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Synchronizing Estrus in Cattle

L.R. Sprott, B.B. Carpenter and T.A. Thrift*

Beef cattle producers using artificial insemination in their herds also can synchronize estrus (heat) to breed fertile females rapidly. Estrous synchronization (manipulation of the reproductive process) reduces and, in some cases, eliminates the need to detect estrus and allows the herd manager to schedule breeding activities in a predetermined period lasting from 1 to 6 days. Artificial insemination (AI) activities are confined to a few intensive days.

Cows not conceiving will return to estrus in 18 to 25 days after the synchronization period. Females will still be synchronized to a slight degree, allowing for a second chance to AI each female in the early part of the breeding season.

Without synchronization, the herd manager is faced with a 21-day period of continual estrus detection and only a single opportunity for AI in most females because only 5 to 7 percent of females will display estrus more than once during the first 21 days of breeding. Other advantages of estrous synchronization include creating a more uniform calf crop, enabling more cows to be bred to a superior sire, and shortening the breeding and calving seasons.

The success of an estrous synchronization program depends on high-quality herd management. Adequate nutrition is essential because undernourished cows may not respond to treatment, much less conceive. Give vaccines prior to the breeding season to prevent reproductive diseases. Arrange for the services of experienced AI technicians. Acquire quality semen to help ensure optimum fertility. Beef cows with calves less than 40 days old may be anestrous (not experiencing estrous cycles), and their response is lower than cows that are cyclic. Response in replacement heifers depends on the proportion that have reached puberty. Fifteen-month-old heifers that have reached 65 percent of their expected mature weight respond better than younger heifers at a lighter weight.

Methods of Estrous Synchronization

There are several ways to synchronize estrus in cattle:

- The intramuscular injection of prostaglandin F2 alpha (Lutalyse®) or some of its analogs (Bovilene®) to destroy the corpus luteum (CL, a hormone-secreting tissue in the ovary). This allows the animal to have a fertile estrus within 2 to 6 days after treatment. Estrus response to these products is acceptable in females already experiencing estrous cycles. Females that are anestrous and those in a stage of the estrous cycle when a CL is not present do not respond. For this reason, prostaglandins are used in a specific manner.

*Professor and Extension Beef Cattle Specialist, Assistant Professor and Extension Livestock Specialist, Assistant Professor and Extension Livestock Specialist; The Texas A&M University System.

- The combination of a subcutaneous progestin implant and an injectable estrogen-progestin mixture (Syncromate B®). A single intramuscular injection of the mixture is given when the implant is placed under the skin of the ear. This destroys the CL or, depending on the stage of the estrous cycle, prevents spontaneous estrus. Treated females display estrus within 2 to 4 days after the implant is removed. This approach synchronizes estrous cyclic females (regardless of the stage of the cycle) and induces estrus in 10 to 30 percent of both anestrous females and replacement heifers near puberty.
- A combination of progestin (melengestrol acetate or MGA) in feed supplements with prostaglandin injections. Females are fed the treated supplement for 14 days, followed by a 17-day period without MGA in the supplement. The females then are injected with prostaglandin.
- The use of gonadotropin releasing hormone (GnRH, trade names Cystorelin®, Fertagyl®) in various combinations with prostaglandin. These methods, as well as the MGA-prostaglandin combination, also will induce estrus in 10 to 30 percent of anestrous females.

The choice of estrous synchronization methods often depends on the herd manager's work schedule. All methods are effective in synchronizing estrus, but must be used according to label or prescribed instructions. Except for Syncromate B®, all synchronizing products require a veterinary prescription.

Expected Pregnancy Rates to Synchronized Estrus

With so many females displaying estrus during a synchronized period, one mistakenly expects a high number of pregnancies. Informal surveys of herd managers indicate that they expect 75 percent or more of the females to conceive during synchrony.

Realistically, conception rates to a single AI service, whether at synchronized or spontaneous estrus, average 50 percent (the range is 40 to 60 percent). If synchronized pregnancy rates are below 40 percent, there may be problems with semen quality, inadequate nutrition, incorrect AI technique, disease, incorrect use of the treatment compounds or a low proportion of estrous cyclic females. These are management problems that should be corrected. Otherwise, pregnancy rates to AI service will remain low.

Natural service, compared to AI, during synchronization yields no higher pregnancy rates. Using natural service is not recommended because bulls cannot efficiently service as many females as can be artificially inseminated. Research shows that bulls vary greatly in breeding stamina. Consequently, any recommendation regarding a bull-to-cow ratio in naturally mated, synchronized females would be inaccurate. Fighting during competition among bulls for estrus females causes other problems as well. Fighting may injure bulls and consumes time that should be spent on mating. The result is that not enough females are serviced.

Furthermore, the economic value of estrous synchronization is more quickly realized when a proven, superior AI sire is mated to a large number of females in a short time. Clearly, using a superior sire is the major advantage, but exposing many females to him in a short time has additional economic advantages because more females conceive in fewer days. Studies indicate that having a high proportion of early conceiving females results in greater income. Estrous synchronization dramatically enhances the opportunity for early conception.

Insemination Schedule

Depending on the type of synchronization treatment chosen, a concentrated period of insemination can last from 1 to 6 days. Treatments allowing for only 1 day of insemination require that every synchronized female be inseminated on the same day. This is referred to as "time mating" or "mass mating." Such treatments result in females responding and displaying estrus within 60 hours. With such tight synchrony, estrus detection generally is not needed, and pregnancy rates are not compromised compared to AI after estrus detection.

If a decision is made to detect estrus in synchronized females, confusing circumstances can occur. The high degree of mounting activity makes it difficult to find and handle estrus females comfortably. However, one valid reason to detect estrus at this time is that there may be too few responding females to justify "time mating." In this instance, semen and labor are wasted. Second, bull semen may be costly enough to warrant the judicious use only in females confirmed, through detection, to be in estrus.

Regardless of the type of treatment chosen, it is prudent to schedule the first day or days of insemination to coincide with the start of the usual breeding season. This gives all synchronized females the opportunity to display estrus at least twice in the first 20 to 30 days of breeding. A late start reduces the proportion of early conceiving females. Treatments permitting "time mating" and those requiring estrus detection are discussed in the following sections.

Synchronization with Prostaglandins

Prostaglandins are produced naturally in the animal's body. After prostaglandins are injected into cyclic females, estrus occurs within 2 to 6 days. Remember that anestrous females do not respond to prostaglandin injections. Estrous cyclic females with a functional CL (between days 7 to 16 of their cycles) are able to respond to injections. Estrous cyclic females at days 0 (estrus) to 6 and those from days 17 to 21 of their cycles are without functional CLs and do not respond to injections. However, if injections are given in a specific sequence, estrous cyclic females without functional CLs will respond. Three approaches to the sequence of injections provide herd managers with a choice that best fits their work schedules.

Approach 1

Day 0 — Inject all females intramuscularly. Dosage depends on type of prostaglandin used. Read and follow label or prescribed directions. Although females able to respond to this first injection will display estrus, do not inseminate them at this time.

Day 11 — Inject all females again. Begin estrus detection, and AI each female about 12 hours after her first signs of estrus. Continue estrus detection and AI for 6 days. Day 11 should coincide with the usual start of the breeding season.

Day 17 — End estrus detection and AI.

Days 30 to 36 — Females not conceiving during days 11 to 17 will return to estrus. Follow-up estrus detection and AI are optional.

Approach 2

Days 0 to 6 — No injections are given. Begin estrus detection and AI each female about 12 hours after her initial signs of estrus. Continue estrus detection and AI for 6 days. Day 0 should coincide with the usual start of the breeding season.

Day 6 — Calculate the percent of females already inseminated. If less than 18 percent, the number of estrous cyclic females may not justify continuing the program. If more than 18 percent, inject any female not already inseminated in the first 6 days.

Days 6 to 12 — Continue estrus detection and insemination.

Days 19 to 31 — Females not conceiving during days 0 to 12 will return to estrus. Follow-up estrus detection and AI are optional.

Approach 3

Day 0 — Inject all females and begin estrus detection and AI for 6 days. Day 0 should coincide with the usual start of the breeding season.

Day 6 — Calculate the percent of females inseminated in the first 6 days. If less than 40 percent, the number of estrous cyclic females may not justify continuing the program. If more than 40 percent, inject all females not inseminated in the first 6 days.

Days 6 to 12 — Continue estrus detection and insemination.

Days 19 to 31 — Females not conceiving in the first 12 days will return to estrus. Follow-up estrus detection and AI are optional.

Synchronization with Syncromate B®

This treatment combines a subcutaneous progestin implant and an injectable estrogen-progestin mixture. Place the implant under the skin of the ear at the time the injection (2 cc per female) is given. Remove implants after 9 days. Females without nursing calves respond within 30 to 72 hours after implant removal. Females with nursing calves respond similarly but only if the calves are removed for 48 hours (beginning when implants are removed). In this treatment, "time mating" is initiated and completed between 48 and 54 hours after implant removal. Do not treat more females than can be effectively inseminated in this 6-hour window. Return calves to their dams immediately after completing insemination procedures.

While away from their dams, calves should have access to fresh water, high quality hay and about 2 pounds per head per day of a palatable starter ration or creep feed. Studies show that 48-hour calf removal does not reduce performance long-term. Even though their dams' udders become full, subsequent milk production and udder health is unaffected. It may be best to exclude cows with calves less than 40 days old from treatment because their estrus and pregnancy responses are likely to be very low.

If calves are not removed from their dams, the response to treatment is delayed and requires estrus detection beginning 30 hours after implant removal and continuing for 96 or more hours. Not removing calves also reduces estrus response and pregnancy rates, particularly in thin, anestrous females.

The following is a recommended schedule.

Day 0 — Place one implant under the skin of the ear and inject (intramuscularly) 2 cc of the estrogen-progestin mixture. Clean the ear with an antiseptic solution before implanting.

Day 9 — Remove all implants, and temporarily remove any calves. Females may be housed near their calves but must not be allowed to nurse. This improves response to treatment.

Day 11 — At 48 to 54 hours after implant removal, inseminate all females. Return calves to their dams after insemination. Day 11 should coincide with the usual start of the breeding season.

Days 30 to 32 — Females not conceiving on day 11 will return to estrus. Follow-up estrus detection and AI are optional.

Synchronization with MGA and Prostaglandins

MGA is a progestin feed additive that can be obtained from feed mills permitted to mix medicated feeds. MGA is used to prevent estrus in feedlot heifers, but it also can be used to synchronize estrus in breeding females. Trials using MGA to synchronize estrus showed females responding to treatment required up to 7 days to display estrus, and fertility was depressed. Consequently, females should not be inseminated at this estrus.

To avoid these problems, researchers developed an alternative that combines MGA in the feed with a prostaglandin injection. In this approach, MGA is fed in a supplement that delivers 0.5 mg of the compound per head per day. Feeding continues for 14 days and is then terminated. After a 17-day period without MGA in the feed, females are given a single injection of prostaglandin. Animals that respond display estrus within 2 to 6 days. Six days of estrus detection are required after injections are given. The recommended schedule for MGA and prostaglandin treatment follows.

Day 0 — Begin feeding the supplement containing MGA. Supplement should be designed to deliver 0.5 mg of MGA per head per day.

Day 14 — Discontinue MGA in the feed. Responding females display estrus within 6 to 7 days. This estrus is subfertile, and animals should not be inseminated at this time.

Day 31 — Inject all females with prostaglandin.

Days 31 to 36 — Begin estrus detection and AI each female about 12 hours after her initial signs of estrus. Day 31 should coincide with the usual start of the breeding season.

Days 50 to 55 — Females not conceiving at days 31 to 36 will return to estrus. Follow-up estrus detection and AI are optional.

Synchronization with GnRH and Prostaglandin

GnRH (gonadotropin releasing hormone) is a naturally occurring hormone that causes the release of other hormones. One of these hormones affects follicle development on the ovary, while another causes ovulation to occur. GnRH has been used to treat ovarian disorders in dairy cows, but research indicates that GnRH, given to estrous cyclic and non-cyclic females, will induce ovulation and alter patterns of follicular development. When used in certain combinations with prostaglandins, estrus is synchronized and "time mating" can be used. Other combinations of the compounds also will synchronize estrus to a lesser degree and estrus detection is required. Response to GnRH in mature cows is acceptable, but response has been inconsistent in heifers. The use of GnRH in heifers is not recommended. Two approaches for using GnRH with prostaglandins follow.

Approach 1

Day 0 — Inject GnRH intramuscularly in all females. Dosage depends on the type of GnRH (Cystorelin®, Fertagyl®) used.

Day 7 — Inject all females with prostaglandin.

Days 7 to 12 — Begin estrus detection and inseminate each female about 12 hours after her initial signs of estrus. Day 7 should coincide with the usual start of the breeding season.

Days 26 to 31 — Females not conceiving at days 7 to 12 will return to estrus. Follow-up estrus detection and AI are optional.

Approach 2

Day 0 — Inject GnRH in all females as in Approach 1.

Day 7 — Inject all females with prostaglandin.

Day 9 — At 48 hours after prostaglandin, inject all females again with GnRH.

Day 10 — At 20 to 24 hours after the second GnRH injection, "time mate" all females. Day 10 should coincide with the usual start of the breeding season.

Days 29 to 32 — Females not conceiving at day 10 will return to estrus. Follow-up estrus detection and AI are optional.

Which Synchrony Method Should be Used?

The four treatment methods and their different approaches to synchronize estrus require varying amounts of time to implement. Managers having limited time and available labor should consider the methods that allow for "time mating."

Before any treatment is selected, however, determine the number of females that can potentially respond to treatment. A potentially low number of responsive females is a signal that treatment may not be justified. Well-managed beef herds that calve in 80 days or less usually respond well and would, therefore, justify the cost of treatment. In longer calving periods, cows can be sorted into groups and treated according to their calves' ages. Any cow whose calf is at least 40 days old can be treated.

Beef cows with calves less than 40 days old may be anestrous and will respond poorly to estrous synchronization. Cows that are anestrous because of inadequate nutrition will not respond well. Response in replacement heifers depends on the proportion of females that have reached puberty. Fifteen-month-old heifers weighing at least 65 percent of their expected mature weight respond well compared to younger heifers at a lighter weight.

All treatment methods result in approximately 50 percent pregnancy rates among females that respond to treatment. Overall pregnancy rate depends on the number of females that display estrus during the period. For example, all females must respond to treatment and display estrus if a 50 percent pregnancy rate to a single service is to be achieved. If only 50 percent of the females respond and display estrus, the pregnancy rate would be only about 25 percent. The use of quality semen and experienced technicians can help ensure the chances of conception in females that respond.

Field trials indicate that at least 60 percent of the females should be estrous cyclic before treatment to recover costs associated with the program. If the number of responding females is unknown, detect estrus for 5 to 6 days before any treatments are given. If less than 18 percent of the females are in estrus during that time, the response to subsequent treatment will be low. An alternative is to detect estrus after any treatment. Either approach allows managers to actually see the degree of response and decide if the program should be continued.

Return on investment is affected by pregnancy rates, rate of growth of AI offspring and market prices. Table 1 shows the maximum affordable costs of AI/estrous synchronization per female in commercial beef herds. Changes in pregnancy rates, AI offspring performance or weight gain, and market prices per pound affect the maximum affordable costs of a treatment program.

Other reasons to use AI/estrous synchronization are not based solely on the potential pregnancy and performance responses. The advent of expected progeny difference (EPD) values for bulls of various breeds allows producers to literally tailor their breeding program for specific characteristics. Replacement heifers can be inseminated to calving-ease bulls, thereby reducing or eliminating calving problems. Field trials show that this can reduce the costs associated with calving problems by as much as $57 to $65 per head. AI and estrous synchronization also can be used to create heifers with improved maternal characteristics, the value of which is realized when they give birth. Insemination to sires with improved marbling ability and growth in their offspring has been shown to improve feedlot performance and carcass value by as much as $40 per head. Club calf production from estrous synchronization/AI treatments in commercial cows can increase income by as much as $300 to $600 per pregnant female. Clearly, registered

Table 1. Maximum Affordable Cash Costs of AI and Estrous Synchronization in a Commercial Beef Herd as Affected by Pregnancy Rate, Offspring Performance and Market Price*

Percent of females in estrus	Percent of herd pregnant to AI[1]	Average weight increase of AI calves[2]	Market prices per pound				
			$.60	$.70	$.80	$.90	$1.00
40-50	20	50	$6.00	$7.00	$8.00	$9.00	$10.00
		70	$8.40	$9.80	$11.20	$12.60	$14.00
		90	$10.80	$12.60	$14.40	$16.20	$18.00
60-70	30	50	$9.00	$10.50	$12.00	$13.50	$15.00
		70	$12.60	$14.70	$16.80	$18.90	$21.00
		90	$16.20	$18.90	$21.60	$24.30	$27.00
80-90	40	50	$12.00	$14.00	$16.00	$18.00	$20.00
		70	$16.80	$19.60	$22.40	$25.20	$28.00
		90	$21.60	$25.20	$28.80	$32.40	$36.00
90 or more	50	50	$15.00	$17.50	$20.00	$22.50	$25.00
		70	$21.00	$24.50	$28.00	$31.50	$35.00
		90	$27.00	$31.50	$36.00	$40.50	$45.00
90 or more	60	50	$18.00	$21.00	$24.00	$27.00	$30.00
		70	$25.20	$29.40	$33.60	$37.80	$42.00
		90	$32.40	$37.80	$43.20	$48.60	$54.00

*Does not include the potential increase in herd performance (growth and milk) by superior female AI offspring saved as future replacements.

[1]Assumes that approximately half the females in estrus conceived to a single AI service.

[2]Average weight advantage of AI offspring compared to non-AI offspring in pounds.

breeders should consider AI as an economic way to access their breeds' most popular sires.

If semen is very expensive, estrus detection is recommended after any treatment. This results in the financially efficient use of semen and cost savings. Treatment compounds and their specific uses result in varied costs ($5 to $15) per treated female, but trials in beef females using a $7 per head product showed a positive return on investment. These trials also demonstrated that the degree of estrus response, pregnancy rate, performance of AI offspring and market prices had more impact on returns than did semen and product costs. In these trials, pregnancy rate was only 30 percent of 800 inseminations, but return on investment of product was still positive.

Using MGA in combination with prostaglandins requires specific consideration. Adequate intake of the MGA feed supplement by each animal ensures proper dosage and acceptable estrus response. Intake varies among individual animals, but dosage rate is designed to overcome some of the variation. Nevertheless, animals should be forced to consume the supplement, and this can be accomplished in a confined or semi-confined feedlot. Using MGA feed supplements to synchronize females grazing open range or pasture is not recommended because adequate intake cannot be assured. This is especially true during spring time in the South when females to be treated may have enough quality grazing and consequently, no appetite for supplemental feeds. Intake cannot be assured unless animals are confined for the required 14-day feeding period. Females unaccustomed to eating daily, hand-fed supplements may require a 7- to 14-day "training" period in which they are fed the supplement without MGA. This helps ensure adequate consumption. After this time, MGA can be added to the supplement to begin treatment.

Use of GnRH also requires specific consideration. Response in heifers to GnRH has been inconsistent, therefore, it is recommended for use only in mature females.

Precautions and Prior Planning

Before initiating any treatments, herd managers should read and follow product labels or prescribed directions. Incorrect use results in disappointment, low treatment response and low pregnancy rates. Some products cannot be used in lactating dairy cows.

Prostaglandins should be used with extreme caution. They cause abortions in animals and humans. They are readily absorbed through the skin and can cause breathing difficulties. Any contact with the skin should be avoided. Accidental spills should be immediately washed from the skin.

After the product is selected, the work schedule associated with that product should be placed on a calendar. The first day or days of insemination should coincide with the usual start of the breeding season. When the program for a particular approach is begun, do not alter the schedule. Timing of work activities associated with injections and insemination days are critical to success. On injection and insemination days, additional people may be needed to move cattle through the chute, administer injections, read ear tags, thaw semen and inseminate.

Remember, estrus detection in synchronization programs can be confusing because of the high degree of mounting activity. It is recommended that at least two or three observers be used during each detection period (lasting about 1 hour, two to three times each day). Application of heat mount patches (Kamar®) also may help improve the efficiency of finding estrus cows. To reduce the confusion from repetitive mounting, females confirmed in estrus should be sorted from the others about midway through each observation period. The remaining females should be observed for the latter half of the hour and additional estrus females should be sorted from the pen.

Whether using "time mating" or estrus detection followed by AI, there is the potential for many females to be inseminated in a concentrated period of time. Depending on herd size and insemination schedules, as many as four technicians may be needed. Only experienced technicians should be used and they should be allowed to alternate after every 10 to 15 inseminations to avoid exhaustion. Tired technicians are less effective in their procedures. If "time mating" is used, AI technicians should either thaw semen or perform inseminations and not be asked to perform other duties.

Contact the AI technicians several weeks in advance of beginning the program. Professional technicians usually have a full schedule during spring and autumn, and they will need to coordinate their work schedule. All necessary products, semen and equipment should be purchased at least 10 days in advance of treatment. The working facilities must be in good order. Most programs require that females be put through the chute at least three times to implement the treatments and to perform inseminations.

Keep accurate records of all activities. Ear tag numbers are used in recording which sire was used on each female and her date and time of observed estrus. It also may be necessary to record which AI technician performed each insemination in order to assess technician efficiency. On insemination days, the record keeper should not be asked to perform other duties. The speed at which experienced technicians perform inseminations requires that the record keeper be alert and free from distractions.

Handle cattle in a manner that reduces stress. Work them quietly, avoid excessive prodding and refrain from the use of dogs at or near the chutes. Stress has been shown to affect production of certain hormones that can negatively impact reproduction. Stress reduction also may have positive effects on the efficiency and attitudes of AI technicians because most technicians prefer to inseminate cattle that are calm rather than those that are overly excited. Though these may seem like insignificant details, they also are important to the program's success.

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