

**Induction and synchronization of oestrus**

Synchronization of oestrus involves manipulating the ovarian cycle in order to mate the female at a predetermined time. This allows for greater management control of reproduction, improved reproductive efficiency and a predetermined parturition time. Synchronizing oestrus reduces the number of checks required for determining when it is present and increases the intensity of oestrus when a group of cows are in oestrus at the same time. Timed artificial insemination (AI) can also be used on all cows in a dairy herd at the same time when protocols designed to bring all cows into oestrus within a narrow window of time are used. Oestrus synchronization is also necessary for embryo-transfer programmes. Effective methods for the synchronization of oestrus are also necessary in order for AI to be used in the beef cattle industry, although AI is used to a much smaller extent in beef cattle than in dairy cattle. This is because of the extensive nature of beef cattle operations, while dairying is an intensive operation. Increased use of AI would allow the use of superior genetics in the beef industry, as has been done in the dairy industry for some time. Fertility is the most important trait for beef cattle, since beef breeders get most of their income from calves born into the herd. The fertility of the first oestrus after parturition (‘foal-heat’ in mares) is low, and the timing of ovulation can be erratic, so animals can be treated with luteolytic agents at this time to induce regular oestrus. Oestrogen (as oestradiol cypionate, Table 5.2) is also used to induce oestrus in ‘jump’ mares used as teaser for semen collection from stallions. Methods for oestrus synchronization must produce a high proportion of females in heat at a predetermined time, maintain high rates of fertility and have no undesirable side-effects. In addition, they should be easy to perform and be of low cost.

**STRATEGIES FOR SYNCHRONIZING OESTRUS.**

The presence of a functional CL during the luteal phase of the cycle prevents ovulation. Progesterone produced by the CL delays the maturation of LH-dependent follicles and primes the brain for oestrous behaviour. In the absence of pregnancy, prostaglandin F2α causes luteolysis and decreases progesterone levels. This restores the LH pulse frequency and amplitude, allowing the subsequent development of the dominant follicle, leading to oestrus, ovulation and normal luteal function. Treatment of animals having a functional CL with prostaglandin F2α will thus result in oestrus and ovulation a few days thereafter. Schedules for oestrus synchronization have been devised based on PGF2α, a combination of PGF2α and GnRH and a combination of progestins and PGF2α.

**Prostaglandin F2α-based systems.**

Injection of PGF2α will induce regression of the CL and not adversely affect subsequent oestrous cycles. However, PGF2α is not effective on newly established CL, and cows injected on days 1–5 of the oestrous cycle are non-responsive. There are a number of waves of follicular development in each oestrous cycle, and cows injected on days 7 or 15 of the oestrous cycle have a highly developed follicle ready to ovulate after CL regression PGF2α treatment on days 7 or 15 will therefore induce oestrus 3 days after injection. A practical approach (Fig. 5.13) is to inject PGF2α twice, 14 days apart, so that the cows will be responsive to PGF2α at least at the
second injection and come into oestrus shortly thereafter. Alternatively, cows can be injected at the beginning of 1 week and those that come into oestrus later in the week are inseminated. The remaining cows are injected with PGF2α at 14 days after the first injection and then inseminated when oestrus is detected or at the latest 4 days after the last injection of PGF2α. However, not all cows respond to PGF2α treatment, particularly before day 12 of the oestrous cycle. Improved synchronization of oestrus is obtained with an additional injection of PGF2α 2 weeks before the initial injection. Cows are rebred 21 days after the first insemination if they are seen to be in oestrus. This decreases the number of days open and the net cost per cow. However, this process requires detection of oestrus, keeping accurate records and the identification of individual animals.

**GnRH and the Ovsynch® protocol.**

Treatment with PGF2α results in regression of the CL, but does not synchronize the growth of follicles or affect the preovulatory surge of LH. Injection of GnRH at 7 days before treatment with PGF2α synchronizes follicular growth and oestradiol secretion with luteolysis and improves the timing of oestrous behaviour. The Ovsynch® protocol (Fig. 5.14) utilizes GnRH and PGF2α in a procedure that allows for AI without oestrus detection in lactating dairy cows. The protocol can be used at any point in the oestrous cycle and is particularly useful when the efficiency of oestrus detection is poor. The Ovsynch® protocol without oestrus detection results in pregnancy rates that are similar to multiple treatments with PGF2α every 14 days and insemination at detection of oestrus. In addition, the Ovsynch® protocol reduces the number of days postpartum to first insemination and the number of days open. The initial treatment with GnRH will ovulate a dominant follicle if it is present and initiate a new follicular wave, or a new follicular wave may be occurring spontaneously. The injection of PGF2α given 7 days later will cause regression of the CL. A second injection of GnRH is given 48 h later and will cause the dominant follicle that has grown from the first injection of GnRH to ovulate. Cows are inseminated 16–20 h later so that capacitated sperm are present at the time of ovulation. In some cases, cows will be in oestrus shortly after treatment with PGF2α and these cows should be inseminated at that time. The Ovsynch® protocol does not improve conception rates in heifers compared to insemination at detected oestrus. However, the Ovsynch® protocol does remove the difficulty of detecting oestrus and therefore reduces the number of days open in heat-stressed cows. It is also useful in treating cows with either ovarian or follicular cysts without identifying the type of cyst, since the GnRH treatment will remove the follicular cyst and PGF2α treatment will remove the luteal cyst (see below). Cows with inactive ovaries in which follicular development has ceased do not respond well.

**Progestin-based systems.**

Treatment with a progestin for 7 days before treatment with PGF2α improves the synchronization and detection of oestrus and conception rates. Short-term exposure to progestins will also induce the onset of oestrous cycles in a proportion of anoestrous cows and heifers. Early use of progestins for oestrus synchronization utilized treatments in excess of 14 days. These resulted in abnormal follicular growth and decreased fertility, and were linked to deleterious effects on sperm transport and viability in the reproductive tract of ewes. Short-term treatment with progestin of less than 10 days’ duration is now used along with a treatment to cause regression of the
CL, such as PGF2α or oestrogen (Fig. 5.15). Progestin is normally administered to dairy cows using implants (CIDR or PRID). For beef cattle, norgestomet is available in the Synchro-Mate-B® implant or melengestrol acetate (MGA) is given in the feed (Table 5.2).

The implant is placed at the base of the ear and an injection of oestradiol valerate and norgestomet is given when the implant is inserted. The CL regresses spontaneously while the implant is present. The injection of oestrogen and progestin is designed to cause early regression of the CL in cows in the early stage of the cycle. Alternatively, MGA can be fed to beef cattle for 14 days, followed by an injection of PGF2α 17 days later. The treatment with MGA will initiate oestrus in anoestrous females and synchronize oestrus in cyclic females, but will result in a low-fertility oestrus in the 7 days after MGA is withdrawn. The PGF2α treatment occurs in the latter part of the next oestrous cycle, which will cause a high rate of CL regression and synchronisation of oestrus. This procedure induces oestrus in about 80% of yearling heifers and is used for this purpose. However, since the protocol takes about 34 days to achieve synchronized oestrus, it cannot be used with postpartum cows that calved late in the season without affecting the start of the new breeding season. A number of protocols have been developed using progestins to induce puberty and synchronize oestrus in beef heifers. A progestin treatment (norgestomet implant) can be used between the GnRH treatment and the PGF2α treatment (GnRH–P–PGF). A further modification of an additional GnRH treatment 48 h after the PGF2α treatment (GnRH–P–PGF–GnRH) induces a final LH surge and a highly synchronous time of oestrus, which allows the use of timed AI without oestrus detection. Another approach uses an initial injection of oestrogen and a progestin implant (CIDR) for 7–8 days, followed by an injection of PGF2α when the CIDR is removed and a second injection of oestrogen 24–48 h later (E–CIDR–PGF–E). The first oestrogen injection will cause regression of FSH-dependent follicles and the CIDR implant with progestin induces turnover of LH-dependent follicles. Once these follicles become atretic, a new wave of follicular development begins. The injection of PGF2α will cause any CL present to regress, and the final oestrogen injection will induce oestrus and ovulation. The induction of puberty and oestrus is more effective the closer the animals are to a naturally occurring oestrus. Controlled breeding programmes result in significant financial savings to dairy producers. The additional costs for drugs and labour are more than offset by the savings from decreased labour for oestrus detection, lower costs from fewer days open and fewer replacement heifers needed. Producers can also control the time of calving, to take advantage of seasonal variations in pricing and constraints to production. Beef cattle producers can use controlled breeding programmes to induce puberty and synchronize oestrus in heifers by the start of the breeding season, so they will calve early and improve lifetime production. For more information on the manipulation of the oestrous cycle in dairy and beef cattle, see the reviews by Thatcher et al. (1998) and Day (1998). Synchronization of oestrus in pigs can be accomplished by treatment with progestogen for 14–18 days (Altrenogest® in the feed, Table 5.2) and then breeding at oestrus. Ewes during the breeding season can be injected with PGF2α twice 9 days apart and then treated with an intravaginal sponge impregnated with MAP (Table 5.2) for 12 days. Ewes will exhibit oestrus 48–72 h after the removal of the sponge. In the non-breeding season, PMSG treatment (Table 5.1) is also necessary to induce ovulation.