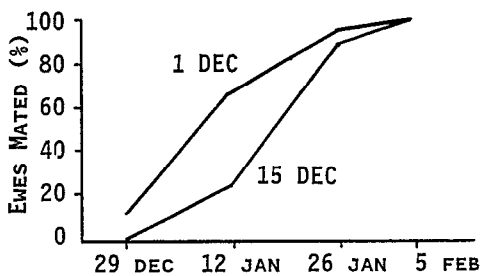

FIG. 1 Mating pattern in ewes joined on 1 Dec and 15 Dec.

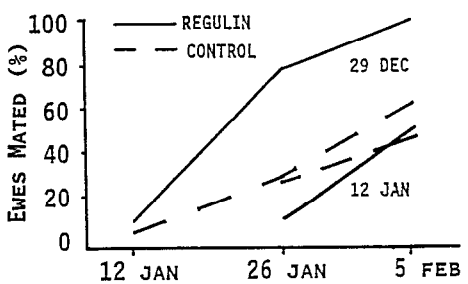

FIG. 2 Mating pattern in treated and control ewes joined on 29 Dec and 12 Jan.

In contrast, melatonin treatment increased the incidence of first mating in ewes joined on 29 December (Fig. 2). Thus, compared to untreated controls, melatonin treatment resulted in more ewes mating by 26 January (78% *v* 28% $P<0.001$) and by 5 February (100% *v* 58% $P<0.001$). With ewes joined on 12 January, treatment with melatonin delayed mating over the first fortnight of joining (8% *v* 26% $P<0.01$) but by the end of joining little difference remained (55% *v* 49%).

Return to service rates were higher in ewes joined on 1 December compared to joining at the latter 3 times (25% *v* 7% $P<0.001$). Melatonin treatment had no effect (15% *v* 12%).

Pregnancy, Lambs Present

There was an interaction between melatonin treatment and joining date for pregnancy rate (% ewes pregnant/ewes joined) (Table 1) but not litter size. Melatonin treatment reduced the pregnancy rate in ewes joined on 1 December and 15 December (69% *v* 83% $P<0.01$). Joining on either 1 December or 15 December resulted in a similar pregnancy rate (73% *v* 79%).

TABLE 1 Effect of joining date and melatonin treatment on pregnancy rate and lambs per ewe.

Joining date	Melatonin		Control	
	EP/EJ* %	LP/EJ* %	EP/EJ* %	LP/EJ* %
1 December	65	84	82	110
15 December	73	105	84	111
29 December	72	91	41	51
12 January	49	79	46	56

* EP = Ewes pregnant
EJ = Ewes joined
LP = Lamb present at scanning

In contrast, melatonin treatment increased the pregnancy rate in ewes joined on 29 December (72% *v* 41% $P<0.001$). Melatonin had no effect on pregnancy rate in ewes joined on 12 January (49% *v* 46%).

Melatonin increased the incidence of multiple pregnancies (% ewes with 2 lambs/ewe pregnant) in the ewes (40% *v* 30% $P<0.05$). Multiple pregnancy rate did not vary systematically with time of joining treatment (33% *v* 38% *v* 24% *v* 44% respectively).

Over all ewes, there were 86 lambs present per 100 ewes joined (Table 1) (assuming 2 lambs per

multiple pregnancy). The melatonin treatment trend was for fewer lambs in the 1 December group, a similar number of lambs in the 15 December group and more lambs in the 29 December and 12 January groups.

DISCUSSION

These results demonstrate that continuous release melatonin implants can influence reproduction in seasonally breeding ewes. Furthermore, timing of treatment and joining has a major influence on the direction and magnitude of the response. For the ewes used in this study, treatment during early to mid November for early to mid December joinings, had no affect on the mating pattern of ewes, returns to service or litter size. However, treatment apparently lowered finally pregnancy rates resulting in fewer lambs present. By contrast, treatment in early December for a late December joining resulted in more ewes mated and because of this, more pregnant ewes and more lambs present. The major reason for the apparently higher number of lambs present in ewes treated in mid December was the (non-significant) increase in litter size (1.60 vs 1.22) in these ewes. Collectively, these finding indicate that melatonin treatment in early-mid December is necessary to achieve 20-40 more lambs present/100 ewes. Whether later treatment and joining can produce similar results could not be determined from this study. These studies are presently underway in other flocks.

The pregnancy response achieved in the early December treated ewes is like that achieved in self-replacing wool flocks (e.g. Merino) in Australia where 20% more pregnancies are expected from maiden ewes (Staples, L.D. pers. comm.). However, unlike the Australian ewes, melatonin had no influence on litter size.

The means by which reproduction was enhanced in the latter 2 joining groups is not fully consistent with results achieved in less seasonal breeds in Australia. In the Australian work with Merino type ewes, responses are obtained over a longer period (October, November, December joinings), when 10% more ewes become pregnant, 13% more pregnant ewes carry multiples and 23% more lambs are present (Staples, L.D. pers. comm.). Furthermore, lambing is more concentrated. Reasons for the difference could be the: divergent genetic backgrounds of Merinos compared to Coopworths; incomplete isolation of ewes and rams in the present study or the joining of treated and control ewes in one mob. This latter factor would probably minimize treatment differences on mating activity.

The Coopworth ewes in this study began mating during December and most ewes were mated by late January. This is about 8-10 weeks earlier than is usual for ewes of this breed in New Zealand. This early onset of mating activity is not due to melatonin treated ewes running with controls since it has been recorded in this flock over the 2 previous seasons (McMillan, W.H. unpublished). Furthermore, it is unlikely to be associated with the breeding background of the ewes since they are purchased from a range of sources. Clearly, something associated with the local environment or the management of the flock may explain this occurrence. The frequent close association of Poll Dorset rams and the ewes prior to entire joining may hold a key to their early breeding. However, it is clear from the mating pattern (Fig. 1) that the classic ram effect response cannot account for the shift in mating pattern.

In summary, these findings demonstrate firstly, that Coopworth ewes can produce more lambs in response to continuous melatonin release implants but timing of treatment is crucial. For this flock, early December treatment is appropriate. Secondly, the results describe an onset of breeding activity that is 8-10 weeks earlier than expected for Coopworth ewes. While ram-ewe interaction may explain this, it is not as simple as the classic ram effect.

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