

Estrus Synchronization Protocols for Beef Females

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Introduction

Artificial insemination (AI) can be an effective tool for beef producers to use to make faster genetic progress in the herd. Unlike the dairy industry where cattle are handled multiple times a day, incorporation of AI can be difficult because beef cattle are not handled often or easily. Decades ago, scientists began developing methods to control the expression of estrus to decrease the amount of labor and time required for AI. An understanding of estrus synchronization protocols can be beneficial to producers considering using AI in their genetic program.

Requirements for the Control of Estrus

One of the major limitations in effectively synchronizing estrus in beef cows is that most postpartum beef cow herds consist of both anestrous and cyclic cows. Thus, for a system to effectively control estrus in all cows, it must: (1) induce death of the corpus luteum (CL), (2) control follicular growth, and (3) induce estrus and ovulation in both shallow and deep anestrous cows. Shallow anestrous cows are those that are nearing the spontaneous resumption of estrous cycles, while deep anestrous cows are several weeks from initiating estrous cycles. A good example of a deep anestrous cow is a first-calf heifer in moderate to thin body condition and only 30 days after calving. The goal, then, is to develop a system that can be delivered to all cows and result in a synchronous, fertile estrus in most cows (>70%) in the first one to four days of the breeding season.

Products Available for Use for Estrus Synchronization

Several pharmaceutical products are available to synchronize estrus in beef cattle. These products can be categorized as prostaglandins, progestins, or gonadotropin-releasing hormones (GnRH) (Table 1). All injections used to control estrus must be administered intramuscularly. It is best to administer the drugs with an 18-gauge, 1½-inch needle. The effectiveness of these products depends on the reproductive state of the female. Prostaglandins and GnRH are most effective when used to synchronize estrus in cyclic females. Cyclic females are those that are coming into estrus at regular intervals. Prostaglandins stimulate regression of the corpus luteum (CL) removing

Table 1. Products used to synchronize estrus.

	Product	Administration	Action
Prostaglandins	Lutalyse	5 ml, i.m.	Regress the corpus luteum
	Prostamate	5 ml, i.m.	
	Estrumate	2 ml, i.m.	
	In-Synch	5 ml, i.m.	
Progestins	MGA	0.5 mg/head/day	Imitate the corpus luteum
	CIDR	7 days intravaginally	
Gonadotropin-releasing hormone (GnRH) ^a	Cystorelin	2 ml, i.m.	Causes formation of a corpus luteum
	Fertagyl	2 ml, i.m.	
	Factrel	2 ml, i.m.	
	Ova-Cyst	5 ml, i.m.	

progesterone from the system which allows a follicle to grow to maturity and stimulate estrus. Prostaglandins are not effective in anestrus females because they do not have a CL. GnRH stimulates follicle rupture, formation of a CL, and recruitment of a new follicle wave. Both reproductive classes of cows have growing follicles, but GnRH is only effective when a cow has a follicle that is 9-10 mm in diameter. GnRH is typically injected at the beginning and end of most estrus synchronization protocols. Studies have shown that GnRH is effective 10%-80% of the time when used at the beginning of the protocol, so its effectiveness is somewhat random and its usefulness if injected alone to anestrus cows is very limited.

Progestins are most effective for synchronization of estrus in anestrus cows. Progestins are any substance that has progesterone-like activity and thus mimic the production of progesterone by the CL during the interval between estrus events. Long term administration of progestins synchronize estrus in nearly every female but conception rate declines if females are treated with progestins for longer than 10 days. Several protocols use 14-day treatment of females with a progestin. In these protocols, females are not inseminated on the estrus that occurs immediately after removal of the progestin. Shorter protocols use five to seven-day progestin treatments but progestin treatment alone for only 5-7 days has limited ability to synchronize estrus in cyclic cows.

Two progestins are available for use in beef cattle. Melengestrol acetate (MGA) is an orally active progestin that is approved for use to synchronize estrus in beef heifers. When fed at .5 mg/head/day, MGA effectively synchronizes estrus in most females. Feed containing MGA is available at many outlets and producers should feed the amount indicated on the label.

In June 2002, the Federal Drug Administration approved the use of the Controlled Internal Drug Releasing (CIDR) device for use in estrus synchronization of beef cows. The CIDR device is the best source of progesterone available for use. Several systems have been developed that utilize the CIDR device to synchronize estrus. A CIDR is a T-shaped device made of soft pliable plastic that is coated in progesterone (Figure 1) that is inserted into the vagina of the cow, and the progesterone is absorbed into the bloodstream. To insert the CIDR device, restrain the female, and prepare a container of clean water with a disinfectant solution. Wash the applicator with water between uses. Insert the CIDR device into the CIDR applicator by pushing the wings together; keep the tail pointed outward. Apply a lubricant to the end of the CIDR device, wipe the vagina clean, and insert the CIDR into the vagina until the device meets significant resistance. Depress the plunger and rotate the applicator approximately one-quarter turn. Best results are obtained when the tail of the device is pointed downward. If significant loss of the CIDR device is observed (> 5%), clip the tail of the CIDR so that approximately 2½ inches protrude from the vagina (For more information view the YouTube video listed below Figure 1).

Estrus Synchronization for Artificial Insemination

Heifer Systems

Synchronizing a fertile estrus in yearling heifers is a challenge. Two factors limit the conception rate to AI in heifers: puberty and follicle growth. Most systems discussed will induce puberty but controlling follicle growth to effectively synchronize a fertile estrus and ovulation is difficult.

Figure 1. The CIDR device, the applicator, and inserting the device in a beef female.



View the video on inserting the CIDR device at:

https://www.youtube.com/watch?v=j8ZHjzzuZNg&list=PLC5aJFY_Be8XJZ_03_QI73TK0826T8Fjq&index=4&t=7s.

Long-term Protocols

MGA – PG

The most reliable and proven protocol for synchronizing estrus in beef heifers is the MGA-PG system (Figure 2). This system was developed in 1988 and works well. The biggest problem with this system is it is not suitable for a fixed-time AI.

Figure 2. The MGA-PG Protocol.



In this system, MGA is fed for 14 days and prostaglandin is administered 19 days after the last day of MGA feeding. Administration of the MGA-PG system synchronizes estrus in most cyclic females and can induce estrus in most anestrous females. Also, after the long-term MGA feeding, heifers come into estrus and are in the middle of the following estrous cycle when PG is administered, thus ensuring that PG is maximally effective in stimulating the regression of the CL. Administration of the MGA-PG system to heifers usually results in estrus in approximately 80% to 100% of females. Since fertility is normal in this system, conception rates to AI usually range from 45% to 70%.

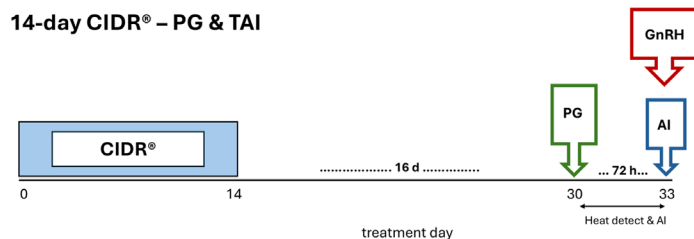
The biggest disadvantage to the use of the MGA-PG system is that it takes 39 days to complete and requires consistent intake of MGA. The MGA is normally supplied to females as a supplement to normal prebreeding diets and should be fed at a rate of 0.5 mg/head/day. It is imperative that all females consume adequate levels of MGA. Therefore, at least 2 feet of bunk space is necessary to ensure that even timid females have access to feed. Producers should also observe feeding to ensure that all females are consuming the MGA supplement. The most common failure of the MGA-PG system is the result of inconsistent, inadequate consumption of MGA.

14-day CIDR-PG & TAI

A CIDR device can replace MGA in this system. The 14-Day CIDR-PG protocol involves inserting a CIDR device for 14 days. Prostaglandin (pharmaceutical trade names Lutalyse®, Lutalyse Hi-Con®, Estrumate®, estroPLAN®, In-Synch®, ProstaMate®, Synchsure®) is administered 16 days after the CIDR device is removed. Heifers can then be observed for estrus and bred accordingly (Figure 3). If adequate labor is available, observe heifers for estrus and breed accordingly for five days after prostaglandin administration.

The number of days of estrus detection can be reduced by injection of gonadotropin hormone-releasing hormone (GnRH; pharmaceutical trade names Cystorelin®, Factrel®, Fertagyl®, Ovacyst®). In this system, estrus should be detected for 72 hours after PG. All heifers in estrus should be inseminated approximately 12-14 hours after first estrus is observed. Heifers not observed in estrus after 72 hours of observation are injected with GnRH and inseminated.

Figure 3. The 14-day CIDR-PG Protocol.

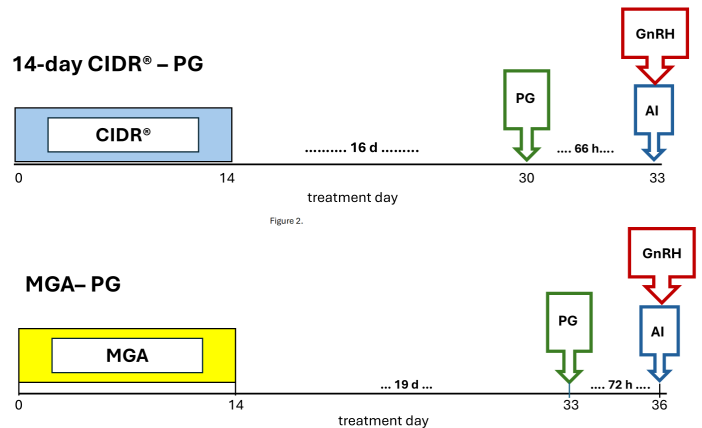


Timed insemination using MGA-PG or 14-Day CIDR-PG

Many producers simply do not have the labor or facilities to support multiple days of estrus detection and cattle handling. The MGA-PG and 14-Day CIDR-PG protocols are both suitable for timed insemination (Figure 4). Timed insemination should occur in heifers 72 hours after PG if you are using the MGA-PG system

and at 66 hours after PG if you are using the 14-Day CIDR-PG system. Females are administered GnRH at the fixed-time AI. GnRH is only necessary for females that are NOT in estrus. Therefore, if females were observed for estrus or if estrus detection aids are used, then GnRH is only given to females that have not yet been in estrus. If cows were not observed or an estrus detection aid used, then all females need to be injected with GnRH at fixed-time AI. Conception rates to timed insemination are higher when using the 14-Day CIDR-PG protocol than the MGA-PG protocol.

Figure 4. Adapting to fixed-time insemination.



Short-term Protocols for Heifers

7-Day Co-Synch + CIDR and the 5-Day CO-Synch + CIDR

One of the major drawbacks to using the MGA-PG and 14-Day CIDR-PG protocols is the length of time (33-39 days) from the beginning to the end of treatment. Three short-term protocols have been developed for use in heifers. These protocols are the 7-Day CO-Synch + CIDR, the 5-Day CO-Synch + CIDR, and the 5-Day CIDR + PG.

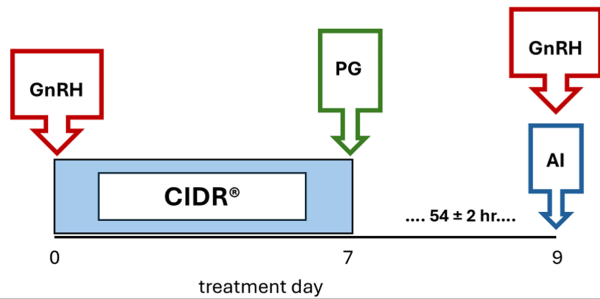
The first two systems begin with insertion of a CIDR device and an injection of GnRH (Day 0). The CIDR is removed and PG given 7 (Monday-Monday) or 5 (Monday-Saturday) days later. A second injection of PG is needed when using the 5-Day CO-Synch + CIDR system. The second injection is administered 6-10 hours after CIDR removal and the first PG injection. Timed insemination occurs about 54 hours after CIDR removal in the 7-Day CO-Synch + CIDR protocol and from 60-72 hours after CIDR removal in the 5-Day CO-Synch + CIDR protocol; most research favors the timed insemination at 72 hours.

The third system, called the 5-Day CIDR + PG protocol is a simplified version of the 5-Day CO-Synch protocol. The weakness of the 5-Day CO-Synch protocol is the first injection of GnRH which forces the addition of the second injection of PG. For the last decade we have used the 5-Day CIDR + PG protocol and observed excellent conception rate to AI. In this protocol, a CIDR is inserted for five days and PG administered at CIDR removal. The highest AI conception rates are achieved if estrus detection patches (see ASC 264) are placed at CIDR removal and heifers with activated patches at 48 hours are inseminated that evening. All remaining heifers are inseminated 72 hours after CIDR removal (see Figure 5). If the split time AI isn't possible, then inseminate all heifers at 72 hours and give GnRH. Approximately 3,000

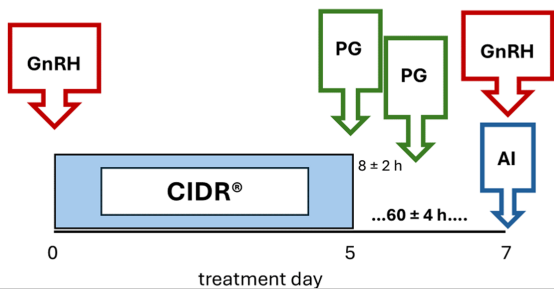
heifers have been inseminated in Kentucky using the modified 5-day CIDR + PG protocol since 2015. Conception rates to AI consistently reach 60%. Conception rates to AI are typically higher in heifers using the 5-Day systems compared to the 7-Day protocol.

Figure 5. Three protocols to synchronize estrus for fixed-time AI in heifers.

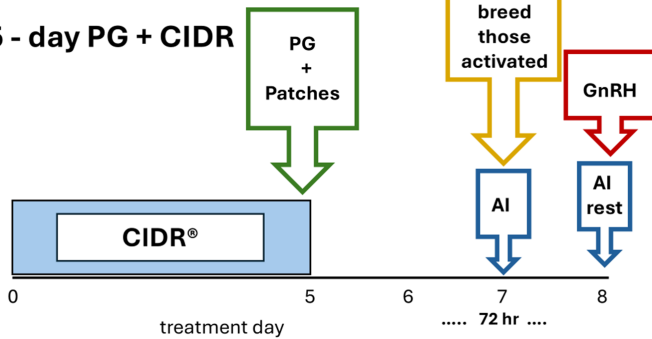
7-day CO-Synch + CIDR



5-day CO-Synch + CIDR



5-day PG + CIDR



Cow Systems

Many new systems for controlling the expression of a fertile estrus have been developed in recent years. Beef cow-calf producers have numerous ESAI protocols at their disposal. Many of these protocols can result in acceptable pregnancy rates but vary in cost, effectiveness, and implementation. To determine the appropriate system, producers need to consider several factors: 1) proportion of cows that are anestrous and the calving distribution, 2) available labor, skill, expertise, and facilities for accurate detection of estrus and stress-free handling of cattle, 3) cost of synchronization treatment, 4) value of semen, 5) availability of AI technician, and 6) acceptable level of success. Each of these factors will affect the choice of estrus synchronization protocol. A major consideration affecting the system of choice is labor availability for estrus detection and AI. Systems are available that require complete, limited, or no estrus detection (fixed-time inseminations or TAI).

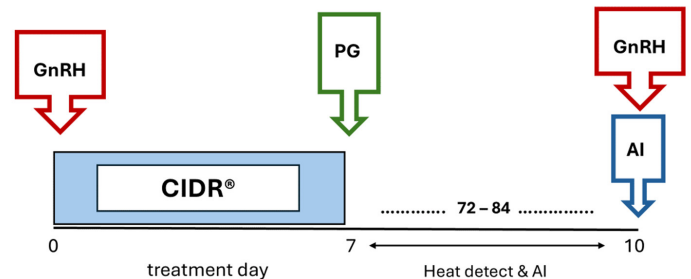
ESAI Systems with Limited or No Estrus Detection

Select Synch + CIDR & TAI

Many beef producers have neither the time nor the available labor for adequate estrus detection and the cattle handling necessary for Select Synch. Also, the availability of a quality AI technician is often limited. Thus, many producers desire protocols in which estrus detection is limited (two to three days) or cows are artificially inseminated at a fixed time (TAI). Select Synch + CIDR & TAI was developed to reduce the number of days of estrus detection. The Select Synch + CIDR & TAI begins with an injection of GnRH (100 µg) and insertion of a CIDR followed seven days later by treatment with PG and removal of the CIDR insert (Figure 6). Best management practice includes placing an estrus detection patch on females at CIDR removal. Cows are observed for estrus for 72-84 hours after PG is administered and the CIDR is removed. Cows observed in estrus are inseminated accordingly. At 72-84 hours, all cows NOT observed in estrus are subjected to TAI and are given a second injection of GnRH. Treatment of postpartum cows with Select Synch + CIDR & TAI has several advantages: 1) only three days of estrus detection, 2) inclusion of the CIDR prevents early estrus (before PG) and induces estrus in more anestrous cows, 3) results in high AI pregnancy rates. The high AI pregnancy rates are the result of combining the higher conception rates to AI following accurate estrus detection and conception that occurs in some cows that would have been missed using estrus detection alone.

Figure 6. The Select Synch + CIDR & TAI Protocol.

Select Synch + CIDR® & TAI



Select Synch + CIDR & TAI should be used for ESAI if:

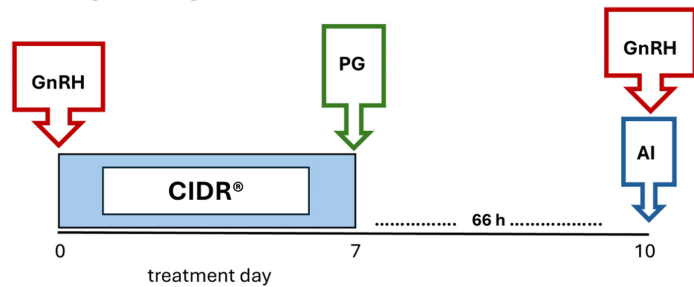
1. A large proportion of the cows are anestrous before treatment. If cows are a little thinner (BCS 4-5), the herd consists of several young cows, and many of the cows are less than 45 days postpartum, a system that includes a CIDR is necessary.
2. Facilities and labor are available for daily estrus detection and cattle handling for at least 3 days.
3. A technician is available twice daily for at least three days.
4. The value of the semen is moderate to high. When the value of the semen is high, conception rate must be maximized. Select Synch + CIDR & TAI maximizes pregnancy rates to AI but the cost is higher because all cows are inseminated. Conception rate is lower even though the AI pregnancy rate is higher.
5. Higher AI pregnancy rates are more important to the producer than the higher costs of the estrus synchronization protocol.

7-Day CO Synch + CIDR

Producers that desire systems that require NO estrus detection should use 7-Day CO-Synch + CIDR (Figure 7). In this system, all cows are subjected to a second injection of GnRH & TAI about 66 hours after CIDR removal and PG. Acceptable AI pregnancy rates can be achieved when GnRH & TAI occurs at any time from 48-72 hours after PG, but the highest AI pregnancy rates appear to occur when TAI occurs near 66 hours after PG administration.

Figure 7. The 7-Day CO-Synch + CIDR Protocol.

7 – day CO-Synch + CIDR



Systems that incorporate total TAI are more variable in AI pregnancy rate than systems that use either total or partial estrus detection. The decision to use systems with complete TAI needs to involve an assessment of your or the producer's comfortable level of risk. Systems that use total TAI involve higher risk. Several management factors can reduce the risk involved with systems that use complete TAI. First, cows must have adequate nutritional status and be in a BCS ≥ 5 (BCS scale 1-9; 1 = emaciated, 9 = extremely obese) both at calving and at the beginning of treatment. Mineral status (i.e. copper and selenium) of the cows can affect pregnancy rate and many cows in the Southeast are deficient in these two minerals. Second, cows must be at least 30 days (preferably 45 days) postpartum at the beginning of treatment. Third, minimize the number of primiparous cows that are subjected to the TAI protocol. Fourth, cows must have been previously vaccinated and dewormed at least 28 days before AI. Success is possible using TAI systems if the risk factors are minimized.

7-Day CO-Synch + CIDR & TAI should be used for ESAI if:

1. Facilities and labor are not available for daily estrus detection and cattle handling.
2. Technician availability is limited.
3. The value of the semen is low to moderate. When the value of the semen is high, conception rate must be maximized. CO-Synch + CIDR & TAI reduces conception rates to AI and the cost per pregnancy is higher because all cows are inseminated. Semen of high value should not be used.
4. Pregnancy rates of anestrous cows to this system have been acceptable but low. Reducing the proportion of anestrous cows will reduce the risk associated with TAI protocols.

7&7 Synch

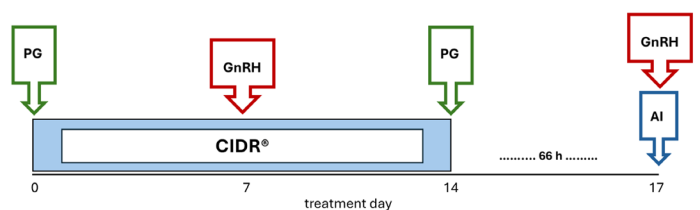
The most recently developed protocol for ESAI is the 7&7 Synch protocol (Figure 8) designed by Dr. Jordan Thomas at the University of Missouri. One of the weaknesses in most previous protocols is the effectiveness of GnRH. For GnRH to stimulate follicle rupture,

the formation of a new CL, and the initiation of a new follicle wave, the female must have a follicle on her ovary that is at least 9-10 mm in diameter. The 7&7 protocol is designed to increase the percentage of females that have large, responsive follicles when GnRH is administered. This system begins with an injection of PG and insertion of a CIDR device. Seven days later, all females are administered GnRH to stimulate rupture of the dominant follicle and initiation of a new wave of follicular growth. Seven days after GnRH, the CIDR is removed, and a second injection of PG is given to regress any remaining CL. Females are subjected for TAI 66 hours after CIDR removal and PG.

This protocol has a few advantages over others. More females are observed in estrus (10-15%) and the conception rate to AI is higher (6-8%) for the 7&7 Synch protocol compared to the 7-day CO-Synch + CIDR. Although this protocol is still fairly new, it appears to have advantages in estrous response and conception rate when used in mature cows especially when using sex-sorted semen. The effectiveness of this protocol in heifers is not clearly defined. If considering this protocol for heifers, FTAI should occur at 54 hours instead of 66 hours.

Figure 8. The 7&7 Protocol.

7 & 7 Protocol



Resynchronization of Estrus

The CIDR device can also be used to synchronize return heats in females previously subjected to estrus synchronization and AI. To resynchronize estrus (Figure 9), a CIDR device is inserted 21 days after the previous AI date. Seven days later, the CIDR device is removed, and pregnancy is determined using either transrectal ultrasonography (consult your herd veterinarian) or by using a chute-side blood sampling kit (Alertys, IDEXX Inc). Females that are pregnant receive no further treatment. Females that are not pregnant receive prostaglandin and an estrus detection patch is placed on the females tailhead (see ASC 264). Females are time inseminated 66 hours after the CIDR is removed. Preliminary data using Resynch appear excellent. In this trial with over 3,000 females, 83% of all females conceived to AI with some farms exceeding 90%. This resynchronization protocol can result in high pregnancies with reasonable labor inputs. For example, one farm in this trial had 35 cows and average facilities for handling beef cattle. This producer used Resynch in 2021-2023 and then exposed the females to a borrowed bull for 30 days. This farm averaged 86% AI pregnancy rates and 97% overall pregnancy rates. To achieve 86% AI, this producer worked his cattle 6 times in a month. On average, it took 2.5 hours to work the cattle including the time involved to get the cattle up. This producer hired one laborer and an AI technician with a total labor cost of \$950 (30 hours at \$20/hour plus \$10 per cow for the technician). This producer used sex-sorted semen and averaged 30 steers to sell each year instead of 17. Resynchronizing estrus for AI can be

a more economical approach to breeding for small (20 cows or fewer) beef cattle operations.

Reuse of a CIDR device is not approved by the FDA and is not recommended by its manufacturer. Reuse of the CIDR devices can lead to increases in vaginal infection that could reduce fertility. Additionally, the concentration of progesterone released by the previously used CIDR devices may not be adequate for effective estrus synchronization. Unpublished data have demonstrated that the effectiveness of the CIDR device is reduced in once- and especially twice-used CIDR devices.

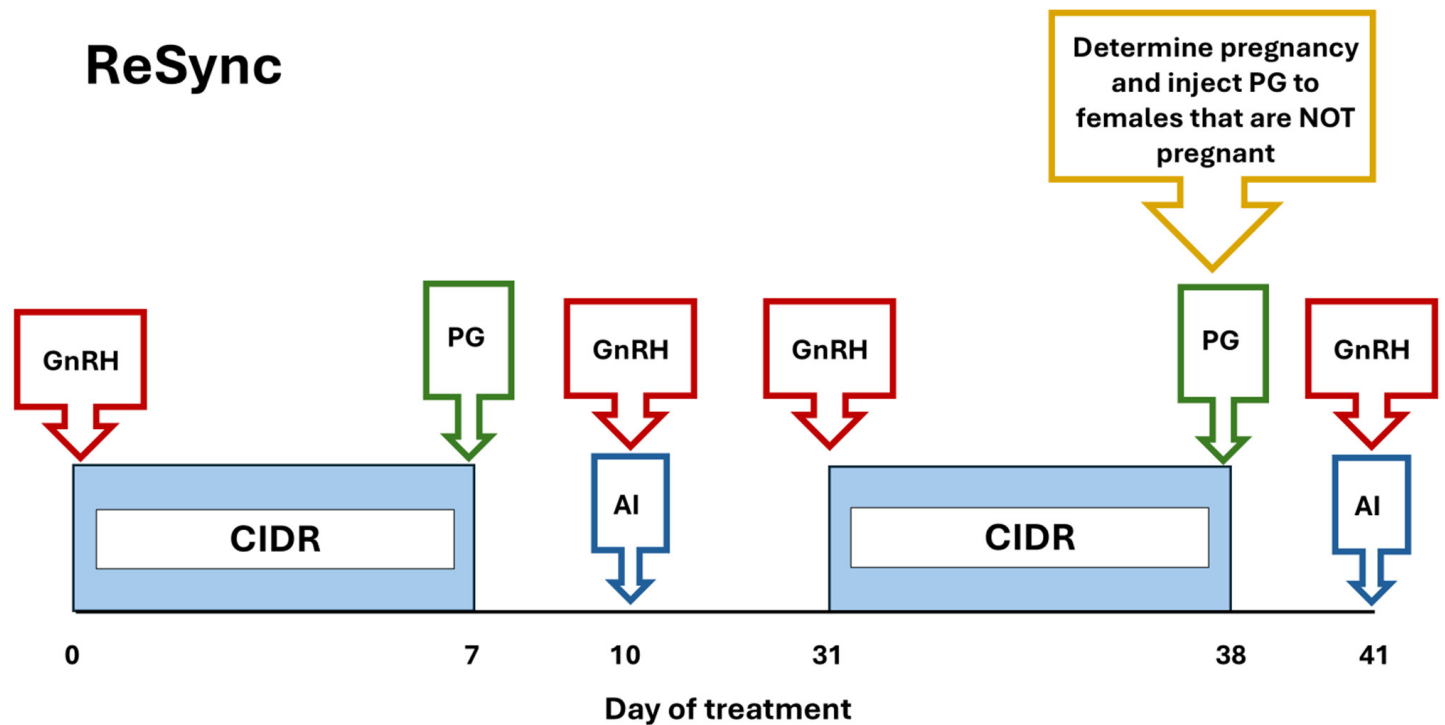
Many cattle producers reuse CIDR devices. If a CIDR device is to be reused, care must be taken to ensure that the device is clean. Immediately after removal, wash the CIDR devices with a limited amount of water and a soft-bristled brush. Do not soak the CIDR devices. After cleaning, the CIDR devices should be dipped in a disinfectant, rinsed with clean water, and allowed to dry.

The best possible option for reusing CIDR devices is to get them sterilized using an autoclave. An autoclave uses heat and pressure for sterilization. Many veterinarian offices have autoclaves and may be willing to sterilize CIDR devices. CIDR devices can be safely reused once in a 365-day period.

Summary

Numerous protocols can synchronize a fertile estrus in beef females. Unfortunately, the industry does not have one protocol that works for every female on every farm in every situation. Also, every protocol has the potential to succeed and fail so the perfect protocol for every producer does not exist. To minimize risk and maximize satisfaction, producers need to consider the goals of their operation, the amount of labor available, access to adequate facilities, the degree of investment necessary to reach production and/or marketing goals.

Figure 9. The Resynch protocol for mature cows. Estrus is synchronized using the 7-day CO-Synch + CIDR protocol. Twenty-one days after FTAI, a CIDR is inserted, and GnRH is administered to every female. After seven days, the CIDRs are removed, and pregnancy is determined in all females using either the chute-side pregnancy kit (Alertys, IDEXX) or by ultrasonography. Open females are administered PG and inseminated 66 hours later. Pregnant females are untreated.



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