MELATONIN AND ADVANCED BREEDING FURTHER RESEARCH: TWO DOSAGE REGIMES AND THE INFLUENCE OF THE STAG

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1 INTRODUCTION

Advanced calving of farmed deer herds has been the subject of a number of recent papers to Deer Branch courses for veterinarians (Fennessy *et al*, 1986; Fisher and Fennessy, 1987; Pearce, 1988; Wilson *et al* 1988; Fennessy and Fisher, 1988; Wilson 1989) and elsewhere in the international literature (Adam and Atkinson, 1984; Adam *et al*, 1986; Adam *et al*, 1989; Asher *et al*, 1988; Fisher *et al*, 1988; Fisher and Fennessy, 1990; Fisher *et al*, 1990; Webster and Barrell, 1985; Wilson *et al*, 1990). The recent introduction to the market of "Regulin" melatonin implants has made advanced calving commercially available for use by deer farmers.

The usual technique is for a three-treatment regime for yearling hinds, but a range of treatments and start dates have been reported in the literature. These are summarized in Table 1. For commercial purposes a regime to advance the breeding season which has the lowest cost for the maximum benefit is desired. Thus, further research was required into a reduced dosage regime.

Earlier research has suggested that the presence of melatonin-induced early rutting stags advanced the onset of oestrus in untreated hinds (Fisher *et al*, 1990; Wilson *et al* 1990). Further field work was required to establish the reliability of the "stag effect". The potential advantage of this effect is with mixed-age breeding hinds since there are practical difficulties with melatonin treatment of hinds with calves at foot.

This paper reports in brief detail results of recent trial work undertaken to investigate a two dosage melatonin treatment regime for yearling hinds and the influence of the "stag effect" on mixed age hinds. Data is reported elsewhere in full (Wilson, 1990).

2 MATERIALS AND METHODS

2.1 Experiment 1

This experiment compared a 30-day interval three dosage regime with a 45-day interval two dosage regime in one-year-old hinds. 2 x 18mg Regulin implants were given subcutaneously in the neck on each occasion. Trial design is summarized in Table 2.

2.2 Experiment 2

This trial set out to establish whether induction of early rutting behaviour by stags using melatonin treatments, and early introduction to the breeding herd, resulted in the early induction of ovulation in mixed age hinds. Stags on two properties were treated and underwent a mating programme according to the schedule in Table 3. On farm 1, a third group of 150 hinds were exposed to vasectomised treated stags prior to joining with entire treated stags.

Table 1 Summary of the literature of research procedures and results for advancement of calving in red deer using subcutaneous melatonin implants ("Regulin")

Authors	Date/s for treatments						No. hinds	Age of hinds at treatment (yr)	No Implants/ Treatment	Stag*	Pregnancy rate %	Day advanced calving c.f controls	
	Oct	Nov	Dec	Jan	Feb	Mar						Mean	Median
Barrell and Staples (1987)	-	-	20	20	-	-	8	MA**	2	T	NS	16	
	-	-	-	20	18	-	8	MA**	2	T	NS	8	
			Control				8	MA**	0	T	NS	-	
Fisher *et al* (1988)	-	-	16	15	14	-	9	1	2	NS	NS	11	
			Control				9	1	0	NS	NS	-	
	-	-	-	15	15	-	18	3	2	NS	NS	11	
			Control				18	3	0	NS	NS	-	
Fennessy and Fisher (1988)	-	-	NS	NS	NS	-	9	1	2	T	89	10	12
	-	-	-	NS	NS	-	9	1	2	T	89	11	12
	-	-	-	NS	-	-	9	1	1	T	89	10	11
	-	-	-	NS	-	-	9	1	2	T	89	6	11
	-	-	-	NS	-	-	9	1	3	T	78	9	10
			Control				9	1	0	T	100	-	-
	-	-	-	NS	NS	-	6	2	2	T	100	0	-1
	-	-	-	NS	-	-	6	2	2	T	100	4	1
	-	-	-	-	NS	-	6	2	2	T	100	-3	-6
			Control				8	2	0	T (†Early ovarian activity recorded)	88		
Fisher *et al* (1990)	21	20	10	-	-	-	5	1	2	(2/5) C	75+	NR	
	-	10	10	9	-	-	5	1	2	(5/5) C	100	NR	
	-	30	30	29	-	-	5	1	2	(5/5) C	100	NR	
	-	-	20	19	18	-	5	1	2	(3/5) C	80	NR	
	-	-	-	9	8	10	5	1	2	(3/5) C	100	NR	
	-	-	-	29	28	28	5	1	2	(0/5) C	100	NR	
			Control				5	1	0	(0/5) C	100	NR	
Fisher and Fennessy (1990)	-	-	-	14	12	-	9	MA	2	T	100	20	
	-	-	-	14	12	-	9	MA	2	C	100	11	
			Control				9	MA	0	T	100	12	
			Control				9	MA	0	C	100	-	
Wilson *et al* (1990)	-	27	23	21	-	-	23	1	2	T	91		18
	-	27	23	23	-	-	22	1	2	T	91		36
	-	-	3	5	9	-	26	1	2	T	100		22
	-	-	3	5	9	-	25	1	2	T	92		15
	-	-	3	5	10	-	30	1	2	T	100		12
	-	-	16	18	23	-	28	1	2	T	93		23
			Controls				155	1	0	T	90		

*T = Melatonin treated
C = Untreated
** = Mixed age 2 or more years
NS = Not specified
\+ = 1 hind rejected from trial
NR = Not recorded
† = Ovarian activity was monitored by blood hormone analyses in this study Pregnancy rates were to stags joined April 12

2.3 Pregnancy detection

For these trials, ultrasound pregnancy diagnoses were undertaken on a sample of approximately 25 hinds from each treatment group either May 25 or June 8, and foetal age estimates made according to the technique of Bingham *et al* (1990) and Wilson and Bingham (1990). Median predicted calving dates were calculated for purposes of comparison of treatment effects.

Table 2 Experiment 1 **Summary of melatonin treatment regime and mating programme for 1-year-old hinds**

Farm	1 Hawkes Bay			2 Gisborne			3 Taumaranui		
Locality									
Group	T2	T3	C	T2	T3	C	T2	T3	C
n.	18	19	18	50	118	50	54	197	65
Treatment dates* (Hinds and Stags)	Dec 8 Jan 20	Dec 8 Jan 7 Feb 9	-	Dec 8 Jan 20	Dec 8 Jan 7 Feb 7		Dec 8 Jan 20	Dec 8 Jan 7 Feb 7	
Date stags joined	March 6			March 1			March 1		
Stag treated (T) or untreated (C)	T	T	T	T	T	C	T	T	C
Date stags replaced with untreated stag	April 25			April 12			April 12		
Date stag withdrawn	May 20			May 12			May 12		
Date ultrasound examination	June 8			May 25			May 25		

T2 . Two melatonin treatments
T3 , Three melatonin treatments
C , Untreated control
* Two x 18 mg melatonin implants per treatment
NR Not recorded

Table 3 Experiment 2 **Summary of melatonin treatment regime and mating programme for stags mated to untreated mixed age hinds**

Farm	1 Hawkes Bay			2 Taumaranui	
Location					
Stag status	Treated Vasectomised	Treated Entire	Untreated Control	Treated Entire	Untreated Control
No. stags	3	7		42	0
Date treated*	Dec 8 Jan 7 Feb 9	Dec 8 Jan 7 Feb 9	- - -	Dec 8 Jan 7 Feb 7	- - -
Date stags joined					
Hind group VTS (n = 150)	Feb 16	Mar 6+	April 25+	Hind group TS (n=947) Mar 1	April 12+
Hind group TS (n = 150)		Mar 6	April 25+	Hind group C (n=137)	Mar 1
Hind group C (n = 300)			Mar 15		April 12+
			April 25+		
Date stags withdrawn	May 20 all groups			May 12 all groups	
Mating management	S	S	S	M	M
Hind stag ratio	50 1	50 1	50 1	40 1	50 1
Date ultrasound examination		June 8		May 25	

* = 2 x 18 mg melatonin implants
VTS = Treated vasectomised and entire stags
TS = Treated entire stags
C = Untreated control stags
+ = Stags replaced those joined earlier
S = Single sire groups
M = Multi-sire groups

3 RESULTS

3.1 Experiment 1

Results of experiment one are presented in Table 4. The two-treatment regime resulted in an advance of predicted median calving date compared with controls of 12-20 days (average 15 days) while three treatments resulted in an advance of predicted median calving date of 10-18 days (average 12 days).

Table 4 Data from Experiment 1
Predicted pregnancy rates and calving dates for melatonin treated and control one-year-old hinds

Farm	1			2			3		
Group	T2	T3	C	T2	T3	C	T2	T3	C
% pregnant	93	92	100	65	83	70	95	82	88
Predicted median calving date	Nov 18	Nov 21	Dec 1	Nov 18	Nov 30	Dec.8	Nov 22	Nov 16	Dec 4
Days advanced median calving	13*	10*		20+	8+		12+	18+	

T2 Two melatonin treatments 45 days apart
T3 Three melatonin treatments 30 days apart
C Untreated control
* Mated in-contact with control hinds
\+ Mated apart from control hinds

3.2 Experiment 2

Results of experiment two are presented in Table 5. These results show that hinds mated with stags which were induced to rut early calved 8-10 days earlier than those exposed to untreated control stags. Exposure to vasectomised stags earlier had no effect on median calving date.

Table 5 Data from Experiment 2
Predicted pregnancy rates and calving dates for mixed-age hinds exposed to vasectomised and/or entire treated stags, or untreated control stags

Farm	1			2	
Hind group	VTS	TS	C	TS	C
% pregnant	100	100	87	96	100
Predicted median calving date	Nov 16	Nov 15	Nov 25	Nov 22	Nov 30
Days advanced median calving	9	10	-	8	-

VTS Hinds exposed to vasectomised followed to entire treated stags
TS Hinds exposed to entire treated stags
C Hinds exposed to untreated stags

4. DISCUSSION

The reasons and practical implications for advancing the onset of the breeding season have been discussed previously (Wilson, 1989).

4.1 Experiment 1

This study has confirmed that melatonin administration to hinds by a 45-day interval two-treatment regime is as effective in advancing the median calving date as a 30-day three-treatment regime commonly used by other researchers. The onset of oestrus in treated hinds was as early as March 3 on one farm and March 10 and 13 on other farms. Mating commenced with control hinds March 29 to April 11 which is considered normal for this age group of farmed red deer.

The important practical implication of experiment one is that a two-treatment regime requires less handling of hinds, and therefore a lower labour input. Fewer implants were used and this resulted in a lower cost. It now appears that a farmer can choose a two-treatment regime to reduce both drug costs and labour input. It would appear from a number of reports in the literature that late November is the optimum period for commencement of treatment regimes.

4.2 Experiment 2

The influence of an early rutting stag on the onset of the breeding season in mixed age hinds confirms the results of Fisher *et al* (1990) who reported a 12 day advance in mixed-age hinds after exposure to early rutting stags. Moore and Cowie (1986) reported an earlier calving in hinds that had been exposed prior to the rut to vasectomised stags. In that trial stags were not treated with melatonin and an average of five to six days advancement of median calving date was noted. Data from this study supports that of Fisher and Fennessy (1990) indicating that on large commercial deer farms an 8-10 day advance in median calving date can be expected.

The mechanism for advancement of oestrus in hinds as a result of early rutting stags is not entirely clear. McComb (1987) reported a synchronising effect of stag roaring noises. However, the equivalent effect in sheep ("the ram effect") has been shown to be both a pheromonal and behavioural effect including ram vocalisation (Martin *et al*,1986). Thus more work needs to be done to determine the physiological basis for this phenomenon.

The practical advantages of the use of the "stag effect" are significant. For commercial herds it is not practical to muster and yard mixed-age hinds from mid November to late January because of the risk of mismothering newborn calves and of injuries to small deer. Therefore, melatonin implantation regimes in mixed-age hinds similar to those used in yearling hinds are not advisable. There also remain some concerns about the possible influence of melatonin on the onset of lactation when administered to late pregnant deer although the literature is confusing in this regard (Asher *et al*, 1988; Nowak *et al*, 1985, Adam *et al*, 1990). The ability to advance the onset of breeding season simply by melatonin treatment of stags precludes these potential problems. The farmer must accept however, that the advancement of oestrus resulting from the "stag effect" is approximately only half of that achievable with melatonin treatment of hinds in combination with mating with treated stags. Early weaning and optimum nutrition may be necessary to achieve the maximum response to either technique.

5 CONCLUSION

These trials have shown that a refinement of the usage of melatonin implants in yearling hinds involving two treatments 45 days apart is as effective as previously reported 30-day interval three treatment regimes in advancing the onset of the breeding season, and that an alternative use of melatonin to advance calving of mixed age hinds is to treat stags only. Both uses investigated in this study have a lower cost and may have practical advantages to the farmer. The application of these results are that the farmer can better utilise spring pasture growth, weaning can be advanced to reduce late summer feed deficits, farmers selling weaner deer achieve a higher return because of higher weaner body weights, and there is now a practical way of advancing calving in mixed-age hinds which obviates the need

to yard the animals with young calves at foot. This can now be achieved more economically than by using previously reported regimes.

Data will be reported in full in the Proceedings of the Second International Conference on the Biology of Deer Production 1990.

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