

Manipulation of the breeding season in red deer

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Abstract. Red deer *Cervus elaphus* are seasonal breeders with mating in the autumn and subsequent calving in summer. Under the temperate climatic conditions in New Zealand, there is considerable interest in commercially practical treatments to advance the time of mating and hence the calving season to take advantage of high quality spring pasture.

Gonadotrophic stimulation and treatment with melatonin have been used successfully to induce ovulation prior to the normal breeding season and advance the calving date in hinds. Although such techniques using pregnant mare's serum gonadotrophin releasing hormone following progesterone priming are very effective in inducing ovulation prior to the normal breeding season, fertility at the synchronised oestrus has generally been poor. Since stag fertility is likely to be major contributor to this problem, research is also concerned with advancing the breeding season in stags using melatonin treatment.

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Introduction

Red deer *Cervus elaphus* are "short day" seasonal breeders with oestrus in hinds occurring during the autumn (i.e., they require a period of decreasing day length to simulate their reproductive system). In New Zealand, a March-April mating results in calving in November-December. Consequently hinds are required to lactate through the summer when both feed supply and quality are less reliable than during the spring (August-November).

Therefore there is considerable interest in practical approaches to advance the

breeding season in red deer, so that lactating hinds have access to high quality spring pasture at least in least in early lactation.

Reproduction in females

A simplified scheme for the regulation of the female reproductive cycle is presented in Fig. 1 indicating the possible routes for advancing the breeding season in female deer, namely:

- (I) manipulating day length
 - (II) treatment with melatonin
 - (III) treatment with gonadotrophin releasing hormone (GnRH)
 - (IV) treatment with luteinizing hormone (LH) or follicle stimulating hormone (FSH)
- pregnant mare's serum gonadotrophin (PMSG) has both LH-like and FSH-like activity
- (V) treatment with progesterone

Gonadotropic stimulation

Gonadotropic stimulation (using PMSG or GnRH) following progesterone priming has proved to be a satisfactory method for inducing ovulation in hinds prior to the start of the normal breeding season. The routine procedure has involved the insertion of a controlled internal drug releasing device containing 9 or 12% progesterone (CIDR, Alex Harvey Industries, Hamilton, NZ) in the vagina for a period of 12-15 days. The hinds are treated with the PMSG (single injection) or GnRH (continuous infusion for 7 days via an osmotic minipump; Alza, Palo Alto, USA) at CIDR withdrawal. The summarised results of two trials are given in Table 1.

In trials to date, PMSG at a rate of 200-300 iu gives are more consistent ovulatory response than treatment with GnRH (200-800 ng/hour). However, though the induction of ovulation has been successful, fertility at the resulting oestrus is variable, but generally poor. It is likely that low stag fertility is the major contributor to this prob-

Table 1. Induction of ovulation in red deer hinds treated in early March about one month prior to the start of the normal breeding season; ovulation recorded at laparoscopy 7-12 days after treatment.

Treatment	Number of hinds ovulating	
	Maiden hinds (15 month age)	Lactating hinds (27 months age)
Control - no treatment	1/19	----
Progesterone only	5/18	0/13
Progesterone /PMSG	11/12	11/13
Progesterone /GnRH	12/26	8/13

Table 2. Induction of ovulation in yearling red deer hinds given various melatonin treatments; ovulation was synchronised by progesterone or prostaglandin treatment.

Treatment	Hinds Ovulating
Control	0/6
Fed melatonin	
Did not eat supplement	0/9
Ate supplement	9/11
Melatonin implants	12/16

lem, since fertility has been improved by treating stags with long acting melatonin implants ('Regulin', Gene Link Australia Ltd, Melbourne) to advance the breeding season. Preliminary results to date have been encouraging with improved fertility to the induced oestrus (50% with treated stags in 1986 compared with 13% with untreated stags in 1985; Moore unpublished data).

Melatonin

Webster and Barrell (1983) reported that daily injections of melatonin commencing about 3.5 months prior to the normal breeding season, advanced mating by 26 days and calving by 32 days in yearling red deer hinds. Hinds subjected to a manipulated photoperiod of short days (8 hours light/16 hours dark) responded similarly to the melatonin-treated hinds. In this study, stags were also subject to the manipulated photoperiod.

Our own studies have investigated two other methods of melatonin administration, namely Regulin, or feeding the melatonin directly to hinds. In one experiment, 42 yearling red deer hinds were used: 6 were untreated controls, 20 were offered melatonin mixed with a daily ration of pelleted feed (only 11 of 20 regularly ate the supplement) and 16 received melatonin implants. Treatments were applied from December to March, when the hinds were treated with progesterone or prostaglandin to synchronise oestrus and then laparoscoped. The results are summarised in Table 2.

When the Invermay and other melatonin studies are considered together (Adam and Atkinson, 1984; Adam et al., 1986; Barrell and Staples, 1991), melatonin treatment shows considerable promise as a practical technique to advance the breeding season in red deer, especially now that useful long acting implants are likely to become commercially available. However,

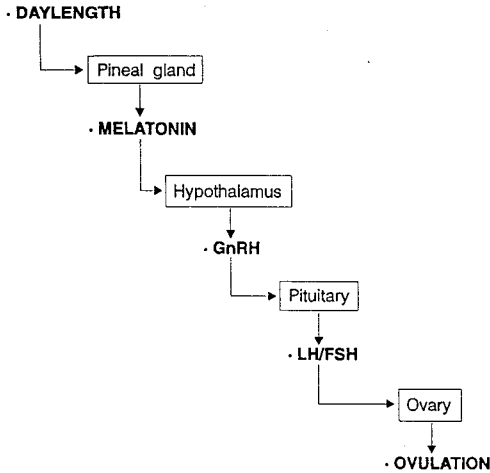


Fig. 1. Simplified description of the endocrine regulation of the reproductive axis in female red deer.

there have been concerns about the possible influence of melatonin on lactation in the hind (and hence on calf growth rate) so that this has been a focus of a recent study. In this work, the growth rates of calves sucking either melatonin-treated (Regulin implants in mid-January and mid-February) or control hinds over the lactation period were virtually identical (32.3 kg and 32.4 kg gain from the start of melatonin treatment to weaning).

However melatonin is contra indicated for use in pregnant female deer as it may be inhibit the onset of lactation (Asher and Barrell, pers comm).

Based on the limited data available at present, it would appear that both the timing and the length of the melatonin treatment period are likely to be important factors affecting the success in advancing the breeding season in hinds.

Reproduction in stags

Where the objective is to ensure that stags are both sexually active and fertile

prior to the normal breeding season, the possibilities include manipulating day length or treatment with melatonin. It is very likely that much of the problem with low fertility of at the induced oestrus prior to the normal breeding season is due to the stag, there being considerable variability between stags both in terms of rutting behaviour and fertility at this time. Therefore the use of melatonin to advance the breeding season in stags is being investigated. In one study, groups of red stags

were either left as untreated controls or treated with melatonin implants (Regulin) in November or December (late spring - early summer). Several physical measures including liveweight, scrotal circumference and testis diameter were monitored. Scrotal circumference, an indication of testicular growth, revealed that the effect of the melatonin implants was becoming apparent only 4 weeks after the start of treatment, with maximal scrotal circumference being recorded 2 month after the start of treatment, 1-2 months earlier than the controls. The patterns of liveweight change were also altered markedly while the treated stags started roaring in January, about 2 months before the controls. The melatonin treated stags cast their hard antlers in late April/early May, some 4-5 months earlier than usual indicating a major alteration in the normal pattern of testicular growth and regression.

Although there is only limited information available, the indications are that treatment of stags with melatonin will ensure a

substantial improvement in fertility prior to the normal breeding season.

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