extension
ALABAMA A&M & AUBURN UNIVERSITIES

Estrus Synchronization and Artificial Insemination Programs for Beef Cattle

► One factor in a successful artificial insemination program is estrus synchronization. Learn about the advantages of synchronization in beef cattle and offers helpful information on understanding the normal estrous cycle. General reproductive information as well as tips for why synchronization programs sometimes fail are also included. Another topic covered is the timing of AI for maximum conception.

Artificial insemination (AI) is a reproductive method that allows cattle producers to use sires that have superior genetics at an affordable price. Incorporating superior genetics into a herd more rapidly improves economically important attributes such as growth, maternal, and carcass traits and also decreases the incidence of dystocias (difficult calving deliveries).

Part of a successful AI program is estrus synchronization, which typically involves administering a series of hormones to induce a group of cows or heifers to be fertile at a chosen time period, which makes it easier to determine when the cows are in heat. Estrus synchronization with AI in beef cattle offers the following advantages over entirely natural mating or AI without estrus synchronization.

- The number of days necessary to observe the herd for signs of heat (such as standing to be mounted) is reduced, which ultimately allows for closer observation. The hormones administered can also cause stronger heats that have more noticeable signs of estrus.
- The breeding season is shorter and more concentrated, which allows for more efficient labor management during the breeding season and ultimately during the resulting calving season.
- Artificial insemination can result in less stressful calving seasons by allowing the use of calving ease sires resulting in fewer dystocias.

The end result of a successful estrus synchronization and AI program early in the breeding season is a more consistent, uniform calf crop that is older and heavier at weaning because of the increased growth time as is shown in Table 1. More pounds of calf at weaning equals more potential for profit, especially with calves that are more uniform in age and genetics. The level of uniformity creates a marketing advantage, whether you are marketing feeder cattle, replacement heifers, or both.

The hormones used for estrus synchronization often mimic what occurs during a cow or heifer's normal estrous cycle; therefore, understanding the physiology of the normal estrous cycle is critical to understanding estrus synchronization.

The Normal Estrous Cycle

Estrus refers to a cow or heifer in standing heat or standing to be mounted. Estrous is the 21-day cycle from one estrus (heat) to the next. The average estrous

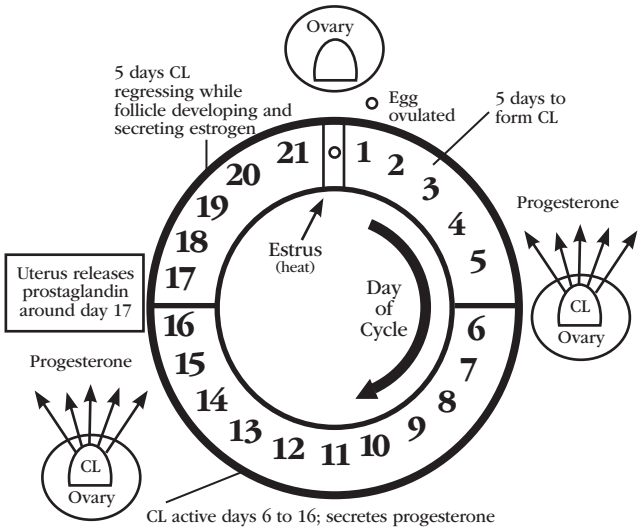

Figure 1. Cyclicity—the normal 21-day cycle

Table 1. Differences in Weaning Weight and Market Value of Calves Born in a 120-day Calving Season

	Calf 1	Calf 2	Calf 3	Calf 4
Birth weight (lb.)	80	80	80	80
Average daily gain (lb./day)	2.0	2.0	2.0	2.0
Age at weaning (days)	245	205	165	125
Weaning weight (lb.)	570	490	410	330
Difference in weaning weight	Baseline	-80 lb.	-160 lb.	-240 lb.
Market price ($/lb.)	1.30	1.35	1.40	1.45
Market value of calf	$741	$662	$574	$479
Difference in market value	Baseline	-$79	-$167	-$262

cycle, from one standing heat (estrus) to the next, is 21 days in the cow (figure 1), with a range of 18 to 24 days. The cycle begins on day 1 when the egg is ovulated from a follicle on the ovary. The egg moves into the oviduct where, if viable sperm from the bull are present, it is fertilized and moves into the uterus. Regardless of whether the egg is fertilized, by approximately day 5, the site of ovulation on the ovary develops into a corpus luteum (CL), which secretes the hormone progesterone into the cow's blood. While the CL is secreting progesterone, the cow does not come into estrus.

Around day 17, if the cow is not pregnant, the uterus secretes the hormone prostaglandin F2 alpha (PGF2α) that causes the CL to regress in about 3 to 5 days. While the CL is regressing, a new egg-containing follicle is developing that secretes the hormone estrogen, causing the cow to come into standing heat on about day 20 or 21 of the estrous cycle. Cows should be inseminated near the end of standing heat (see section on timing of artificial insemination for maximum conception) to provide enough time for the sperm to undergo a process called capacitation, which gives sperm the ability to fertilize the egg, before they encounter the egg. Cows ovulate approximately 4 to 16 hours after the end of standing heat.

If the cow becomes pregnant, the embryo in the uterus prevents the release of PGF2α; hence, progesterone secretion by the CL continues, cycling ceases, and the pregnancy is maintained. If no problems occur during pregnancy, the embryo develops into a fetus that is born as a calf about 283 days after the egg was fertilized as shown in Table 2.

Estrus Synchronization Programs

The majority of estrus synchronization programs use one or a combination of the following three basic methods that work with the physiology of the cow's normal estrous cycle.

- Prostaglandin (PGF2α) injections cause CL regression (see section on the normal estrous cycle) and standing heat in 1 to 5 days, unless the cow or heifer is in the first 5 to 7 days of her estrous cycle when her CL is not responsive to PGF2α.
- Progesterone or progestins, released from controlled internal drug release inserts (EAZI-BREED CIDR) or ingested in feed by feeding melengesterol acetate (MGA), mimic the effects of the cow's natural progesterone by preventing heat from occurring as long as they are present in the body. Once removed, the cow or heifer typically comes into heat in 1 to 3 days. However, a heifer is subfertile during the first heat following MGA treatment due to ovulation of an older egg (oocyte), so the heifer should be bred on a subsequent, synchronized heat.
- Gonadotropin-releasing hormone (GnRH) injections promote and synchronize follicle growth and induce ovulation. A GnRH injection administered approximately 48 hours after a prostaglandin injection provides a more concise synchrony of ovulation.

Federal law restricts the majority of reproductive hormones to use by or on the order of a licensed veterinarian. Therefore, contact your veterinarian for specific recommendations and products before initiating an estrus synchronization program.

Table 2. General Reproductive Information

	Average	Range	Comments
Age at puberty	10 to 12 months	6 to 24 months	Varies with breed. Brahmans and continental breeds usually reach puberty later than British breeds.
Gestation	283 days	273 to 290 days	Bull calves are often carried slightly longer. Brahman-type cattle often have longer gestations.
Length of estrous cycle	21 days	18 to 24 days	Heifers often have slightly shorter cycles than cows.
Length of estrus (heat)	18 hours	6 to 30 hours	Signs include restlessness, clear mucous vaginal discharge, mounting other animals, but the main sign is standing to be mounted.
Interval to first heat after calving	45 days	16 to 90+ days	Retained afterbirth and uterine infection delay onset. Adequate body condition is critical.
Reproductive lifespan	10 years	Up to 15 years (rarely longer)	Management, death loss, genetics, culling, etc. play a large part in determining reproductive lifespan.

Some things to remember when working with reproductive hormones are as follows:

- Always follow label directions and adhere to all other Beef Quality Assurance guidelines.
- Always be careful when handling reproductive hormones because they can be absorbed through the skin and affect humans.
- Exercise extreme caution when handling reproductive hormones if you are a woman of childbearing age, an asthmatic, or a person with bronchial or other respiratory problems.

To review recommended estrus synchronization protocols for both cows and heifers, refer to the Beef Reproduction Task Force, a multistate extension activity in cooperation with the North Central Agriculture and Natural Resources Program Leaders Committee and the Cooperative State Research, Education and Extension Service, at http://beefrepro.unl.edu/resources.html. Recommended protocols are updated frequently and provide a comparison of both cost and labor resources to help beef producers select the appropriate estrus synchronization protocol for their operations.

Why Do Estrus Synchronization Programs Fail?

The following are the two main reasons why estrus synchronization programs fail:

- **The animals were not cycling.** Cows must be in sufficient body condition at calving and have adequate nutrition available to return to reproductive cyclicity postpartum. Heifers may not have reached puberty. Heifers need to be at approximately 65 percent of their mature body weight at first breeding.
- **The animals were cycling, but heat was not detected after injection of PGF2α and/or removal of progesterone/progestin.** The signs of heat may have been present but just not detected. Cows are usually in estrus for only 12 to 24 hours and may only show signs of standing heat a few times. Observe for standing heat at least 30 minutes twice a day. Early morning and late afternoon are the best times for heat detection. The cow or heifer did not respond to the PGF2α injection because she was in the first 5 to 7 days of her estrous cycle, when her CL is not responsive to PGF2α.

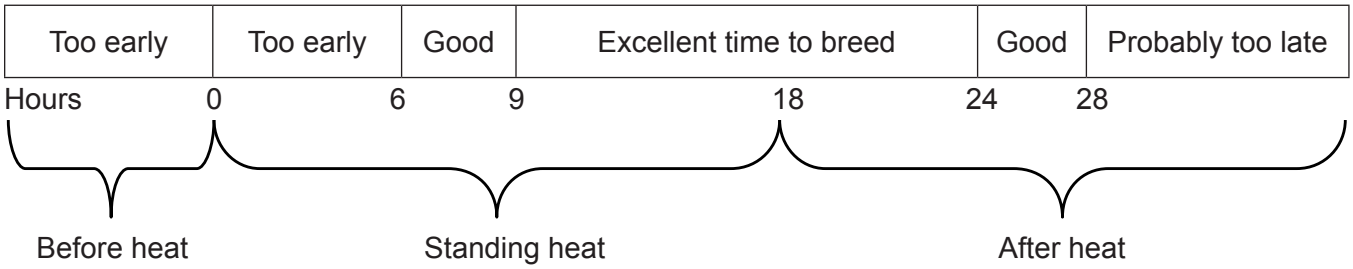

Figure 2. Timing of artificial insemination for maximum conception

Timing of Artificial Insemination for Maximum Conception

Figure 2 shows general guidelines for timing of AI based on observed standing heat, or estrus. Actual times will vary depending on the length of standing heat, but the goal is to inseminate near the end of a heat period. Cows ovulate approximately 4 to 16 hours after the end of standing heat. Inseminating near the end of heat provides time for the sperm to undergo capacitation, which gives sperm the ability to fertilize, before they encounter the egg. In general, it is better to have the sperm waiting for the egg, rather than the egg waiting for the sperm, because the egg has a shorter lifespan.

Some things to consider when timing AI include the following.

- Good heat detection is critical for successful AI. Observe for standing heat at least 30 minutes twice a day. Early morning, late afternoon, and evening are the best times for heat detection.
- Maximum conception rates for AI occur when animals are bred near the end of standing heat. Traditional AI has therefore followed the AM-PM rule. An animal first observed in heat in the AM should be inseminated that PM. An animal first observed in heat in the PM should be inseminated the next AM.
- Some producers may consider using timed AI, in which insemination occurs at a predetermined time following an appropriate synchronization program. Timed AI allows for a more regimented schedule. Recent improvements in timed AI and estrus synchronization protocols have increased pregnancy rates while allowing for easier scheduling of labor resources and less cattle handling. If a timed AI program is used with estrus synchronization, the need for heat detection can be eliminated.
- Another method is to combine AI and natural service with the use of cleanup bulls to boost overall pregnancy rates and reduce the amount of heat detection and drug expense. Commonly, estrus synchronization and AI are used for one AI service, and then cleanup bulls are turned out for the remainder of the breeding season.

Conclusion

Estrus synchronization and AI are reproductive tools that when used properly ultimately enhance the profitability of a well-managed beef cattle operation. The most common failure of estrus synchronization and AI programs is poor attention to detail. Neglecting crucial management practices, such as nutrition, record keeping, AI technician proficiency, good heat detection, and proper timing of estrus synchronization protocols, generates poor results. Therefore, attention to detail is the key to having a successful estrus synchronization and AI program.

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