ARTIFICIAL BREEDING OF FARMED FALLOW DEER (*DAMA DAMA*)

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Abstract: There has been considerable interest in the artificial manipulation of farmed fallow deer (*Dama dama*) to improve productivity and increase genetic gains. Alteration of seasonal breeding patterns by strategic use of the pineal hormone, melatonin, has proven useful in aligning the high energy demands of lactation with seasonal patterns of forage availability in temperate regions of the southern hemisphere. Artificial insemination has been applied commercially to farmed fallow deer for rapid dissemination and international exchange of desirable genetic material. Conception rates of around 70% have been obtained for fixed-time (65-70 hr post-progesterone withdrawal) laparoscopic intrauterine insemination of frozen-thawed semen (20-40 million live spermatozoa/inseminate). Semen is collected primarily by electroejaculation. However, artificial vagina technology has recently been developed. Multiple ovulation-embryo transfer technology for fallow deer is still in the experimental stages. Average rates of 7-20 ovulations have been obtained following treatment of does with intravaginally-delivered progesterone and exogenous gonadotrophin preparations. However, fertilization and embryo recovery rates are generally low and further studies are required to determine causative factors. Cryopreservation and embryo transfer have yet to be attempted for this species.

Key Words: artificial insemination, *Dama dama*, embryo, embryo transfer, fallow deer, melatonin, progesterone, reproduction

Résumé : On s'intéresse beaucoup à la manipulation artificielle des daims en élevage (*Dama dama*) pour améliorer la productivité et pour multiplier les avances génétiques. L'artération du cycle saisonnier d'accouplement par l'usage stratégique de l'hormone pinéale, mélatonin, se montra efficace pour aligner les exigences d'énergie élevées de la lactation avec les cycles saisonniers du fourrage disponible dans les régions tempérées de l'hémisphère du sud. L'insémination artificielle s'appliqua à l'élevage commercial des daims pour avancer la multiplication rapide et l'échange internationale de matériaux génétiques désirables. On obtint des taux de conception d'environ 70% par l'insémination intrautérine laparoscopique à une heure fixe (65-70 heures après le retrait de progestérone) du sperme congélé-décongelé (20-40 millions de spermatozoïdes par dose). Le sperme se collectionne surtout par électroéjaculation. Pourtant, on développa récemment la technologie du vagin artificiel. La technologie pour le transfère multiple des embryons des daims reste au niveau expérimental. On obtint des taux moyens de 7-20 ovulations par la suite de l'administration aux biches par voie vaginale des préparations de progestérone et de gonadotrophine exogène. Cependant, les taux de fertilisation et de la récupération d'embryons restent généralement bas et d'autres recherches sont nécessaires pour en déterminer les causes. On n'a pas encore essayé la cryopréservation et le tranfère d'embryons pour cette espèce.

Mots-Clés : daim, *Dama dama*, embryon, insémination artificielle, mélatonin, progestérone, reproduction, transfère des embryons

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Reproductive performance of fallow deer (*Dama dama*) is a criterion of productivity that is under constant scrutiny by the breeder. The proportion of does that rear offspring annually is the major factor affecting profitability. In the short history of fallow deer farming in the southern hemisphere, a considerable improvement in the reproductive efficiency of this species has been achieved by suitable adjustments to methods of breeding, feeding, and management that have been generally applied to other domestic farm animals. However, in recent years there has been an international recognition of the genetic and reproductive gains that can arise from the appropriate application of artificial and controlled breeding programmes. This paper summarizes recent research and commercial advancements in manipulation of seasonal cycles, artificial insemination, and embryo transfer of farmed fallow deer. The observations pertain mainly to studies conducted in the southern hemisphere.

Control of Seasonal Breeding Patterns

Both subspecies of fallow deer, European (*D. d. dama*) and

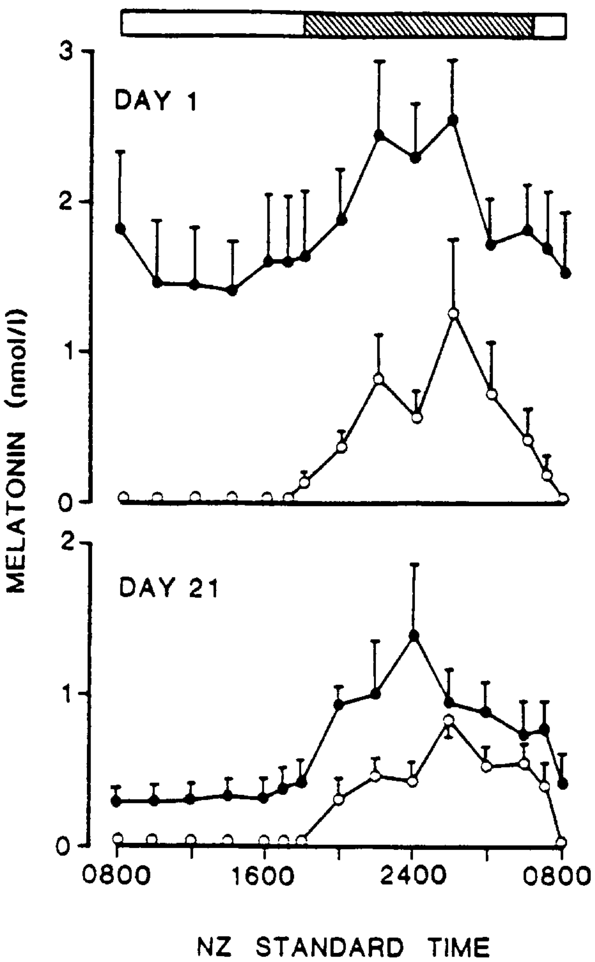

Fig. 1. Circadian profiles of mean (± S.E.) plasma melatonin values of 4 fallow deer does receiving single Regulin implants (●) and 4 control does (o) (Asher et al., 1988b).

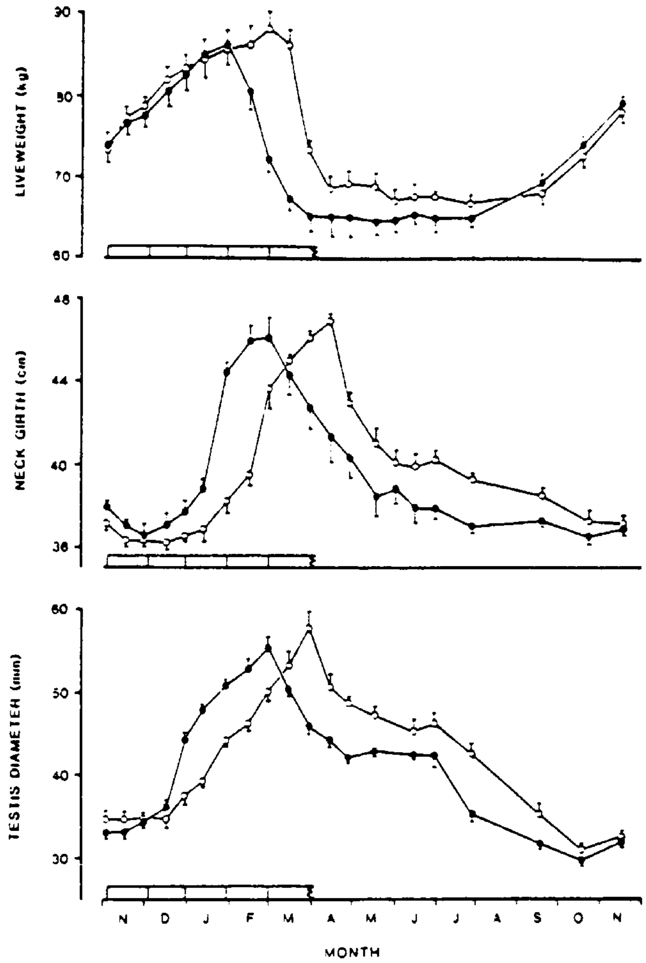

Fig. 2. Seasonal profiles of mean (+ S.E.) liveweight, neck girth and testicular diameter of 4 melatonin-treated (●) and 4 control (o) fallow deer bucks. Horizontal bars indicate the period of melatonin implantation (G.W. Asher and A.J. Peterson, pers. commun.).

Mesopotamian (*D. d. mesopotamica*), exhibit highly seasonal patterns of reproduction, with mating activity occuring in autumn (April/May) and parturition occuring in summer (December). However, summer fawning is not necessarily ideal on pastoral farms, where peak pasture production and quality often occur in spring. This results in poor alignment between optimum pasture quality/production and the high energy demands of lactation. A closer alignment, leading to more efficient utilization of pasture and better rates of fawn growth, requires a shift in the previous mating season from autumn to late summer.

Estrus/ovulation control with CIDR devices and PMSG or GnRH

Estrus/ovulation in fallow deer can be advanced by up to six weeks using intravaginal CIDR (Controlled Internal Drug Release) devices (Type S or G; 9 or 12% progesterone, NZ Dairy Board, Hamilton, New Zealand) in conjunction with pregnant mare serum gonadotrophin (PMSG) or gonadotrophin releasing hormone (GnRH). However, conception rates have been low following such treatments; possibly due to a suboptimal buck fertility/libido. Furthermore, there has been the additional complication of some does conceiving twins following PMSG treatment (Asher and Macmillan, 1986; Asher and Smith, 1987). However, these problems could be circumvented possibly by treating the bucks with melatonin implants to advance the rut and optimizing the dose of PMSG administered to does to induce monovulation only.

Exogenous melatonin usage

More recent studies on out-of-season breeding have centered on the administration of the pineal hormone, melatonin, as its mode of action is similar in both sexes. Melatonin is the main messenger of the photoperiod signal. Blood melatonin concentrations are elevated naturally during darkness. In summer, the total duration of secretion within each circadian period is short. However, this secretory period increases as days become shorter. The increasing levels of melatonin secretion as autumn approaches stimulate breeding activity of both males and females. Artificial control of the onset of the breeding season involves supplementation of natural melatonin with exogenous melatonin in summer ; thus inducing a physiological "short-day" state.

The first attempts at such supplementation involved daily

Table 1. Mean (± S.E.) date of first estrus, conception, and parturition for melatonin-treated and control fallow deer does in 1987 (Asher et al., 1988b).

	n	Mean (± S.E.) date of first estrus	Mean (± S.E.) date of conception	No. does conceiving	No does fawning	Mean (± S.E.) date of fawning
Melatonin-treated does						
Pubertal does	6	2.0 Mar (± 7.4)	5.5 Mar (± 8.1)[1]	6	3	19.7 Oct (± 1.7)
Non-pregnant adult does	6	28.3 Feb (± 5.2)	28.3 Feb (± 5.2)	6	4	23.5 Oct (± 0.6)
Pregnant does	6	24.3 Feb (± 2.6)	24.3 Feb (± 2.6)	6	6	23.0 Oct (± 0.8)
	18	27.6 Feb (± 3.0)	28.7 Feb (± 3.2)	18	13	22.4 Oct (± 0.6)
Control does						
Pubertal does	6	26.5 Apr (± 0.4)	30.0 Apr (± 3.8)[1]	6	4	16.0 Dec (± 1.0)
Non-pregnant adult does	6	21.8 Apr (± 1.3)	21.8 Apr (± 1.3)	6	5	13.6 Dec (± 1.3)
Pregnant does	6	20.5 Apr (± 0.9)	20.5 Apr (± 0.9)	6	6	10.8 Dec (± 0.7)
	18	22.9 Apr (± 0.8)	24.1 Apr (± 1.7)	18	15	13.1 Dec (± 0.4)

[1]One pubertal doe in each of the treated and control groups was observed to exhibit a subsequent estrus.

feeding of bucks during summer with melatonin-laced pellets (Asher et al., 1987). This was designed to elevate blood melatonin concentrations several hours before the natural elevation at night, thereby augmenting night-time profiles. The major drawback of this form of melatonin administration is the vagary of voluntary feed intake. However, significant treatment responses relative to control bucks were observed. In addition to an increased rate of neck muscle hypertrophy during and immediately after the treatment, bucks exhibited an earlier attainment of fertility. This was confirmed by the presence of viable spermatozoa in ejaculates as early as January (Asher et al., 1987).

More recently, subcutaneous melatonin implants (Regulin; Regulin Ltd, Melbourne, Australia) have provided a more reliable method of administration of the hormone. The implants elevate perpetually blood melatonin concentrations for 30-40 days, with exogenous levels superimposed on endogenous night-time levels (Fig. 1; Asher et al., 1988b). In recent trials, the administration of melatonin implants to fallow does, and bucks in summer produced spectacular results (Asher et al., 1988b). The rut of treated deer (pubertal does, adult does, and adult bucks) was advanced by 7-8 weeks following the application of single melatonin implants on four occasions at 30-day intervals starting in November (early summer). The advanced reproductive development of the treated sire-bucks (Fig. 2) was evident in the full rutting response to the early estrous activity of the treated does. The significance of this treatment is apparent in the high conception rate (99%) to the first estrus and the earlier fawning time of the melatonin-treated does (Table 1). However, the appreciably higher mortality rate of early born fawns, a result of inclement weather in October (late spring), may seriously limit the desired degree of advancement of the breeding season. Moreover, such treatment is unsatisfactory for use in pregnant does. Most does treated with melatonin during late pregnancy failed to initiate lactation, and subsequently lost their fawns (Asher et al., 1988b).

A more recent study has revealed that the interval of the administration of subcutaneous melatonin implants may affect the degree of advancement of rutting activity and fertility of fallow bucks (H.N. Jabbour, pers. commun.). Treatment with melatonin implants every 56 days, starting in early November, was more effective in advancing spermatogenesis than was treatment every 30 days. The former treatment resulted in the production of better quality semen, characterized by a high concentration of live spermatozoa, in mid to late January (summer) in contrast to very low concentrations of live spermatozoa observed in the latter group at that time. Such a treatment regimen has the potential to allow for the harvest of semen for cryopreservation and subsequent marketing before the onset of the natural rut.

Artificial Insemination

The application of artificial insemination (AI) technology within the fallow deer farming industry is still in its infancy. However, the future potential of AI is enormous, particularly in relation to the establishment of genetic improvement schemes. AI allows for a more rapid dissemination of desirable genetic material than would be remotely possible by natural mating. This is particularly important when considering such rare genotypes as the Mesopotamian fallow deer. Moreover, AI provides a safer and cheaper means of international exchange of semen. There is also the important possibility of employing deer AI to identify genetically superior sires (e.g. sire-referencing schemes).

Estrous synchronization

Natural estrous detection in fallow does can be performed by using bucks fitted with ram mating harnesses (Asher, 1985; Asher and Macmillan, 1986; Asher and Smith, 1987). However,

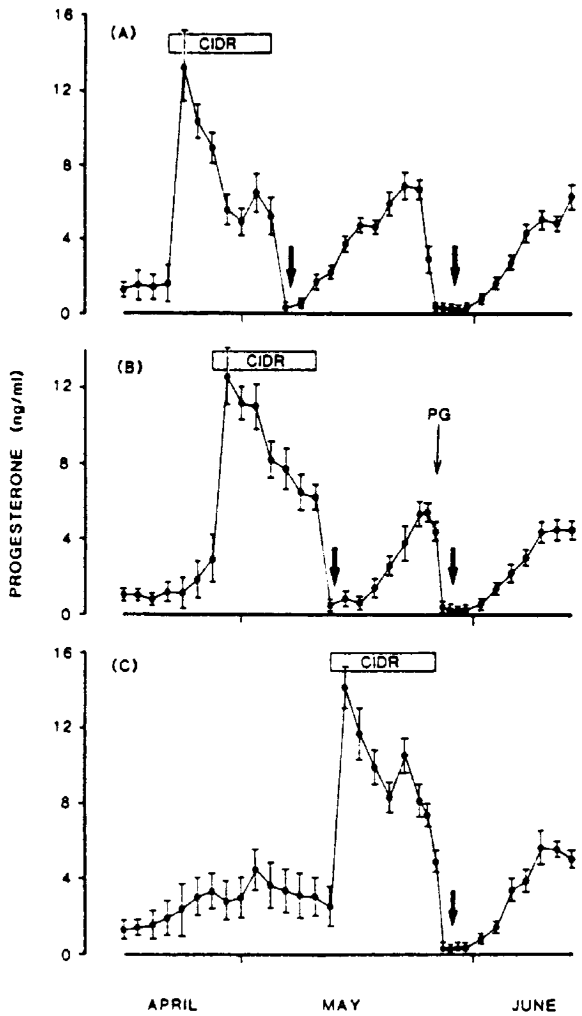

Fig. 3. Profiles of mean (± S.E.) plasma progesterone values of fallow deer does (n=5 per profile) during different treatment regimens designed to synchronize estrus on May 28. (A) initial 14-day CIDR device followed by a 21-day estrous cycle; (B) initial 14-day CIDR device followed by an i.m. injection of prostaglandin analogue on day 13 of the subsequent cycle; (C) 14-day CIDR device treatment alone. Arrows indicate the mean times to onset of estrus (Asher and Thompson, 1989).

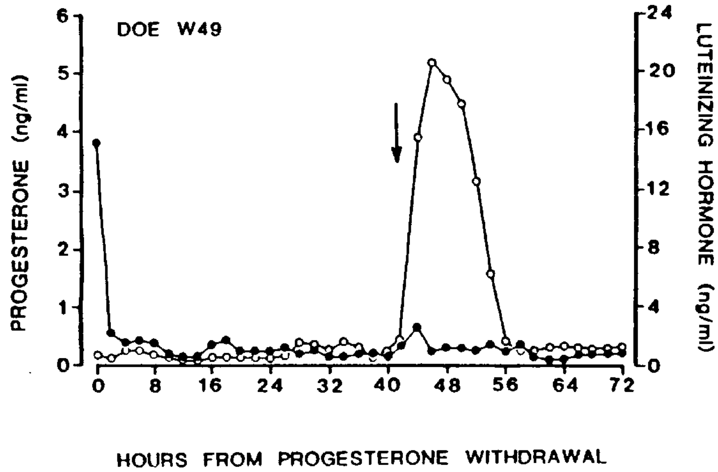

Fig. 4. Profiles of plasma progesterone (●) and luteinizing hormone (o) concentrations following CIDR device removal from a fallow doe in early May. The arrow indicates the onset of estrus (Asher and Thompson, 1989)

fixed-time AI following estrous synchronization is more practical and cost effective than following detected natural estrus. The response of the does to the synchronization treatment, as indicated by the proportion of does displaying estrus and the degree of synchrony of estrus, is most consistent after the onset of the natural breeding season (C.J. Morrow and G.W. Asher, pers. commun.). Synchronization of estrus and ovulation can be achieved either by simulating the activity of the corpus luteum through the administration of progesterone (14-day treatment with CIDR devices) or by shortening the luteal phase of the estrous cycle by injecting prostaglandin between days 12 and 15 of the estrous cycle. It is also possible to obtain a high degree of synchrony of a return estrus following synchronization of the first estrus (Fig. 3) (Asher and Thompson, 1989). This may provide a practical alternative to insemination at the first synchronized estrus, as there is suggestion that embryonic mortality rates may be slightly higher following induced rather than natural estrus (Asher et al., 1988a). However, within the framework of the potential breeding season of fallow deer, there is little scope for utilizing the return estrus without accepting the consequences of fawns born late in summer. The early induction of the breeding season by strategic application of melatonin implants may be a practical solution.

The intravaginal CIDR device has been comprehensively tested for its efficacy in synchronizng estrus in fallow deer does (Asher, 1985; Asher and Thompson, 1989). The retention rate of the device is very high (98-100%) and during insertion it elevates blood progesterone concentrations to levels comparable to those observed during the mid-estrous cycle (Fig. 3). Following CIDR device removal, progesterone is cleared rapidly from the blood stream within two hours (Fig. 4) (Asher and Thompson, 1989). This stimulates an increase in luteinizing hormone (LH) secretion from the pituitary gland, culminating in the onset of estrus and the pre-ovulatory LH surge 40-55 hr later (Asher et al., 1986; Asher and Thompson, 1989). Ovulation occurs about 24 hr after the onset of estrus (Asher et al., 1990a).

Induction of premature regression of the corpus luteum by injecting the powerful luteolytic hormone prostaglandin F-2α (or one of its analogues) results in very tight synchrony of estrus in fallow deer does (Asher and Thompson, 1989). However the cervid corpus luteum appears to be refractory to prostaglandin before Day 10 of the estrous cycle (Gover, 1985). This necessitates the administration of the luteolysin either as a single injection between days 12 and 15 of the estrous cycle or as two injections 10-12 days apart. A recent study on fallow does has shown that a single injection of cloprostenol (Estrumate; Imperial Chemical Industries PLC, Cheshire, UK) on day 13 or 14

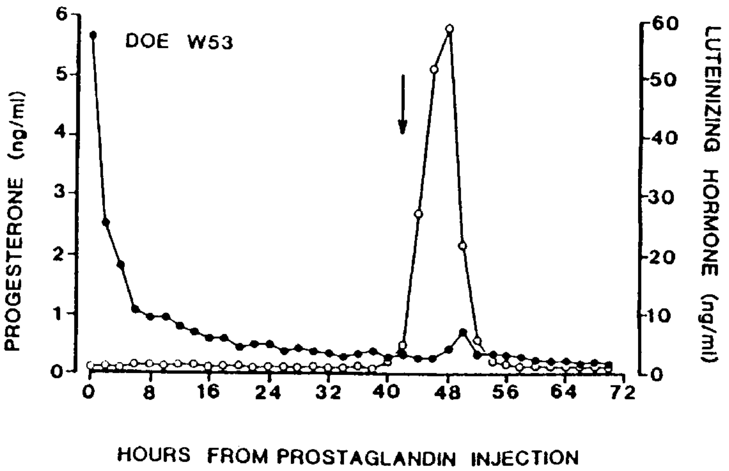

Fig. 5. Profiles of plasma progesterone (●) and luteinizing hormone (o) concentrations following administration of prostaglandin analogue on day 13 of the estrous cycle of a fallow doe in early May. The arrow indicates the onset of estrus (Asher and Thompson, 1989).

of the estrous cycle will result in rapid regression of the corpus luteum and clearance of endogenous blood progesterone over a 12-14 hr period (Fig. 5) (Asher and Thompson, 1989). As with CIDR device withdrawal, ovulation occurs about 24 hr after the onset of estrus (Asher et al., 1990a). Further studies are required to establish a suitable twin-injection protocol for estrous synchronization in fallow deer does.

There are two important considerations with respect to estrous synchronization in fallow deer does. First, non-parous (pubertal) does are generally unsuitable for AI programmes as they do not exhibit a suitable degree of estrous synchrony following CIDR device withdrawal/prostaglandin injection (G.W. Asher, unpublished data). Secondly, the use of PMSG (100 IU-500 IU) at or near CIDR device withdrawal/prostaglandin injection is contra-indicated due to an unacceptably high incidence of multiple ovulations. Multiple ovulation is associated with lower conception rates and higher embryonic mortality in fallow deer (Asher and Smith, 1987). Furthermore, PMSG undoubtedly alters the temporal relationship between the synchronization treatment and the onset of estrus/ovulation, requiring a different timing schedule for insemination.

Semen collection and processing

Semen collection from fallow deer bucks is highly seasonal due to the circannual pattern of spermatogenesis. Semen has been collected primarily by electroejaculation which has limited the widespread application of AI. Due to their intractability, bucks require heavy sedation (e.g. 5 mg ketamine hydrochloride and 2.5 mg xylazine hydrochloride/kg liveweight) (Asher et al., 1987) and electrical stimulation per rectum. This method limits the frequency of semen collection.

Because of the disadvantages of electroejaculation an alternative method of semen collection is presently being investigated at the Ruakura Agricultural Centre, New Zealand (H.N. Jabbour, pers. commun.). This involves the development of an internal artificial vagina (AV). For semen collection with the AV, ovariectomized fallow does are treated with CIDR devices for six days and 0.05 mg estradiol benzoate (EDB) 24 hr after CIDR device removal. The does are fitted with the internal AV at the mean time to onset of estrus, generally 18-24 hr after EDB injection (H.N. Jabbour, pers. commun.), and exposed to the bucks. Following mating, the AV is removed and the semen is aspirated and assessed for quality. It should be stressed that the aforementioned treatments for the induction of estrus in ovariectomized does are only optimal during the breeding season (H.N. Jabbour, pers. commun.). This implies, that for early semen collection, treatment of the does with melatonin implants may be necessary to advance the "breeding" season.

Cryopreservation of fallow deer semen is comparatively simple and effective. For the commercial supply of semen, a standard protocol has been adopted by the Ruakura Artificial Breeding Centre (Asher et al., 1990b). After the ejaculate volume and concentration/motility of spermatozoa is established, the semen is diluted to a concentration of 200 million live cells/ml in sodium citrate-egg yolk-glycerol diluent (Krzywinski and Jaczewski, 1978). The extended semen is then loaded into 0.25 ml straws (50 million cells/straw) and frozen in nitrogen vapour to -125°C in a programmable freezer (6°C/min reduction) before transferal to liquid nitrogen. This often results in post-thaw recovery rates in excess of 75% (Asher et al., 1990 b).

Insemination techniques

The two methods of AI practiced on fallow deer in New Zealand and Australia are intravaginal/intracervical (per vaginam) and laparoscopic intrauterine insemination. Intravaginal insemination is the simplest method but requires large quantities of viable spermatozoa (in excess of 100 million) for reasonable success rates. As this form of insemination is analogous to natural mating, semen placement is timed to coincide with the mean time to onset of estrus, being approximately 48 hr after CIDR device withdrawal/prostaglandin injection (Asher et al., 1988a; Asher and Thompson, 1989).

Intracervical insemination is likely to be less wasteful of spermatozoa than intravaginal insemination. Although optimum timing of insemination is yet to be determined, present studies indicate that at least 40-50 million live spermatozoa are required. Success rates of such inseminations performed 48 hr after CIDR device withdrawal have ranged from 40-65% (1989 ultrasound data of commercially inseminated does in New Zealand; G.W. Asher, pers. commun.).

Laparoscopic intrauterine insemination (Asher et al., 1988a; Mulley et al., 1988) allows for a precise placement of relatively small quantities of semen close to the site of fertilization. Early studies involving intrauterine deposition of 85 million live spermatozoa 56-58 hr after CIDR device withdrawal resulted in a disappointing 42% fawning rate (Asher et al., 1988a). More recently, intrauterine inseminations performed with 30-40 million live spermatozoa at 65-70 hr after CIDR device withdrawal resulted in 60-70% conception rates (Asher et al., 1990b). This suggests that in the former study insemina-

Table 2. Mean (± S.E.) ovarian response, ova recovery and fertilization rates following treatment with PMSG and/or FSH (Thompson and Asher, 1988).

Group	n	CL[1]	TS[2]	OR[3]	% fertilized
1	12	9.2 ± 2.5	16.8 ± 2.0	3.7 ± 1.1	70.0
2	12	6.3 ± 2.9	7.0 ± 3.1	1.1 ± 0.5	84.6
3	12	11.2 ± 3.3	20.4 ± 3.0	1.9 ± 0.5	52.2

[1]corpora lutea
[2]total stimulation points
[3]ova recovery

tions were conducted too early relative to CIDR device withdrawal or relative to time of ovulation. Additional studies are warranted to establish the interaction effect between the time of intrauterine insemination and the dose of spermatozoa on conception and fawning rates.

Ultrasound determination of pregnancy

Ultrasonogrpahic pregnancy diagnosis is a useful tool for the management of fallow deer (Mulley et al., 1987). Recent studies at the Ruakura Agricultural Centre, using a 5 Mh rectal probe, revealed that fetal age can be estimated to within a 5-10 day period within the first 90 days of gestation (J.F. Smith, pers. commun.). This renders the determination of conception to AI as opposed to the return estrus (usually 21-22 days later) a simple process (Asher et al., 1990b).

Embryo Transfer

Multiple ovulation-embryo transfer (MOET) technology in fallow deer is still in the experimental stages. The interest in the technology is based on the possibility of using a proportion of the base herd of European fallow deer as recipients for multiple embryos derived from the very rare Mesopotamian fallow deer. Future application is also important within genetic improvement programmes and international exchange of superior genetic material.

Table 3. Mean (± S.E.) ovulatory response to 200 IU pregnant mare serum gonadotrophin (PMSG) and variable doses of ovine follicle stimulating hormone (FSH) (H.N. Jabbour and G.W. Asher, pers. commun.).

FSH units	CL[1]	TS[2]
0.00	1.1 ± 0.4	2.5 ± 0.7
0.25	7.2 ± 1.7	10.0 ± 1.9
0.50	9.5 ± 2.5	14.9 ± 2.7
0.75	8.6 ± 2.4	17.3 ± 1.9
1.00	7.4 ± 2.1	12.9 ± 2.5

[1]corpora lutea
[2]total stimulation points

Superovulation/embryo recovery

Recent studies have aimed at determining an exogenous hormone regimen that will stimulate a good superovulatory response and high embryo recovery and fertilization rates. (Thompson and Asher, 1988; H.N.Jabbour and G.W. Asher, pers. commun.).

In 1987, a comparative study was undertaken to investigate the efficacy of three different exogenous gonadotrophin regimens (Thompson and Asher, 1988). Thirty-six mature fallow deer does were treated with intravaginal CIDR devices (Type-S, 12% progesterone) for 14 days and then randomly allocated to three treatment groups. Group 1 received 1000 IU PMSG (Pregnecol; Heriot Agencies, Australia) administered as a single intramuscular dose 48 hr before CIDR device withdrawal; Group 2 received 20 mg FSH (Folltropin; Vetripharm, Canada) administered in a decreasing dose regimen twice daily for four days with the last dose coinciding with CIDR device withdrawal; Group 3 received a cocktail regimen of 750 IU PMSG and 14 mg FSH, with PMSG and FSH administered as for Groups 1 and 2 respectively. Does were joined with crayon harnessed fertile bucks immediately after CIDR device withdrawal and observed for four days to record the time to onset of estrus. Ova recovery was performed by uterine flush under surgical conditions between 6-8 days after CIDR device withdrawal. Numbers of corpora lutea and total stimulation points (including cystic and luteinized follicles) were recorded (Table 2).

Treatment with the exogenous gonadotrophins significantly advanced the time to onset of estrus compared with does treated with CIDR devices only (Asher, 1985; Asher and Thompson, 1989). Onset of estrus among superovulated does occurred between 15-24 hr after CIDR device withdrawal. An "all or none" response was observed in does treated with the FSH preparation alone; only four does responded to treatment in Group 2, with the number of ovulations ranging from 4-30. The response of the does in other treatment groups was characterized by a large number of cystic and luteinized follicles, indicating an overstimulation effect and a high ovarian sensitivity to PMSG. This overstimulatory effect was additionally characterised by poor embryo recovery/fertilization rates and embryos at a wide range of developmental stages at the time of collection. This may have been mediated by excessive estradiol secretion leading to a disruption in gamete transport and alteration in the tubal/uterine environments (Thompson and Asher, 1988).

The effects of various gonadotrophin regimens on ovarian ovulatory responses, endocrine changes and ova recovery/fertilization rates were further examined for 50 does in 1989 (H.N. Jabbour and G.W. Asher, pers. commun.). All does were treated with an intravaginal CIDR device (Type-S, 9% progesterone) for 14 days and 200 IU PMSG (Folligon) administered 12 days after CIDR device insertion. Each doe received one of five dose levels of ovine FSH (0, 0.25, 0.5, 0.75, and 1.00 unit Ovagen; Immunochemical Products NZ Ltd, New Zealand) administered in eight intramuscular doses at 12-hr intervals starting at the time PMSG was administered. The does were joined with crayon-harnessed fertile bucks after CIDR device withdrawal, at a ratio of 10:1. Intravaginal insemination (30 million motile spermatozoa/inseminate) were conducted on four occasions at 12-hr intervals starting 24 hr after CIDR device withdrawal. Ova were recovered by uterine flush on day 7 after CIDR device withdrawal and the numbers of corpora lutea and large unruptured follicles (≥ 5 mm) were recorded (Table 3).

There was a curvilinear pattern of ovarian response to increasing doses of ovine FSH. The highest numbers of corpora lutea were observed following treatment with 0.5 unit FSH. There were no differences in the ova recovery rates between the treatment groups; the overall recovery rate was 30.6 ± 5.1%. In contrast to the 1987 data, none of the ova recovered had cleaved. The latter result was particularly disappointing as considerable effort was made to ensure that copious quantities of spermatozoa were present in the vagina. Present indications are that gamete transport, and hence fertilizsation, was adversely affected by high follicular secretion of estradiol. Further studies are needed to define the optimal site and time of semen deposition to improve the fertility of superovulated fallow deer does.

Embryo Cryopreservation/transfer

There are no published accounts describing embryo freezing and transfer in fallow deer. It is unlikely, however, that these steps will be limiting in MOET programmes for this species.

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Wildlife Production:
Conservation and Sustainable Development

Compiled and edited by
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