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Early induction of ovulation in yearling red deer hinds

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ABSTRACT

Yearling red deer hinds were treated to advance the time of the normal onset of ovulation so that mating and subsequent calving would occur about 1 month earlier than usual.

All hinds, except for the untreated controls had 15 days of intravaginal progesterone treatment beginning on 28 February. At progesterone withdrawal hinds were either untreated, or given pregnant mare's serum gonadotrophin (PMS) or gonadotrophin-releasing hormone (GnRH). Stags were introduced on 14 March and the hinds laparoscoped 7 or 12 days later to record the presence or absence of an induced ovulation.

Untreated hinds had a very low incidence of ovulation prior to the onset of the normal breeding season. While the use of progesterone alone marginally increased the number of hinds ovulating, PMS or GnRH treatment was generally necessary to induce ovulation. However, assessed from calving records, fertility at the induced ovulation was poor.

Keywords Red deer; early breeding; progesterone; PMS; GnRH; ovulation; calving

INTRODUCTION

Farmed red deer in New Zealand normally calve early in summer. It would be advantageous to advance breeding so that subsequent calving and lactation with its high nutritional requirements, would coincide with the earlier increase in pasture production associated with spring.

Providing pubertal hinds reach a suitable body-weight (Kelly and Moore, 1977; Fisher and Fennessy, 1985), photoperiodic changes during autumn probably induce the onset of the breeding season. Treatment of ewes, which are also "short-day" breeders, with gonadotrophin-releasing hormone (GnRH), gonadotrophins and progesterone can be used to induce early or out-of-season breeding (Robinson, 1954; McNatty *et al.*, 1981). Therefore we have examined the effects of these treatments on reproductive activity in the pubertal red deer hind in an attempt to induce ovulation, mating and subsequent calving about 1 month earlier than normal.

MATERIALS AND METHODS

Animals and Treatments

Experiments were conducted over 2 years (Experiment I in 1984 and Experiment II in 1985) with a total of 91 yearling (15 or 16 month old; body weight 64.0 to 96.5kg mean ±SD = 80.3±6.7kg) red deer *(Cervus elaphus)* hinds. The combined data for the 2 experiments are presented here.

Details of numbers and treatments are given in Table 1. One group of hinds was untreated (Control). All other hinds had controlled internal drug releasing devices (CIDR, AHI Plastic Moulding Co., Hamilton, New Zealand) containing 12% (w/w) progesterone inserted intravaginally on 28 February. At CIDR withdrawal 15 days later, hinds were left untreated (CIDR) or were given an intramuscular injection of pregnant mare's serum gonadotrophin (CIDR + PMS; Experiment I, *Pregnecol,* Commonwealth Serum Laboratories Melbourne, Australia; Experiment II, *Folligon,* Intervet (Austr.) Pty. Ltd., Australia) or were subjected to a continuous infusion of GnRH (CIDR + GnRH; Sigma Chemical Co., St. Louis, USA) delivered subcutaneously by a 7-day osmotic minipump (Alza Corporation, Palo Alto, USA). PMS and GnRH were administered on the 14 March when CIDRs were withdrawn and all hinds were placed in single-sire mating groups of either 22 (Experiment I) or 12 (Experiment II) hinds. Stags were run with the hinds until 9 May.

TABLE 1 The number of yearling red deer hinds that had ovulated as recorded at laparoscopy.

Group	Experiment	Dose	n	Number ovulated
Control	I		10	0
	II		9	1
CIDR	I		10	3
	II		8	2
CIDR + PMS				
(1U)	I[1]	125	4	1
		250	4	2
		500	4	4
	II[2]	250	8	7
CIDR + GnRH				
(ng/h)	I	62.5	4	1
		125	4	0
		250	4	2
	II	200	7	4
		400	8	3
		800	7	3

[1] *Pregnecol*
[2] *Folligon*

Measurements and Records

All hinds were laparoscoped under xylazine (*Rompun*, Bayer, N.Z. Ltd, Petone, New Zealand)/fentanyl citrate plus azaperone (*Fentaz*, Smith, Kline & French (N.Z.) Ltd, Auckland, New Zealand) anaesthesia to record the presence or absence of an induced ovulation 7 (Experiment I, 21 March) or 12 (Experiment II, 24 March) days after the stags were introduced. The osmotic minipumps were removed at this time. Anaesthesia was reversed with yohimbine (Mackintosh and Van Reenen, 1984).

The day of calving was recorded by observing all hinds daily. Calving corresponding to conception at the induced ovulation was defined as the range in gestation length previously noted at Invermay (227 to 239 d) from the known mating dates and included those hinds calving between 30 October and 13 November.

Statistical Analysis

The proportions of hinds ovulating and calving with Control and CIDR only treatments were comparable in each experiment. In the analysis the data for the 2 experiments have been combined and analyses performed using generalised linear models with a logit link and binomial errors (Nelder and Wedderburn, 1972).

RESULTS

Laparoscopy

At laparoscopy 7 or 12 d after stag introduction, only 1/19 of the Control hinds had a corpus luteum compared with 5/18 of the progesterone-treated hinds (CIDR); this difference was not significant (Table 1). PMS treatment resulted in a linear increase ($P<0.01$) in the proportion of hinds that ovulated with increasing doses in Experiment I. In Experiment II nearly all hinds ovulated indicating that the higher doses of PMS (500 IU *Pregnecol* and 250 IU *Folligon*) were approximately equal in efficacy. All but 1 of the PMS-treated hinds that ovulated had a single ovulation (1 of the 250 IU *Folligon* treated group had a triple ovulation).

Overall, GnRH treatment (CIDR + GnRH) also resulted in an increase ($P<0.05$) in the proportion of hinds ovulating. At the 62.5 and 125 ng/h doses only 1/4 and 0/4 hinds respectively, had a corpus luteum. However, at all other dose rates about half of the hinds had ovulated. This suggested response to dose was, however, not significant. In all hinds that ovulated, single ovulations were observed.

Calving

No Control, 2 CIDR, 2 CIDR + PMS and 3 CIDR + GnRH treated hinds calved corresponding to conception at the induced ovulation (Table 2), with no significant differences between groups.

The calving results (Table 3) showed that no treatment had any significant effect on the proportion of hinds calving before 1 December (data not shown) although the mean calving date was slightly earlier in the CIDR + GnRH group hinds. Additionally, the Control hinds had a calving spread of 30 d compared with 50, 45 and 54 d in the CIDR, CIDR + PMS and CIDR + GnRH group hinds respectively.

Overall 75/91 (82%) hinds put to the stags calved with no significant differences between groups.

TABLE 2 The number of red deer hinds calving to the induced ovulation.

Group	n	Number ovulated at laparoscopy	Number calving to induced ovulation
Control	19	1	0
CIDR	18	5	2
CIDR + PMS	20	14	2
CIDR + GnRH	34	13	3

TABLE 3 The calving results for untreated- and treated-yearling red deer hinds calving as 2 year olds.

Group	Number calving	Mean calving date (Dec)	Calving spread
Control	17/19	10	27 Nov—26 Dec
CIDR	14/18	9	7 Nov—26 Dec
CIDR + PMS	16/20	6	7 Nov—21 Dec
CIDR + GnRH	28/34	2	30 Oct—22 Dec

DISCUSSION

In previous years, red deer calving for the first time as 2 year olds at Invermay have begun calving early in December. Given a 233 d gestation period, successful mating would not be expected to occur before 13 April. Thus, as expected, little ovarian activity was noted in untreated hinds laparoscoped some 3 weeks earlier. Although the use of progesterone alone induced ovulation in some hinds this treatment would not be expected to be successful in a large proportion of prepubertal animals. However, its effectiveness might increase closer to the normal breeding season. In contrast, PMS treatment, at least at the higher dose rates, was most effective in inducing ovulation, demonstrating the need for gonadotrophic stimulation prior to the onset of breeding season. GnRH treatment, perhaps above a threshold dose rate of somewhere between 125 and 200 ng/h, also induced ovulation but at best was effective in only about half the animals. This form of GnRH treatment is thought to stimulate the final stages of follicular maturation primarily by inducing an increase in luteinising hormone levels (McNatty *et al.*, 1981), whereas PMS has both lute-

inising hormone- and follicle-stimulating hormone-like properties. Therefore, there may be a requirement for follicle-stimulating hormone at least in some hinds. Further understanding of these aspects awaits a detailed study of reproductive hormone secretion during sexual development in the red deer hind and following exogenous hormone treatment.

A clear result of the present study is that while ovulations were induced in many hinds few calved to the induced ovulation. In contrast, work in sheep has shown that PMS-induced out-of-season breeding can result in fertility at least equal to that of ewes similarly treated during the breeding season (e.g. Evans and Robinson, 1980) while low-dose GnRH treatment has so far resulted in fertility also comparable to that recorded in naturally ovulating ewes (McLeod and Haresign, 1984). Thus, further work is required to evaluate the contribution of the stag and of experimental manipulation to the low fertility recorded in the present study.

A disadvantage of inducing early calving in some but not all hinds in a herd, is the large calving spread of 45 to 54 d in the treated groups compared with 30 d in the untreated controls. Any practical treatment would probably need to ensure that a high proportion of hinds calved early. While some PMS and GnRH treated hinds calved about 18 d after the induced calving (suggestive of a second post-treatment ovulation) most calved in December along with the untreated controls, indicating that they had probably reverted to anoestrus until the onset of the normal breeding season. The high fertility of both untreated and treated hinds indicates that no detrimental effects of treatment on overall herd fertility were apparent.

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