31 Synchronizing Heats in Beef Cows and Heifers

Daniel Stein, Brian Freking and Barry Whitworth

Overview

- **Provide a summary of some of the most popular estrous synchronization methods.**
- **Discuss answers to key producer questions.**

Introduction

Estrus synchronization is a reproductive management tool that facilitates artificial insemination (AI) to occur, so producers can capitalize on the superior genetics available through the use of commercially processed semen. There are three basic types of synchronization protocols: 1) those including estrus detection only, 2) those including estrus detection and clean-up fixed-time insemination and 3) those including only fixed-time insemination. Estrus synchronization should never be a substitute for nutrition, herd health or herd management. When managed properly, estrus synchronization can effectively be used to facilitate not only AI, but natural service as well. For some producers, natural service may be the easiest method of breeding cattle and estrus synchronization may be as potentially beneficial to producers using natural mating as AI. USDA data shows approximately 8 percent of cow-calf producers in the U.S. incorporate estrus synchronization into their breeding program. For an estrus synchronization program to be implemented successfully, it must be well thought-out and well planned. The benefits of incorporating estrus synchronization into a breeding program, whether using natural service or AI include:

- Improving management by more easily defining the breeding season and the calving period.
- A labor-saving tool if monitoring parturition; females can be grouped by expected date of parturition.
- Increasing the time needed for postpartum recovery in cows and first-calf heifers.
- Allowing for greater use of superior sires through artificial insemination (AI) or by natural service.
- Increasing calf performance and weaning weights due to earlier birthdates in the calving period.
- A more uniform calf crop in size and age, which can be a potential advantage at marketing time.
- Improving nutritional status of females; females can be grouped according to stage of gestation and fed accordingly.

Estrus detection can be a very time- and labor-intensive activity, which makes AI programs impractical for some producers. However, with some synchronization protocols, estrus detection can be eliminated because animals can be inseminated at a pre-determined time, known as fixed-time AI. Synchronization protocols that incorporate fixed-time AI not only synchronize the estrous cycle, but induce ovulation at a pre-determined time to facilitate insemination. The first step in deciding upon a synchronization protocol is for the producer to decide how much time, if any, is available for estrus detection or if estrus detection is even feasible. For synchronization protocols recommended by the Beef Reproduction Task Force; it is suggested that mature cows be in a BCS 5 or greater and at least 50 days or more postpartum at the time of insemination. For young, thin and late-calving cows which are less likely to have resumed their estrous cycle, protocols including a progestin (progesterone) should be considered. An intravaginal insert containing progesterone (Eazi-Breed™ CIDR® Cattle Insert—see section on Products used to Synchronize Estrus in Beef Cows and Heifers) can induce some non-cycling cows to cycle and improve their chance of conceiving. However, these protocols may not be cost effective for cows too thin or cows that have recently calved. Age and weight influence the onset of puberty in heifers; they should attain 60 percent of their mature weight prior to breeding. When 50 percent of the heifers have a **Reproductive Tract Score** of three or greater at 50 days to 60 days prior to breeding, estrus synchronization protocols tend to be more successful. Also, synchronization protocols that include a progestin (progesterone) may induce some prepubertal heifers to cycle.

All Web addresses given in this chapter are subject to change. The links to these websites will be updated regularly at the Master Cattleman website, http://agecon.okstate.edu/cattleman/manual_chapters.asp

Beef Reproduction Task Force Recommendations and Available Tools

The Beef Reproduction Task Force is a multi-state extension group, whose objective is to provide timely information regarding applied reproductive strategies in beef cattle. Choosing an estrus synchronization protocol that can be used with AI or with natural service can be difficult, as a number of synchronization protocols are available. To assist cattle producers in determining an effective estrus synchronization protocol, the Beef Reproduction Task Force provides recommendations for estrus synchronization protocols to be used in either cows or heifers. These protocol recommendations are updated annually by the Task Force. The current protocol recommendations are found at the website: Applied Reproductive Strategies in Beef Cattle - appliedreprostrategies.com.

The Beef Reproduction Task Force also provides a free Excel-based *estrus synchronization planner* developed by Iowa State University. This synchronization planner is a useful tool to aid in planning protocols to fit the producer's desired outcomes. Up to three protocols can be compared in a cost analysis. The Estrus Synchronization Planner is available for mobile devices. Also available is the AI Cowculator App, developed by the University of Florida, which may be downloaded free of charge. The AI calculator is a decision aid tool to assist producers to determine whether they should consider fixed-time AI rather than purchasing herd sires for their cow herds. Calculations are based on user inputs related to costs of natural service sires, cowherd and AI. In addition, the application contains a locator to determine where products may be purchased and technicians who can provide the service, along with additional resources and a link to the AI Cowculator social media.

Products Used to Synchronize Estrus in Beef Cows and Heifers

The mode of action of the commercial products used for synchronization in beef cows and heifers is the same mode of action as hormones produced endogenously and released during the course of the estrous cycle in the animal. Traditional estrus synchronization protocols only synchronize estrus, not ovulation. Current protocols that incorporate fixed-time AI are designed to synchronize not only estrus; but also ovulation in animals that are often in various stages of the estrous cycle when implemented. The fundamental principle of synchronization is to first control the timing of the onset of estrus (standing heat) by controlling the length of the estrous cycle. There are only a few approaches to controlling the length of the estrous cycle. The first is to regress or "kill" the corpus luteum (CL), a structure of the ovary that produces progesterone. Intentional regression of the CL before the time of natural regression, termed luteolysis, will allow the female to come into estrus, thereby shortening the estrous cycle. This intentional regression of the CL is accomplished by the exogenous administration of prostaglandin $F_2\alpha$ (PG), which is endogenously released from the uterus endometrium of the animal during the estrous cycle. The second is to administer exogenous progestins to delay the time of estrus following natural or induced luteolysis that can extend the length of the estrous cycle. Following ovulation, the female will form a CL producing progesterone. In cycling cows and heifers, progestins will not affect luteolysis. Once CL regression has occurred, progestin administration can prevent a cow or heifer from showing signs of estrus and ovulating. Additionally, gonadotropin releasing hormone (GnRH) will initiate a cascade of hormonal responses that will cause follicles greater than 8 mm to 10 mm in size to ovulate. The primary functions of an exogenous administration of GnRH, which is endogenously produced by the animal during the course of the estrous cycle, are to initiate follicle turnover at the start of a synchronization protocol and to synchronize ovulation with the delivery of semen during a fixed-time AI protocol.

Three primary groups of products are used to synchronize estrus or ovulation in beef cattle: prostaglandin $F_2\alpha$ (PG), progestins (progesterone) and gonadorelins (gonadotropin-releasing hormone; GnRH). The prostaglandin products each contain Prostagladnin$F_2\alpha$ or an analogue of Prostagladnin$F_2\alpha$. The prostaglandin products currently available for estrus synchronization are: Lutalyse® (dinoprost tromethamine), ProstaMate™ (dinoprost tromethamine), Estrumate®cloprostenol sodium) and estroPLAN® (cloprostenol sodium). The progestin products include: Eazi-Breed™ CIDR® (controlled internal drug release), an intravaginal insert and MGA® (melengestrol acetate), a feed-additive. The gonadorelin products currently approved by the FDA include: GONAbreed® (gonadorelin acetate) and Factrel® (gonadorelin hydrochloride). GONAbreed® is approved for use in combination with cloprostenol sodium to synchronize estrus cycles to allow for fixed-time artificial insemination in lactating dairy cows and beef cows. Factrel® is approved for use in combination with Lutalyse® (dinoprost tromethamine) for synchronizing estrus cycles in lactating dairy cows.

Producers should visit with a veterinarian about the products used for synchronization as a current veterinary-client-patient-relationship (VCPR) will be necessary before some of these products can be purchased. In all cases, be sure to use the correct synchronization product at the recommended time and follow Beef Quality Assurance practices when administering the products.

Protocols for Heifers; Estrus Detection Required

An inexpensive method of synchronization (Figure 31.1) is the one-shot prostaglandin protocol. However, this method involves several days of monitoring the animals for estrus. This method is based on the physiology of the CL, the structure on the ovary that produces progesterone. Though prostaglandin regresses or "kills" the CL; approximately five days prior to estrus and five days following estrus, prostaglandin has no effect on the CL. Following ovulation, it takes approximately five days for the CL to be fully functional and responsive to prostaglandin. Approximately five days prior to estrus, if not pregnant, the animal will release endogenous prostaglandin from the uterus endometrium to regress the CL naturally. By observing the animals for estrus for five days prior to the administration of prostaglandin; 1) those animals in the stage of the estrus cycles where their CL is regressing will be coming into estrus and 2) those animals that have just ovulated will take five days to form the CL and will respond to the prostaglandin injection.

Another low-cost system for estrus synchronization (Figure 31.2) uses melengestrol acetate (MGA®) and prostaglandin. MGA® is a progesterone-like feed additive, approved to suppress estrus in feedlot heifers and is not approved to synchronize estrus. In 1997, MGA® was approved for feeding 0.5 milligram MGA® daily for up to 24 days to suppress estrus in heifers intended for breeding. As heifers are often confined in a dry-lot during development and breeding, especially if artificial insemination is used, MGA® can be used in this protocol. MGA® should be fed at 0.5 milligram per head per day for 14 days in 2 pounds to 5 pounds of a highly palatable carrier (feed). It is highly recommended to feed the carrier alone for several days before administering the MGA® so the cattle become accustomed to coming to the feed bunk to eat. Females will exhibit estrus two days to five days after withdrawal of the MGA®, but the standing estrus exhibited immediately after MGA® withdrawal is subfertile and females should not be bred on the this estrus. A single injection of PG is administered 19 days after the MGA® has been removed from the feeding program. Most females will exhibit estrus 48 hours to 72 hours after the PG injection. The females will need to be monitored for signs of estrus at least twice per day and females should be inseminated 12 hours after the first observation of standing estrus.

The 7-day CIDR® protocol (Figure 31.3) involves the use of an Eazi-Breed™ CIDR® Cattle Insert, an intravaginal insert which contains progesterone. The CIDR® consists of a "T" shaped nylon backbone that is coated with a silicone layer containing about 10 percent progesterone by weight. The CIDR® is inserted into the vagina using a lubricated applicator following cleaning and disinfection of the applicator and vulva area. The CIDR® is easily removed by pulling an attached nylon cord. A small amount of vaginitis is a common observation at CIDR® removal; however, fertility is not compromised. In the absence of a CL, a CIDR® functions as an artificial CL by releasing progesterone, thereby suppressing estrus and ovulation. The CIDR® is left in the animal for seven days with PG administered at the time of CIDR® removal. Those animals that did not have a CL at the time of CIDR® removal and PG administration, will be in estrus approximately 24 hours before those animals that had a CL, as it takes approximately 24 hours for the CL to regress.

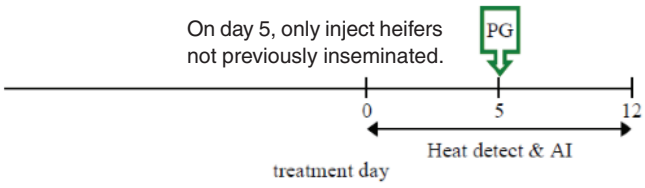

Figure 31.1 One-shot prostaglandin protocol.

Fixed-time AI for Heifers; Limited Estrus Detection

The following protocols (Figure 31.4) are similar to the Heat Detection Protocols (Figures 31.2 and 31.3) except the animals are observed for signs of estrus for a limited period of time (72 hours to 84 hours or 70 hours to 74 hours following the PG injection, respectively). At that time, all heifers that have not shown signs of estrus are to be bred and given an injection of GnRH at the time of insemination. With the Select Synch + CIDR® protocol, GnRH is recommended, as heifers responding with a new follicular wave are more likely to conceive at the clean-up fixed time insemination. The 14-Day CIDR® protocol is

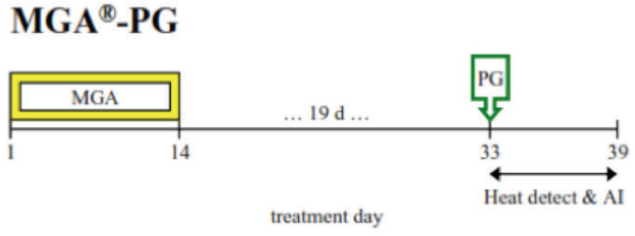

Figure 31.2 Estrous synchronization using Melengestrol Acetate (MGA®) and PGF. MGA®

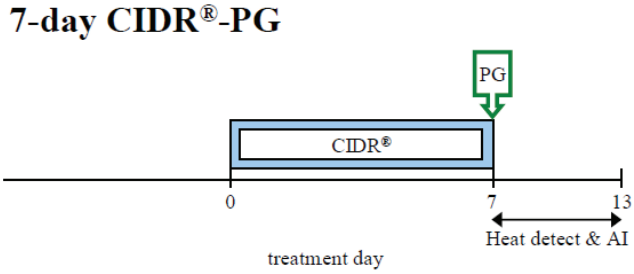

Figure 31.3. The 7-day CIDR® protocol involves the use of an Eazi-Breed™ CIDR® Cattle Insert.

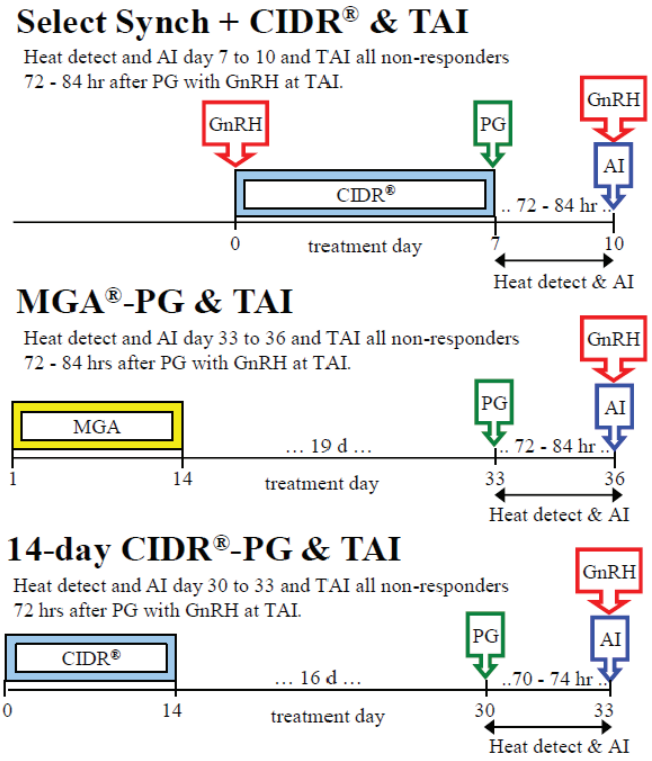

Figure 31.4. Fixed-time AI protocols for heifers with limited estrus detection.

similar to the MGA®-PG protocol except for the interval between CIDR® removal and the administration of PG, which is reduced to 16 days in the 14-Day CIDR® protocol as the progesterone in the CIDR® treated animals is cleared from the body much faster than MGA®- treated animals.

Fixed-Time AI for Heifers; No Estrus Detection

Labor required to detect estrus has limited the use of AI for some producers. Estrus synchronization protocols are currently available, eliminating the need to detect estrus, allowing AI to be performed at predetermined fixed times without reducing AI pregnancy rates (Figure 31.5). The CO-Synch protocol uses GnRH and PG to synchronize estrus and ovulation prior to fixed-time AI. The 7-day CO-Synch + CIDR® protocol for heifers is the same protocol as the 7-day CO-Synch + CIDR® protocol for cows except heifers are inseminated between 52 hours and 56 hours after CIDR® removal and cows are inseminated between 60 hours and 66 hours CIDR® removal.

The 5-day and 7-day CO-Synch + CIDR® protocols are similar, except for differences in the interval from GnRH to PG administration and the length of CIDR® treatment (5 days versus 7 days, respectively). Also, there are two injections of PG required with the 5-day protocol. These two injections of PG are required with the 5-day protocol to effectively regress accessory CL's that form as a result of GnRH-induced ovulations at the beginning of the protocol. The 5-day and 7-day CO-Synch + CIDR®

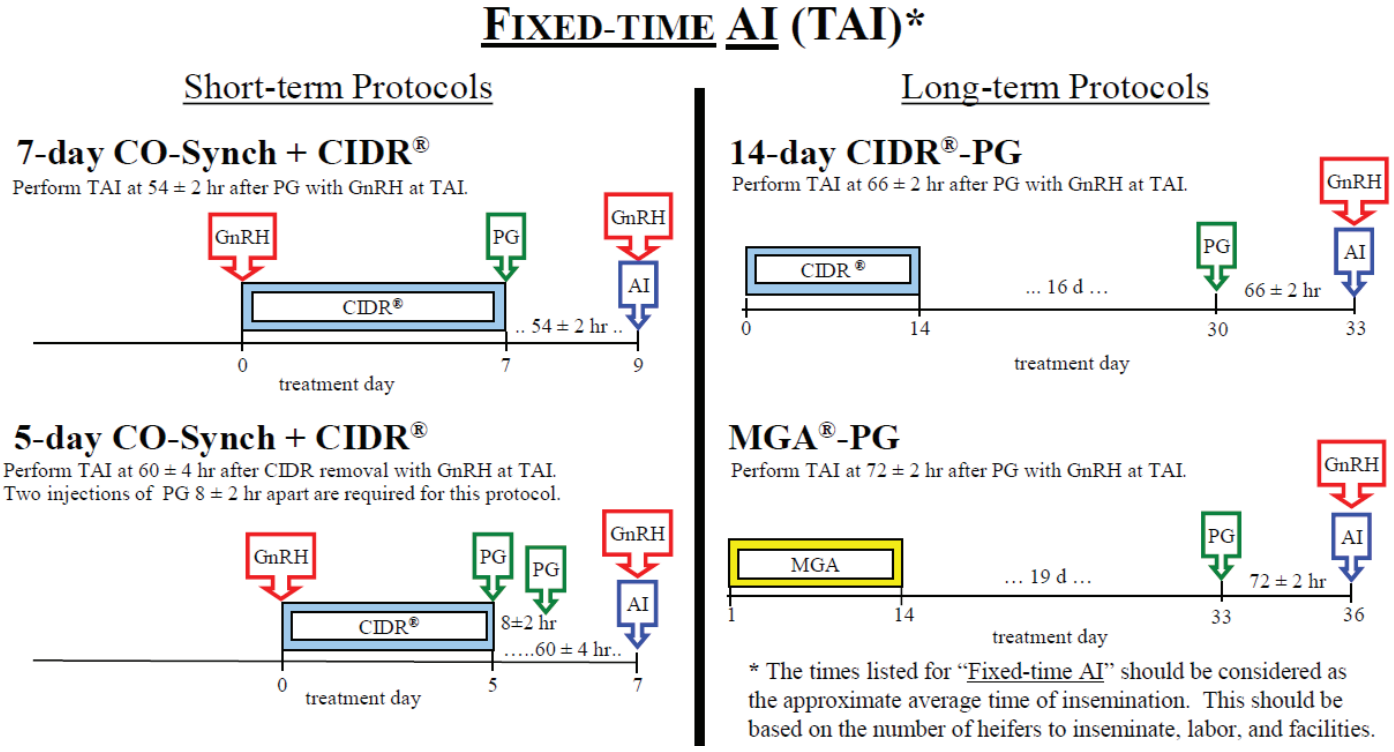

Figure 31.5. Fixed-time AI protocols for heifers with no estrus detection.

protocols have been shown to perform comparably on the basis of pregnancy rates resulting from fixed-time AI. The 5-day protocol provides an effective alternative to the 7-day protocol for use in facilitating fixed-time AI; however, the producer must take into consideration the increased labor and treatment costs associated with the 5-day CO-Synch + CIDR® protocol.

Synchronization Protocols for Cows; Estrus Detection Required

An inexpensive method for synchronizing estrus in mature beef cows is referred to is the Select Synch protocol (Figure 31.6). This protocol consists of a GnRH injection followed one week later by an injection of PG. Females are observed for signs of estrus 36 hours before and up to six days following the PG injection. Cows are inseminated 12 hours after standing estrus is first observed. Most cows will exhibit estrus by day four after the PG injection, although some may exhibit estrus up to six days after PG. Note: five percent to 20 percent of the cows showing signs of estrus 1.5 days to 2 days prior to the administration of the PG. Cows observed standing before the PG injection should be inseminated 12 hours after standing estrus is first observed. To eliminate the possibility of cows coming into estrus prior to the PG, a CIDR® may be used to suppress estrus until PG is administered on day seven of the protocol (Select Synch + CIDR® protocol). The PG

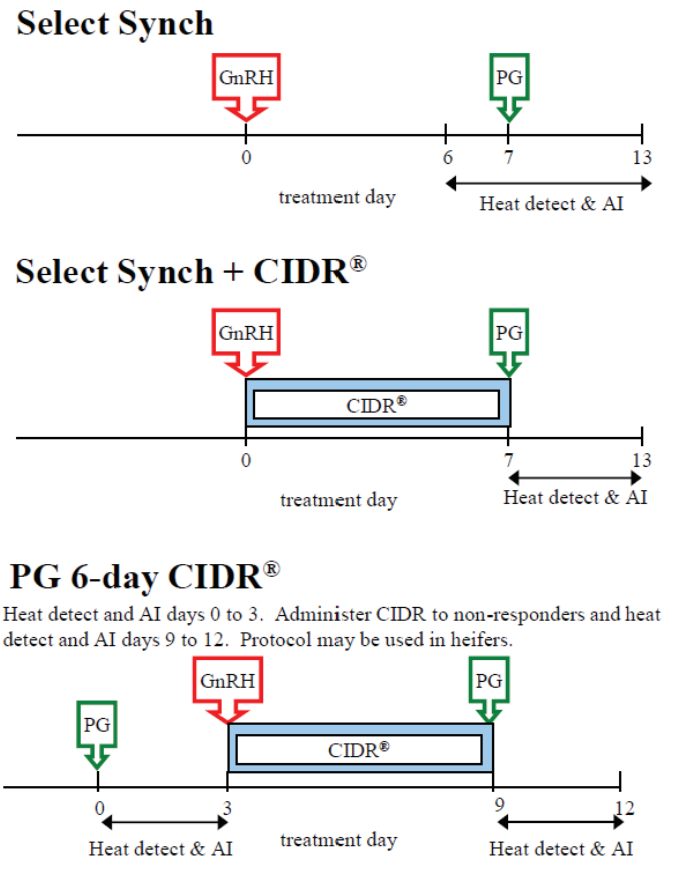

Figure 31.6. Protocols for cows with estrus detection.

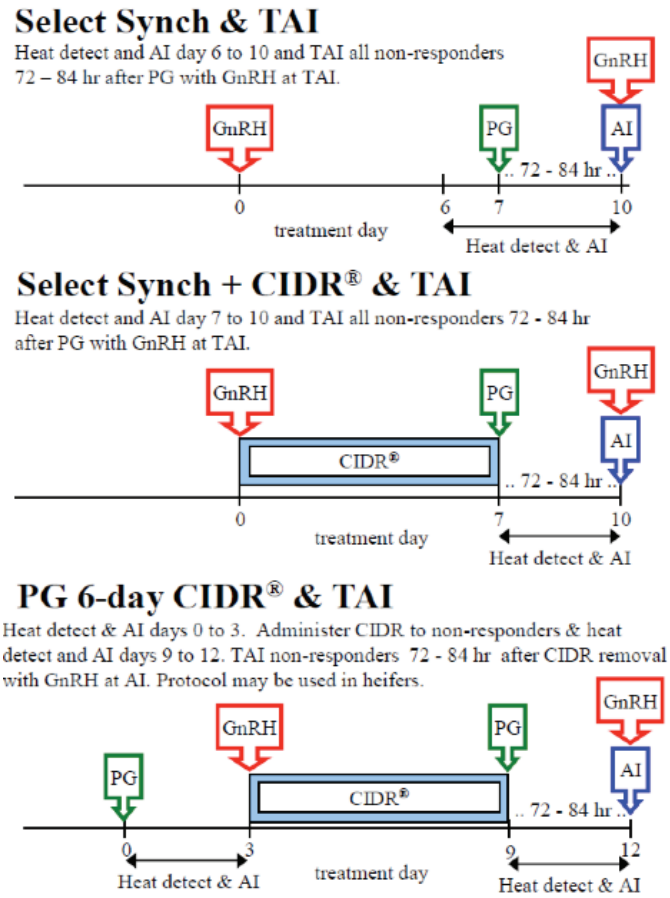

Figure 31.7. Protocols for cows with limited estrus detection.

6-day CIDR® protocol reduces the synchronization costs for any cows inseminated after the first injection of PG. More days of estrus detection are required than with the Select Synch or Select Synch + CIDR® protocol.

Fixed-time AI for Cows: Limited Estrus Detection

The following protocols (Figure 31.7) are similar to the Heat Detection Protocols (Figure 31.6) except the cows are observed for signs of estrus for a limited period of time (72 hours to 84 hours after PG). At that time, all cows not showing signs of estrus are to be inseminated and administered an injection of GnRH at the time of insemination to synchronize ovulation.

Fixed-Time AI for Cows; No Estrus Detection

The 5-day CO-Synch + CIDR® and the 7-day CO-Synch + CIDR® protocols (Figure 31.8) are both effective protocols for fixed-time AI. A slight increase in fertility (3 percent to 5 percent) has been reported with the 5-day protocol versus the 7-day protocol. The two injections of PG required with the 5-day protocol CO-Synch + CIDR® means that the animals are put back through the working facility an extra time compared to the 7-day CO-Synch + CIDR® protocol.

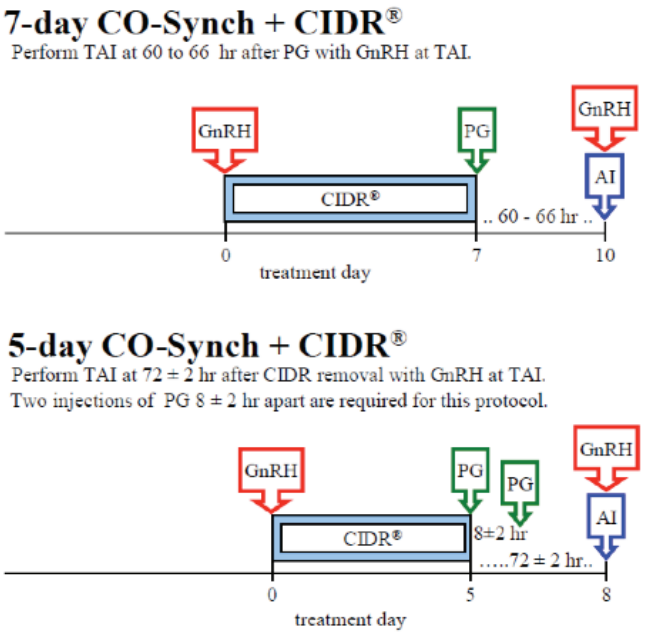

Figure 31.8. Fixed-time AI protocols for cows with no estrus detection.

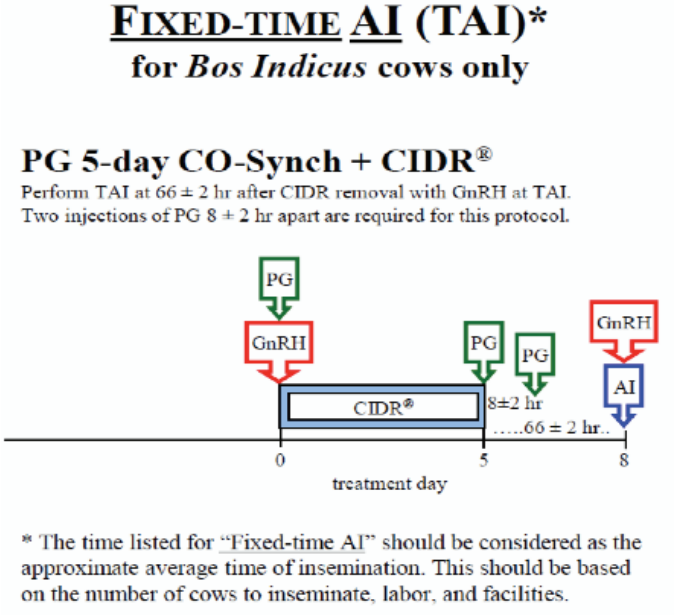

Figure 31.9. Fixed-time AI protocols for Bos indicus cows.

Synchronization systems used in *Bos taurus* do not yield consistently similar results in *Bos indicus* type cattle. The modified 5-day CO-Synch + CIDR® (Figure 31.9) has been shown to be more effective in *Bos indicus*-based breeds of cows, compared to 5-day CO-Synch + CIDR® and the 7-day CO-Synch + CIDR® protocols preferred for *Bos taurus*-base breeds of cows. The modified 5-day CO-Synch + CIDR® calls for an additional injection of prostaglandin at the start of the five-day synchronization protocol, which reduces the lifespan of the CL. One of the main concerns of this protocol is the number of times required to gather and move cattle through the working facilities, labor costs and stress-related conditions associated with cattle handling four times.

Synchronization and Natural Service

Although AI may not be desirable in all breeding program, advantages from synchronization are desirable so the producer can more closely time the calving of a group of females better utilizing labor at calving time and producing a more uniform groups of calves to market. A low cost synchronization protocol not producing a tight synchrony of standing estrus should be utilized, preferably a protocol recommend for use with estrus detection. An extremely close synchrony of a large group of females may overextend the bull power to breed the herd, as typical bull-to-cow ratios will not be adequate when using natural service with synchronization since a greater portion of the herd will be cycling at the same time. The impact of a failure to identify a sub-fertile bull or a disease problem prior to turn out is magnified with a synchronized estrus. Research from Healy et al. (1993) showed that when heifers were synchronized and bred with natural service sires, no differences in the overall pregnancy rates were observed when the bull-heifer ratio was 1-16 or 1-25 in a 28-day breeding season (Table 31.1). However the estimated days to conception, however, was less in heifer stocked at 1-16 (8 days into breeding season), compared with heifers stocked at 1-25 (11 days into breeding season).

Table 31.1. Effect of bull-to-heifer ratio on pregnancy status and date of conception.

	Bull:Heifer Ratio[a]			
	1:50	*1:15*	*1:25*	*1:16*
	Non-synchronized		*Synchronized*	
Number of bulls in pasture	2	2	4	6
Day 6 pregnancy rate, %	40	38	41	53
Day 28 pregnancy rate, %	82	77[a]	83	84[b]
Estimated day of conception after turnout	10[b]	10[b]	11[b]	8[b]

a Each pasture had 100 heifers with different number of bulls present to reach each respective stocking rate.
b Means within row lacking common superscript differ ($P<0.05$. Adapted from Healy et al., 1993)

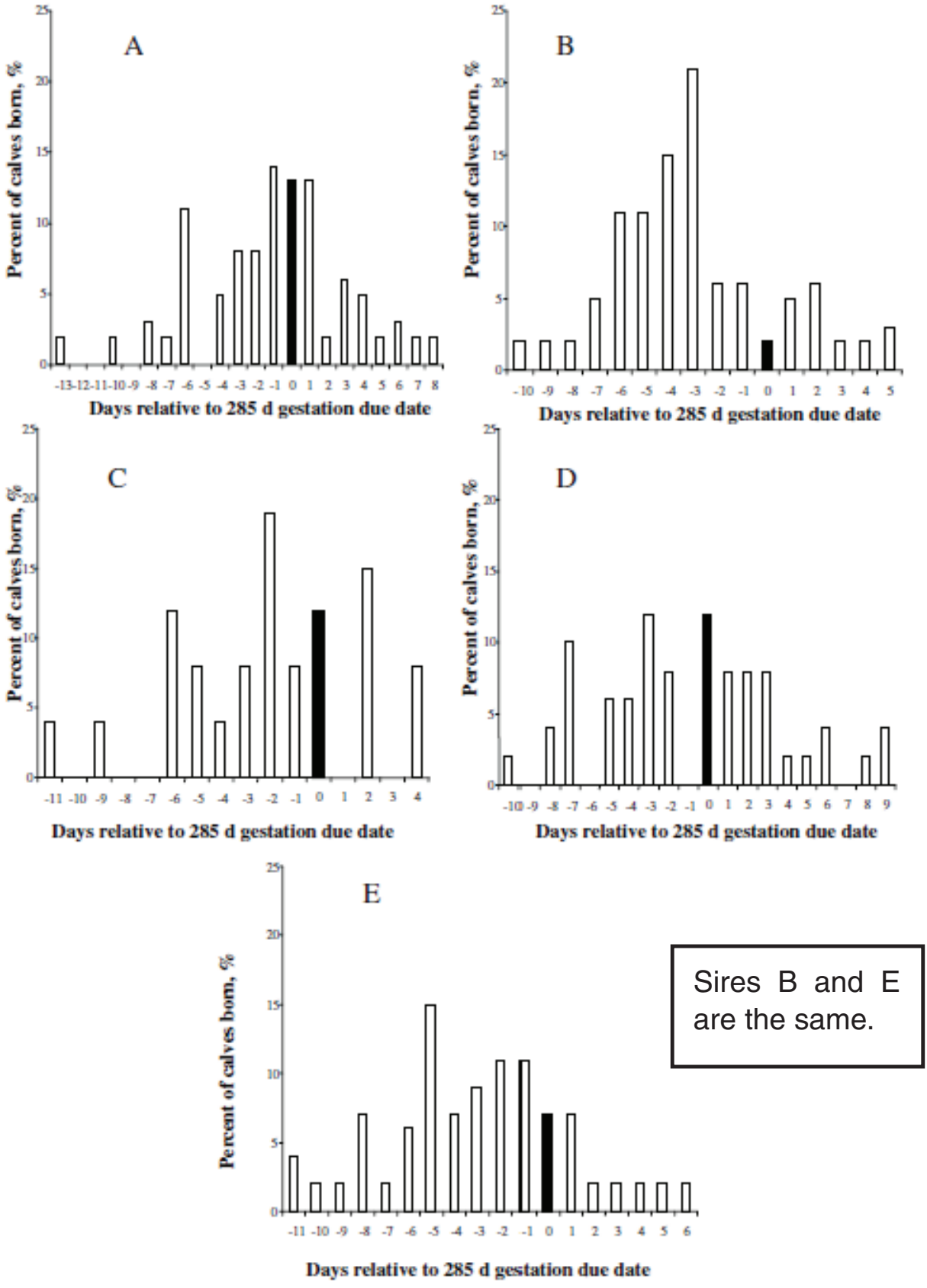

Figure 31.10. Calving distributions for cows that conceived to fixed-time AI at each location.

Guidelines for Using Bulls With Synchronization

(adapted from Johnson and Chenoweth)

1. Use a synchronization protocol recommended for use with heat detection. If the estrus synchronization protocol is one injection of PG, turn bulls out when the PG injection is given or turn bulls out and give PG five days later. For the Select Synch protocol, turn bulls out three days before PG. The tightness of synchrony achieved with a fixed-time AI protocol is not desirable in this case.
2. Use a small pasture or lot to reduce the physical energy the bull uses to travel.
3. Have a complete breeding soundness exam performed on bulls prior to use.
4. Use bulls two years to four years of age that are agile, active and known breeders. Bulls used in a multi-sire group should have their pecking order established well before turnout.
5. Use a bull to female ratio of 1-15 to 1-25.
6. Single sires eliminate bull fights, however, there is some data to indicate fertility was increased when two bulls were used.
7. Monitor activity closely during the two days to five days of most intense activity.
8. After the intense period of activity, it is best to rest the bull for two weeks or more prior to turning the bull back out. This may not be possible in small herds with only one or two bulls.

Management at Calving

There seems to be a concern from producers that if the females are inseminated on the same day, they will calve on the same day. Bader et al. (2005) showed that cows conceived on the same day gave birth to calves during a 16- to 21-day period, dependent upon the respective sire. These distributions indicate successful use of fixed-time AI will not result in an overwhelming number of cows calving on the same day(s).

References

Bader, J.F., F. N. Kojima, D. J. Schafer, J. E. Stegner, M. R. Ellersieck, M. F. Smith, and D. J. Patterson. 2005. A comparison of progestin-based protocols to synchronize ovulation and facilitate fixed-time artificial insemination in postpartum beef cows. *Journal of Animal Science* 83: 136-143.

Dahlen, C.R. 2012. Control of estrus with natural service. Proceedings, Applied Reproductive Strategies in Beef Cattle. December 3-4, Sioux Falls, SD

Ellis,R. W. 2008. Natural Service Mating with Bulls: Management Guidelines. Proceedings, Applied Reproductive Strategies in Beef Cattle. December 2-3, Fort Collins, CO.

Healy, V.M., G.W. Body, P.H. Gutierrez, R.G. Mortimer, and J.P. Piotrowski. 1993. Investigating optimal bull:heifer ratios required for estrus-synchronized heifers. *Journal of Animal Science* 71:291-297.

Johnson, S.K., R.N. Funston, J.B. Hall, G.C. Lamb, J.W. Lauderdale, D.J. Patterson, and G.A. Perry.2013. Protocols for Synchronization of Estrus and Ovulation. Beef Reproduction Task Force. http://www.northwest.ksu.edu/doc43340.ashx

Johnson, S. and P. Chenoweth. Use of Natural Service Sires with Synchronized Estrus. http://beefrepro.unl.edu/pdfs/naturalservice.pdf

Lamb, G.C. 2013. Control of Estrus in Cows. Applied Reproductive Strategies in Beef Cattle. October 15-16, Staunton, VA

Lauderdale, J. W. 2009. ASAS Centennial Paper: Contributions in the Journal of Animal Science to the development of protocols for breeding management of cattle through synchronization of estrus and ovulation. *Journal of Animal Science* 87:801–812.

Nogueira, M.F.G., P. Fernandes, R.L. Ereno, R.A.L. Simões, J. Buratini Junior, and C.M. Barros. 2010. Luteinizing Hormone Receptor (LHR): basic concepts in cattle and other mammals. A review. *Animal Reproduction*. 7:51-64.

Patterson, D.J., D.A. Mallory, J.M. Nash, N.T. Martin, and M.F. Smith. 2011. Strategies to Optimize Use of AI in Cow/Calf Production Systems: Focus on Fixed-Time AI Protocols for Cows. Applied Reproductive Strategies in Beef Cattle-Northwest. September 30 – October 1, Boise, ID.

Pruitt, R.J., L.R. Corah, D.D. Simms, and M.F. Spire. 1982. Natural mating of Estrus-synchronized Heifers and Indicators of Bull Fertility. Cattlemen's Day, Kansas State University Agricultural Experiment Station. Kansas State University, Manhattan, KS. http://hdl.handle.net/2097/7128

Yelich, J. V., and G. A. Bridges. 2012. Synchronization response: *Bos taurus* vs. *Bos indicus* cattle. Beef Improvement Federation Research Symposium and Meeting. April 18-21. Houston TX.