

2021 Protocols for Synchronization of Estrus and Ovulation in Beef Cows and Heifers

Biotechnology presents beef producers with an unprecedented opportunity to improve herd genetics. Producers have more precise tools for genetic selection. Research has led to a better understanding of methods to induce and synchronize estrus and ovulation in postpartum cows and replacement heifers. These improvements enable producers to expand their use of artificial insemination (AI) and make it possible to inseminate cows at predetermined times and to achieve pregnancy rates comparable to those obtained after several days of detecting estrus. Many options exist for synchronization of estrus and ovulation. This short list of protocols, based on research and field use by reproductive physiologists, veterinarians, and professionals in related industries, is intended to help you select an appropriate synchronization option.

Protocol Selection

Before selecting a protocol, assess animals intended for synchronization. Consider body condition of cows and heifers and days postpartum for cows. Evaluate resources, including facilities, labor, experience, and budget.

Heat detection

The first step is to determine how much heat detection is feasible or desired. Ask yourself how much time you can devote to heat detection and if you can do it well. Animal sorting and heat detection is simple and effective in some management systems but difficult in others. Poor heat detection will result in lower AI pregnancy rates. Protocols can be divided into three groups based on time required for heat detection: 7 to 8 days; 3 days, followed by fixed-time AI of all animals not previously detected in heat (cleanup-timed AI); or strict, fixed-time AI.

Cow factors

Any of the synchronization protocols presented here are recommended for mature cows with a body condition score of 5 or greater that are at least 50 days post-calving at the time of AI. Young,

thin, and late-calving cows are less likely to have resumed their estrous cycles at the beginning of the breeding season. If a high percentage of cattle fall into these categories, consider protocols that include a progestin (a compound that acts like progesterone) that mimics the first cycle after calving. An intra-vaginal progesterone-containing insert, such as a CIDR (controlled internal drug release), will induce some noncycling cows to cycle and improve their chances of conceiving to AI. If cows are too thin or have calved too recently, synchronization of estrus may not be cost effective.

Heifer factors

Age and weight influence onset of puberty in heifers. Heifers should attain 60% of their mature weight before breeding. Because mature cow size has increased over the years, producers may underestimate mature size and target weight. Scoring heifer reproductive tracts (1=infantile to 5=tract mature and ovary contains a corpus luteum) 30 to 60 days before the breeding season gives producers a truer measure of physiological maturity and time to adjust rations before breeding. Synchronization programs are more successful when more than 50% of heifers have a tract score of 4 or better. Protocols that include a progestin — delivered orally, such as MGA (melengesterol acetate), or intravaginally as a CIDR — may induce some prepubertal heifers to cycle.

Other factors

Duration of the protocol, number of times handled, and the ability to successfully administer treatments are other factors to consider in protocol selection. For example, successful use of MGA depends on uniform daily consumption by all heifers. Management system, feed resource flexibility, and facilities help determine which protocol works best in a particular environment. Protocol success depends on proper administration and timing of treatments. For help, see the Estrus Synchronization Planner (www.iowabeefcenter.org/estrussynch.html).

This tool generates a daily calendar of activities and can compare costs of up to three protocols.

Cost

Heat-detection protocols generally cost less than fixed-timed AI protocols, provided that labor is available or can be hired. Treatments, semen, and number of handlings contribute to cost of synchronization. Savings from fewer bulls needed for natural service and higher returns based on age and weight of AI-sired calves should also be considered. AI will be most cost effective for producers who capture additional returns from AI-sired calves. A decision tool, *AI Cowculator*, allows users to determine net gain or loss per cow exposed if AI were used in place of natural service. Calculations are based on user inputs related to costs of natural service sires, cowherd, and AI. The tool is available for Android and iPhone devices or as a spreadsheet (*BeefRepro.org*).

Which animals should I synchronize?

When starting an AI program, replacement heifers are the easiest group of animals to work with, and first-calf heifers are the most difficult. Start simply and add more animals as you gain experience.

Products Used

Hormones common to many protocols are prostaglandin F_{2a} (PG), gonadotropin-releasing hormone (GnRH), and progestins. They are available in the commercial products listed in Table 1.

Table 1. Commercial names of products used for synchronization of estrus.¹

Type	Commercial name
Estrus Detection Aid	Aervoe, AIPaint, Detect-her, Estrotect, Kamar, Mark-her, Paintstik, Quick Shot, Tell Tail, Twist-Stik
GnRH	Cystorelin, Factrel, Fertagyl, GONABreed, OvaCyst,
PG	estroPLAN, Estrumate, In-Synch, Lutalyse, Lutalyse HighCon, ProstaMate, SYNCHSURE
Progestin	MGA (melengesterol acetate), CIDR (progesterone)

¹Follow label directions for dose and route of administration.

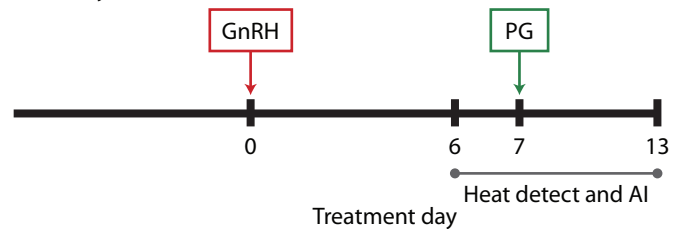
Protocols

Heat-detection protocols

Animals in these protocols should be inseminated 6 to 18 hours after the first observation of standing heat. During peak activity (48 to 72 hours after PG for most systems), plan to spend at least 3 hours per day observing animals to detect heat, and preferably 5 to 6 hours. Divide total observation time into three or more times throughout the day. The larger the group, the more time required for heat detection.

Protocols for use in cows include **Select Synch** and **Select Synch + CIDR** (Figure 1). Include the CIDR when more cows are likely to be noncycling and/or when heat detection before PG is not feasible. With Select Synch, 5 to 20% of animals may show heat 1.5 to 2 days before PG. Both protocols could be applied to the same group of cows, placing CIDRs in young, thin, and/or late-calving cows.

Select Synch



Select Synch + CIDR

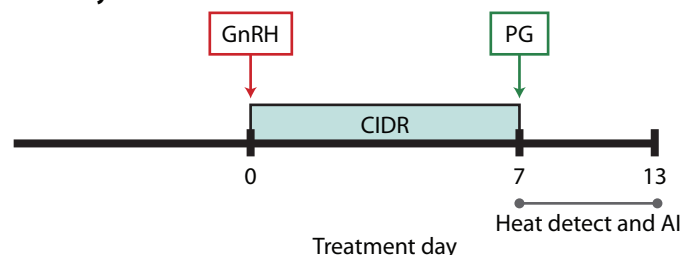


Figure 1. Heat detection only protocols for cows: Select Synch and Select Synch + CIDR.

The **7-day CIDR-PG** protocol (Figure 2) is recommended for use in heifers in contrast to the Select Synch + CIDR protocol for cows. The difference is that heifers do not require the GnRH injection at the beginning of the treatment. Research has shown pregnancy rates from the 7-day CIDR-PG protocol to be similar to those from the Select Synch + CIDR protocol in heifers. Select Synch is not recommended for heifers because it produces a wider range of responses, possibly due to inconsistent response to GnRH.

7-day CIDR-PG

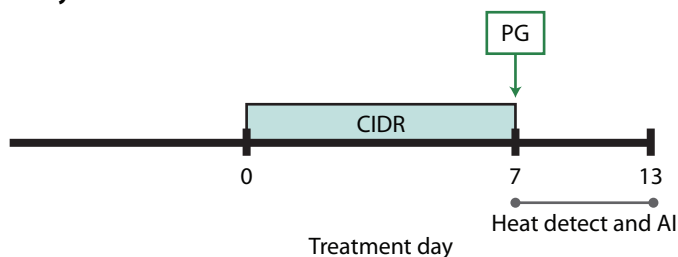


Figure 2. Heat detection only protocol for heifers, 7-day CIDR-PG.

PG 6-day CIDR is another heat detection option (Figure 3). This protocol reduces treatment costs for cows inseminated after the first PG. It requires more days of heat detection and enough synchronization products on hand for all cows. This protocol can be used on cows or heifers.

PG 6-day CIDR

Heat detect and AI days 0 – 3. Administer CIDR to nonresponders and heat detect and AI days 9 – 12. Protocol may be used in heifers.

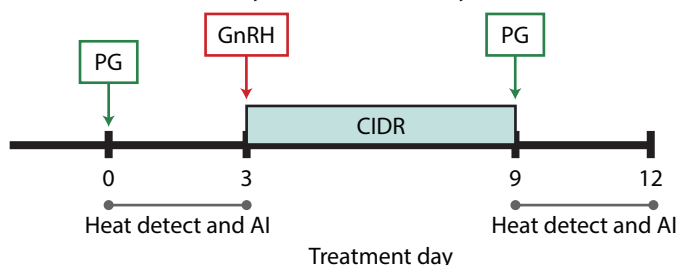


Figure 3. Heat detection only protocol, PG 6-day CIDR.

Feeding MGA is specifically approved for estrus suppression in heifers only. The MGA-based protocol recommended for heifers is **MGA-PG** (Figure 4). This protocol requires more planning because it begins with feeding MGA for 14 days starting 33 days before PG injection. If MGA can be accurately delivered daily, this is an effective protocol for beef heifers. The original recommendation for the interval between the last feeding of MGA and PG injection was 17 days. Delaying this interval to 19 days improves synchrony of estrus.

MGA-PG



Figure 4. Heat detection only protocol for heifers, MGA-PG

A single injection of PG (Figure 5) can be used on heifers. This protocol does not provide the same degree of synchrony as other protocols, and the heat detection period is twice as long. Nevertheless, it is a low-cost method that often works well for those just starting to use AI. It can be used on cows, but because sorting and heat detection are more complex when the calf is present, other options should be considered more carefully. Heifers that have not reached puberty or cows that have not initiated estrous cycles do not have a corpus luteum (the structure that forms at the ovulation site to produce progesterone to maintain pregnancy) and **will not** respond to this treatment. Heifers observed in heat and inseminated before the time of PG injection do not require PG.

1 shot PG

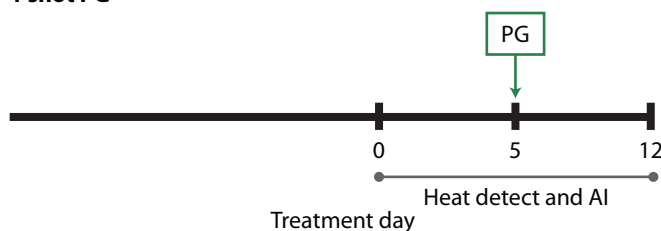


Figure 5. Heat detection only protocol for heifers, single shot PG.

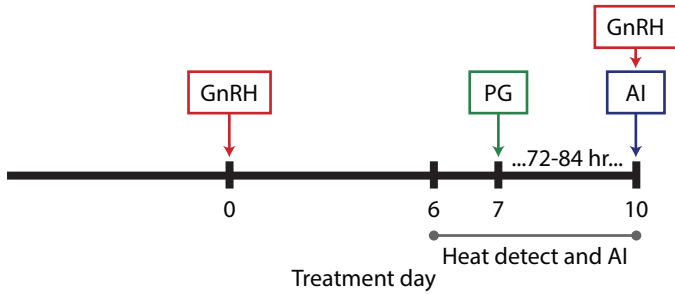
Heat detection and timed AI (TAI) protocols

Heat detection and timed AI protocols involve AI 6 – 18 hours after observed estrus for 3 days, and then TAI of all nonresponders 72 – 84 hours after PG, with GnRH given at TAI. This reduces the amount of time spent on heat detection and gives early responders a better chance of conceiving compared to a single fixed-timed AI.

The same protocols recommended for heat detection are recommended for the combination of heat detection and timed AI in cows (Figure 6). Success still depends on good heat detection, particularly for early heats in the Select Synch protocol.

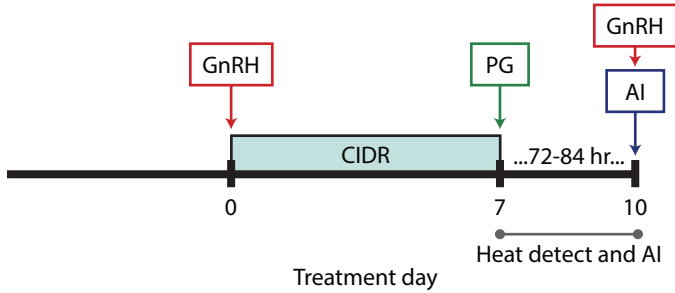
Select Synch and TAI

Heat detect and AI days 6 – 10 and TAI all nonresponders 72 – 84 hours after PG with GnRH at TAI.



Select Synch + CIDR and TAI

Heat detect and AI days 7 – 10 and TAI all nonresponders 72 – 84 hours after PG with GnRH at TAI.



PG 6-day CIDR and TAI

Heat detect and AI day 0 – 3. Administer CIDR to nonresponders and heat detect and AI days 9 – 12. TAI nonresponders 72 – 84 hours after CIDR removal with GnRH at AI. Protocol may be used in heifers.

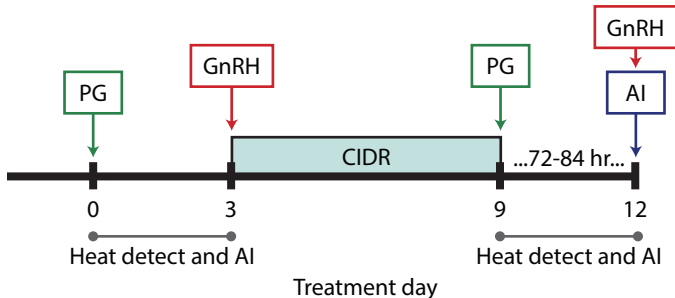


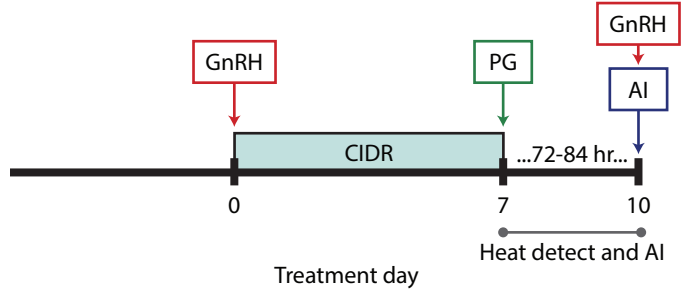
Figure 6. Heat detection and cleanup-timed AI protocols for cows: Select Synch and TAI and Select Synch + CIDR and TAI, PG 6-day CIDR and TAI.

In heifers, one option that combines heat detection and timed AI is the MGA-PG protocol (Figure 7).

A second protocol recommended for use in heifers is **Select Synch + CIDR** (Figure 7). GnRH is recommended on day 0 in this protocol. It adds little additional cost, and heifers that do respond with a new follicular wave are more likely to conceive at the cleanup-timed AI.

Select Synch + CIDR and TAI

Heat detect and AI day 7 – 10 and TAI all nonresponders 72 – 84 hours after PG with GnRH at TAI.



MGA-PG and TAI

Heat detect and AI day 33 – 36 and TAI all nonresponders 72 – 84 hours after PG with GnRH at TAI.

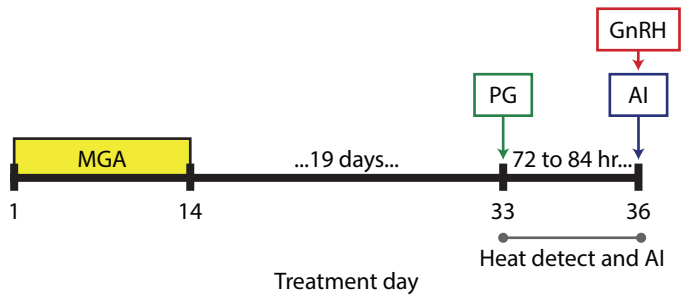


Figure 7. Heat detection and cleanup timed AI protocols for heifers, Select Synch + CIDR and TAI and MGA-PG and TAI.

The third option for combination heat detection and TAI in heifers is **14-day CIDR – PG** (Figure 8). This protocol is similar to MGA-PG, but the interval between CIDR removal and PG is reduced to 16 days because the progesterone in CIDR-treated animals clears the body much faster than melengesterol acetate in MGA-treated animals.

14-day CIDR-PG and TAI

Heat detect and AI days 30 – 33 and TAI all nonresponders 72 hours after PG with GnRH at TAI.

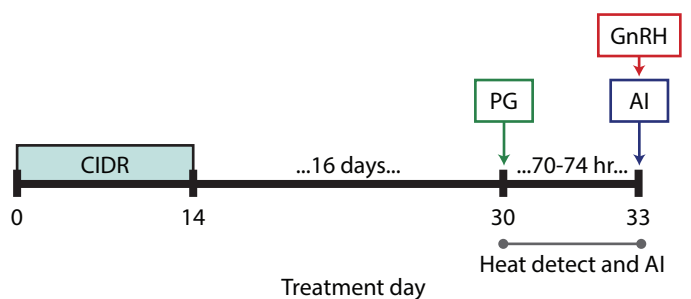


Figure 8. Heat detection and timed AI protocols for heifers, 14-day CIDR-PG and TAI.

Fixed-Time AI Protocols

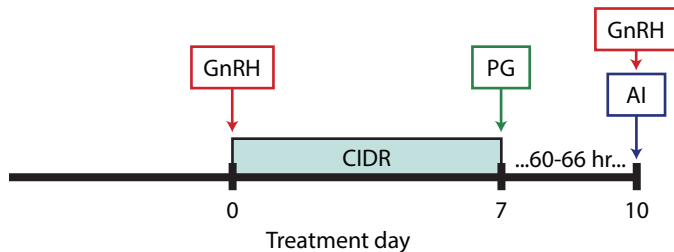
With fixed-time AI protocols, all animals are inseminated at a predetermined time. For cows, fixed-timed AI can produce pregnancy rates similar to those of protocols that require 5 to 7 days of heat

detection. For heifers, pregnancy rates from current TAI protocols tend to be 5 to 10% lower than using heat detection alone. The times listed for fixed-time AI should be considered as the approximate average time of insemination. This should be based on the number of females to inseminate, labor, and facilities. Synchronize no more females than can be inseminated at a particular facility in a 3- to 4-hour period.

Two short-term protocols are recommended for cows (Figure 9) and heifers (Figure 10). The interval from CIDR removal to insemination is generally shorter in heifers than cows. Cows should be inseminated between 60 and 66 hours after CIDR removal in the **7-day CO-Synch + CIDR** protocol, although insemination time for heifers is recommended at 52 to 56 hours after CIDR removal. For the shortened **5-day CO-Synch + CIDR protocol**, two full doses of PG given 8 hours apart are critical for success. Interval from CIDR removal to insemination should be 70 to 74 hours for cows and 56 to 64 hours for heifers. This 5-day protocol has been adapted for *Bos indicus* (Brahman, Nelore) influenced cows by adding a dose of PG at the time of CIDR insertion: **PG 5-day CO-Synch + CIDR** (Figure 11). This protocol has been shown to be more effective in *Bos indicus*-based crossbred cows than the 7-day CO-Synch + CIDR and 5-day CO-Synch + CIDR protocols, which are preferred for *Bos taurus*-based cows.

7-day CO-Synch + CIDR - Cows

Perform TAI at 60 – 66 hours after PG with GnRH at TAI.



5-day CO-Synch + CIDR - Cows

Perform TAI at 72±2 hours after CIDR removal with GnRH at TAI.

Two injections of PG 8±2 hours apart are required for this protocol.

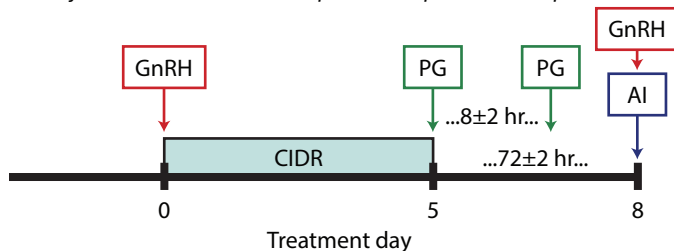
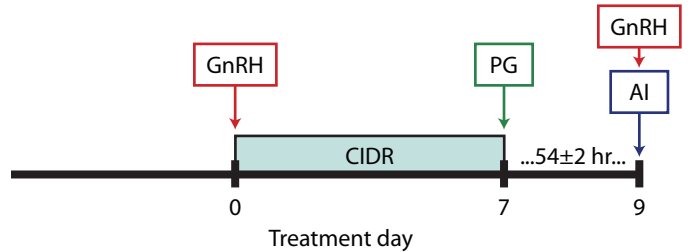


Figure 9. Fixed-time AI protocols for cows: 7-day CO-Synch + CIDR and 5-day CO-Synch + CIDR.

Short-term Protocols – Heifers

7-day CO-Synch + CIDR

Perform TAI at 54±2 hr after PG with GnRH at TAI.



5-day CO-Synch + CIDR

Perform TAI at 60±4 hours after CIDR removal with GnRH at TAI.

Two injections of PG 8±2 hours apart are required for this protocol.

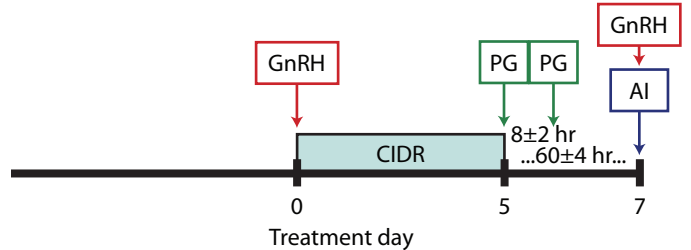


Figure 10. Short-term fixed-time AI protocols for heifers: 7-day CO-Synch + CIDR and 5-day CO-Synch + CIDR.

Bos Indicus PG 5-day + CIDR®

Perform TAI at 66±2 hours after CIDR removal with GnRH at TAI.

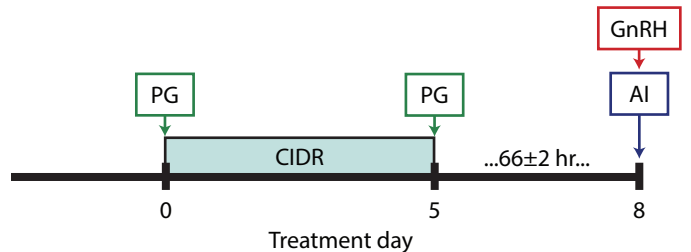
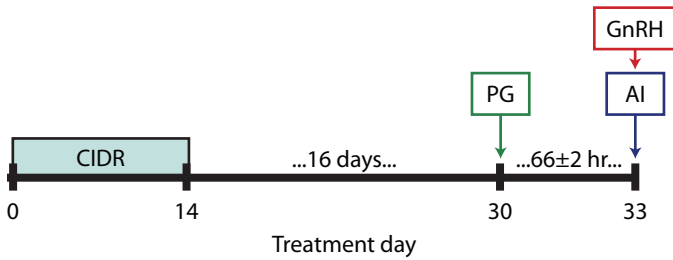


Figure 11. Fixed-time AI protocol for *Bos indicus* cows, PG 5-day CO-Synch + CIDR.

MGA-PG (Figure 12) can be used with fixed-time AI in heifers; however, pregnancy rates tend to be lower than other fixed-timed AI protocols. For many producers a CIDR-based protocol is lower risk for fixed-time AI than MGA-PG because it does not rely on accurate, daily MGA consumption and follicular growth should be better controlled. The **14-day CIDR-PG** (Figure 12) protocol is another long-term, fixed-time AI protocol for heifers. It is 3 days shorter than MGA-PG and requires one more handling than 7-day CO-Synch+CIDR.

14-day CIDR-PG

Perform TAI at 66 ± 2 hours after PG with GnRH at TAI.



MGA-PG

Perform TAI at 72 ± 2 hours after PG with GnRH at TAI.

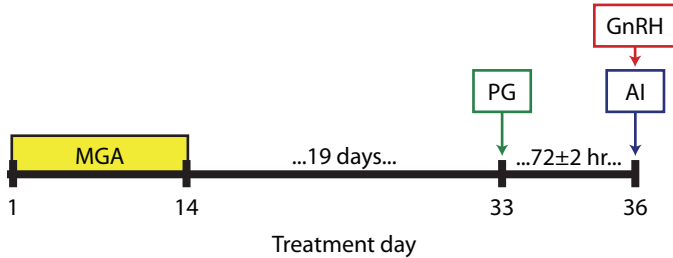


Figure 12. Long-term fixed-time AI protocols for heifers: MGA-PG and 14-day CIDR-PG.

Advanced Systems

Fixed-time AI systems that can be completed in three handlings produce acceptable pregnancy results and have allowed many producers to incorporate AI programs into their operations. The development of these systems also has generated additional data that becomes even more powerful when combined in what is known as a meta-analysis.

Data from 26 herds and more than 10,000 females indicated a 27% improvement in pregnancy rate of females that had been in estrus by the time of fixed-time AI compared to non-estrous females. It is important to not overlook the fact females can conceive even if they have not expressed estrus at fixed-time AI, just not as many as those that have shown estrus. This information has been used to explore ways to improve the implementation of synchronization systems. One way to inseminate more estrous females is to allow additional time for more females to come into estrus and another is to use information on estrous status to determine which females get higher-value, more expensive semen.

Split-time insemination

Split-time insemination aims to increase insemination of estrous females by providing additional time

for more females to show estrus. It accomplishes this by adding a second insemination 20 to 24 hours after the recommend fixed-time AI. Fortunately, reliable heat detection aids (see Table 1) are available and should be applied at the last handling before fixed-time AI. This allows females with activated heat detection patches to be inseminated at the first fixed-time AI and to identify non-estrous females that are then inseminated 20 to 24 hours later. While fixed-time AI protocols call for GnRH at fixed-time AI, estrous females do not require GnRH and often savings from GnRH use can cover the cost of heat detection aids. It is important to give GnRH to non-estrous females at the second insemination period.

The practical question is, “How much improvement in pregnancy rate might result from the additional handling and sorting required?” In general, this approach is advantageous when the estrous response up to the time of the appointed fixed-time AI is relatively low (less than 50% cows and 60% for heifers). Split-time AI is best used where sorting estrus and non-estrous females is relatively easy and diets of one group or the other are not compromised. Additional handlings may expose young calves to more stress, particularly in dusty conditions. Use information on the value of AI pregnancies in your own herd to determine how many more pregnancies are needed to cover the additional inputs. Improvement in AI pregnancy rate with a split-time approach has ranged from 0 to 5%.

An example of a split-time insemination protocol for heifers with the 14-day CIDR-PG protocol is shown in Figure 13. Directions for use with other

14-day CIDR®-PG and STAI- Heifers only

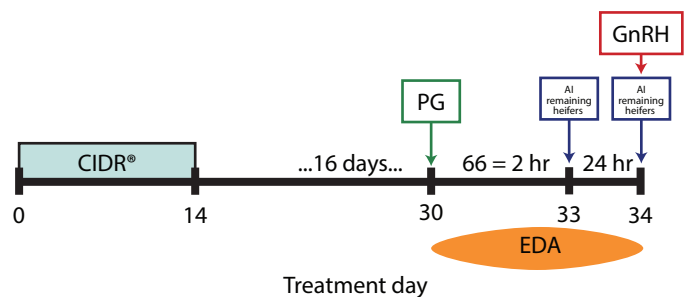


Figure 13. Split-time insemination (STAI) option in a 14-day CIDR-PG protocol for heifers. Estrus detection aid = EDA (see Table 1).

fixed-time AI protocols are outlined in the Estrus Synchronization Planner.

Sexed semen

The process to produce sexed semen is stressful on sperm cells and likely contributes to decreased fertility typically observed when compared to conventional semen. As with conventional semen, pregnancy rates with sexed semen are much greater in females that have been in estrus. Pregnancy rates from sexed semen in non-estrous females are low (5 to 30%) and should be avoided.

While data is not extensive, delaying insemination until closer to ovulation (16 to 22 hours after onset of estrus) is recommended. Sexed semen could be used with any of the recommended protocols for animals detected in estrus. Two approaches are available to minimize time spent detecting heat, but still optimizing results with sexed semen. Within a fixed-time AI protocol, use sexed semen on estrus females and conventional semen on those that have not shown estrus. Again, heat detection aids are recommended to differentiate these two groups. A split-time insemination approach gives additional time for females to show estrus and the same principle applies at the second insemination, if in estrus use sexed semen and if not use conventional semen and give GnRH. While the split-time approach adds an additional handling, it may maximize estrous response and the opportunity to use sexed semen.

The use of a combination of sexed-semen for estrous females and conventional semen for non-estrous

females is illustrated below for the 7-day CO-Synch + CIDR protocol.

Protocol Development

Protocols presented in this publication are based on considerable research data and field use by a group known as the Beef Reproduction Leadership Team. This group is made up of individuals representing the AI and animal health industries, veterinarians, and reproductive physiologists with active research programs in this area. Other protocols should be considered only in unique situations and with the advice of an individual with extensive experience in synchronization of estrus. Protocols should not be altered without sound research data to support modifications.

This publication was developed by the Beef Reproduction Task Force. This multistate extension group aims to improve understanding of the physiological processes of the estrous cycle, procedures available to synchronize estrus and ovulation, and proper application of these systems. The task force is made up of specialists from Kansas State University, Iowa State University, University of Idaho, University of Missouri, University of Georgia, Texas A&M University, Virginia Tech, and New Mexico State University. Task force members are named on the back of this publication. For more information including recordings of previous Applied Reproductive Strategies in Beef Cattle Workshops, upcoming events and the latest protocols, see www.beefrepro.org

7-day CO-Synch + CIDR & STAI - Cows and/or Heifers

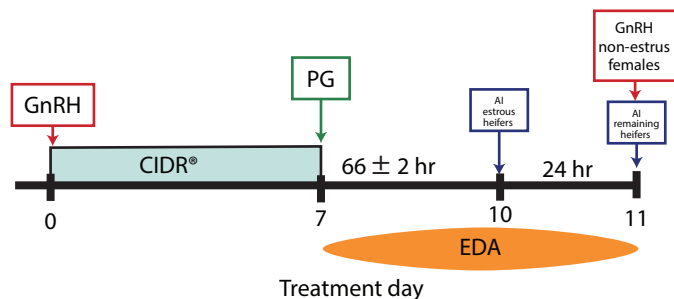


Figure 14. Illustration of use of estrus detection aids (EDA) (see Table 1) and split-time AI (STAI) in a 7-day CO-Synch + CIDR protocol to optimize use of sexed semen.

Authors

S.K. Johnson, Northwest Research and Extension Center, Kansas State University, Colby, Kansas

G. R. Dahlke, Department of Animal Science, Iowa State University, Ames, Iowa

Joe Dalton, Caldwell Research and Extension Center, University of Idaho, Caldwell, Idaho

Jared Decker, Division of Animal Sciences, University of Missouri, Columbia, Missouri

Lee Jones, Tifton Veterinary Diagnostic and Investigational Laboratory, University of Georgia, Tifton, Georgia

G.C. Lamb, Texas A & M University, College Station, Texas

Vitor Mercandante, Department of Animal and Poultry Sciences, Virginia Tech, Blacksburg, Virginia

G.A. Perry, Texas A&M AgriLife Research and Extension Center, Overton, Texas

Ky Pohler, Texas A & M University, College Station Texas

Adam Summers, New Mexico State University, Las Cruces, New Mexico

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MF2573 | September 2021