

HI-TECH BREEDING 392

*Most of the artificial breeding techniques used on deer are based on technology developed for sheep and cattle. Up to now, the deer industry has been a bit tardy in the uptake of these techniques, but the gap is rapidly closing. This article by **Craig Matthews** reviews new developments, how they work, and gives some idea of their cost.*

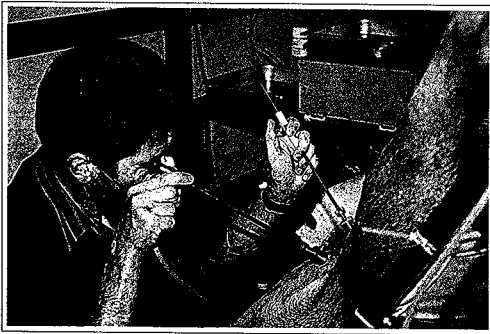
ARTIFICIAL breeding can benefit farmers in several ways: it can trigger early breeding, enable hinds to be inseminated with high quality sperm, and enable lower-quality surrogate hinds to carry high quality embryos.

Early breeding
Hormones can make it possible to synchronise breeding with peak pasture production.

Two hormone treatments to advance breeding have been studied. One method uses progesterone — which prepares hinds for pregnancy — and gonadotrophins, which control gonad activity.

But this technique is expensive and complex, and the commercial introduction of melatonin has rather stolen its thunder.

Melatonin, a hormone produced by the brain, alters the impact of daylength on reproduction. Giving melatonin in summer induces Red deer to start their reproductive cycles earlier. It works for both sexes, so male and female cycles can be synchronised.



Dr Geoff Asher at work with a laparoscope

There are several methods of delivering melatonin. The favoured one is by slow-release implants. Implants reduce labour costs and the animals are handled less frequently.

The new Regulin implants are smaller than previous ones, and can work for more than 40 days when administered as multiple — two or three — implants.

It's a powerful technique, but a number of factors make management somewhat challenging. Administering melatonin too close to

the winter solstice may delay puberty in young animals and can affect reproduction timing in adults. But the longer you treat hinds the higher the proportion that ovulate early. The trade-off must be well-judged.

The mere presence of treated stags or hinds advances ovulation in their untreated herd-mates. This is called social facilitation, but it only brings reproduction forward by weeks rather than months.

Melatonin treatment during later pregnancy

may interfere with foetal and mammary development, so don't treat pregnant hinds with Regulin.

Weaned fawns of treated dams tend to be larger, and some weaners may reach puberty by their first autumn — whether or not this is a good thing is a moot point.

While there's money to be made from earlier fawning, there are also risks. Birth takes place during colder weather, and early puberty in males could induce an early leveling-off in growth. Liveweight advantage at weaning may also be dis-

sipated at the yearling stage, although the evidence is inconsistent.

Geoff Asher notes that some farmers treat their entire herd, some do only their stags, while others treat their stags plus maybe 10 per cent of hinds.

As Regulin isn't cheap — about \$18 per animal — it's probably not cost-effective to treat the whole herd. Asher favours treating all stags plus a few hinds in order to maximise financial returns.

Overall, the benefits of early fawning will accrue to managers who include advanced breeding as part of their total strategy and not as a one-off tryout of a good idea.

Artificial insemination

Artificial insemination (AI) in deer is still in its infancy, although it has huge potential for genetic improvement and breeding hybrids. AI allows for a wider and faster spread of desirable genes. Moreover, AI provides a safe, cost-effective way of exchanging genetic material internationally.

But there are a number of factors that farmers need to consider.

1. Oestrous detection and synchronisation

First, the hind must be in heat. It's difficult to detect in-heat hinds in the paddock. The signs are very subtle — to humans anyway. So, if you want good results you have to artificially synchronise oestrous with the AI.

The most common way of doing this is by using progestagens, the hormones that prepare the ovary for ovulation and the hind for pregnancy. The most common progestagen-releasing device used is the intravaginal controlled internal drug release (CIDR) device, which is inserted into the vagina and left for about 12 days.

The progestagen leaves a "message" that fools the body into believing it's at a later stage in the oestrous cycle. When the CIDR is removed, all the other internal bodily changes that occur during reproduction synchronise.

Another method involves prostaglandin, a chemical which causes formation of a new corpus luteum, a temporary organ that secretes progesterone. Formation of the new organ initiates synchronisation of ovulation. Because more research is needed to validate commercial prostaglandin use, its use in deer farming is uncommon.

2. Collecting semen

This is the main factor limiting AI use in deer. Collecting is limited to

the 4 to 6 months around the autumn rut, and conflicts with standard breeding programmes.

The stag's temperament is another limiting factor, so deer semen is usually collected by electro-ejaculation while the animal is under general sedation. But this puts the sire at potential risk from the anaesthetic.

Cryopreservation — preservation by freezing — is a potential solution. Sperm can be stored almost indefinitely, and Red deer semen survives freezing well.

3. Insemination techniques

The preferred method deposits semen via the abdomen into the uterus by using a laparoscope — a fibre optic cable with a viewing device at its end — to guide the deposit of sperm.

The insemination sequence is as follows: insertion of a CIDR device for 12 days; injection of pregnant mare serum following CIDR removal; insemination 54 to 56 hours later.

Less invasive techniques for depositing semen via the vagina and cervix are being investigated, but much more work needs to be done.

AI can be expensive. Semen can range from \$30 to \$1000 a straw, and synchrony costs can vary anywhere from \$20 to \$80 an animal.

But there are advantages beyond the bottom line:

- AI allows access to superior stags before they are available for natural mating
- because AI can bring about earlier fawning, progeny may command premium prices
- the main advantage, though, is being able to breed high quality stags rather than buying them.

Embryo transfer

Multiple ovulation-embryo transfer (MOET) technology has entered rapidly into international deer farming circles.

Embryos from elite females are transferred to lower quality hinds, who act as surrogate mothers. In this way, farmers can increase numbers of elite stock faster than by natural breeding.

Pure lines of breeding stock can be propagated. Preserved, frozen embryos can be safely and cheaply transported, also minimising disease spread.

One of the keys to making MOET commercially effective is superovulation, that is, each donor producing large numbers of embryos. More embryos transferred per donor lowers the unit cost. The other key fac-

tor is the surrogate hind pregnancy rate. Higher pregnancy rates also lower the unit cost.

One simple economic analysis has calculated the likely return on superovulation. It assumed that 50 per cent of transferred embryos survived to weaned fawns, and that each donor produced between two and six embryos.

The cost per weaned fawn ranged from about \$330 — from donors producing six embryos — to \$840 from donors producing two embryos.

As with any reproductive technology, the financial benefits of embryo transfer depend on the market for the offspring of the presumably high-value donors.

In-vitro fertilisation (IVF)

IVF (the so-called "test-tube" fertilisation technique) has major advantages:

- it reduces dependence on the timing of ovulation
- produces greater numbers of embryos at the correct development stage
- allows for fewer viable sperm for conception
- can salvage genetic material from dead females
- decreases generation intervals through the use of egg-producing cells from pre-pubertal animals.

An IVF protocol for Red deer has been developed, with 80 to 100 per cent fertilisation taking place.

Even more exciting — as detailed in another item in this issue — AgResearch Ruakura scored a notable success a few months back when five of their experimental hinds gave birth to the world's first IVF-produced fawns.

Dr Asher thinks that IVF technology could become more important than AI or embryo transfer.

Twinning

It's possible to induce twinning in deer, although a lot can go wrong and successful twinning needs expert management.

Potential

There's no doubt that artificial breeding has great potential if it's managed right, but no single technique offers a complete breeding programme.

It may be wise to invest in a portfolio of techniques, like a prudent investor buying a range of stocks and bonds. You also need good advice and the staff at AgResearch Invermay are only too willing to help.

Many veterinarians also specialise in artificial breeding. □