Ovsynch, CO-synch, Presynch and Kitchensynch: How did breeding cows get so complicated?

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It is still possible to maintain good reproductive performance in dairy herds without estrus synchronization, but it requires a **sound heat detection program**. Unfortunately, maintaining an efficient heat detection program and quality heat detection personnel can be a never-ending challenge in today's expanding herds. As the accuracy and efficiency of estrous detection declines, the value of incorporating estrus synchronization into the reproductive management program increases proportionately. By grouping cows that calve within a one- or two-week window, programmed breeding allows producers to systematically synchronize and A.I. cows for maximum pregnancy rates with minimal labor inputs. Although it's easy to get confused by the variety of systems available, this variety provides extraordinary flexibility in developing tailor-made reproductive management programs.

How Do You Know if You Need a Synchronization Program?

The primary measure of reproductive performance that is almost immediately impacted by synchronization is days to first breeding (DFB). With a 60-day voluntary waiting period (VWP), the average DFB for a herd with exceptionally good heat detection efficiency (greater than 70 percent) will be the range of approximately 75 days. If average DFB in your herd exceeds 80, you could likely benefit from a systematic breeding program. Even if the average DFB is within an acceptable range, it's important to consider the variation as well. Poor reproductive performance often creates a sense of urgency to breed every cow at every heat for fear that she may not be observed at the return estrus if we let her go by. This results in "bending the rules" with increased numbers of cows being bred as early as 30 to 40 days after calving. These "early" and often less fertile breedings offset the cows that are not bred until 100 to 120 days in milk (DIM) resulting in what may appear to an acceptable "average" DFB. In reality, considerable opportunities may exist to improve reproductive performance through reduced variance in DFB using systematic breeding programs. Any herd with cows greater than 100 DFB presents a considerable opportunity for programmed breeding to demonstrate a significant return on investment.

> **How do you know if your herd needs a synchronization program?**
>
> If your days to first breeding exceeds 80, you may benefit from a systematic breeding program.

The interval between breedings is another good indicator fo the opportunities for programmed breeding to return on investment in a given herd. With timely pregnancy diagnosis at 30 to 45 days and prompt reinsemination, very few cows should exceed 50 to 55 days between breedings.

However, the traditional method of injecting cows with prostaglandin at open diagnosis typically results in about half of them rebred in three to five days, while the other half often "slip through the cracks," resulting in extended intervals to rebreeding. Implementing timed breeding protocols to open cows at open diagnosis "ensures" they will be reinseminated in a timely fashion.

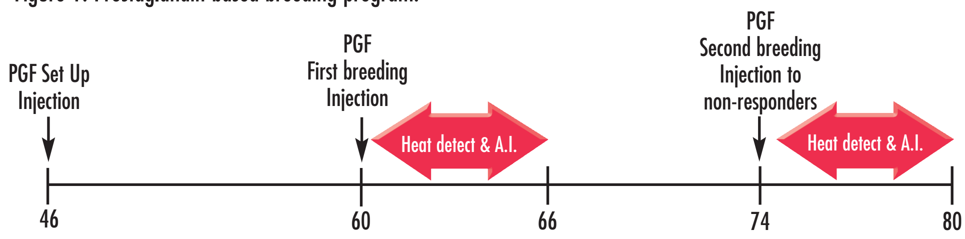
The Basics of Synchronization - Prostaglandin F2α (PGF)

The foundation hormone of any synchronization protocol is PGF. As in the naturally cycling cow, PGF brings cows into heat by removing the CL and the inhibitory effects of progesterone on gonadotropin (FSH and LH) secretion. However, PGF alone has several distinct limitations. First, PGF is not effective in animals that do not have a CL. This includes prepubertal heifers, anestrous cows, or cycling females in the first five to six days of the estrous cycle. Secondly, PGF has no effect on follicular waves. Cow-to-cow variation in the size of the dominant follicle at the time of PGF injection results in considerable variation in the interval to estrus following PGF injection. Cows with large follicles at PGF injection may display estrus within 36 to 48 hours, whereas those with small follicles or in between waves at the time of PGF injection may not respond for four or five days. That's why fixed-time A.I. after PGF alone seldom produces acceptable results. However, PGF alone is a very effective management tool if most cows are cycling and if the heat-detection program is intense enough to catch animals as they respond.

Prostaglandin-Based Breeding Programs

In prostaglandin-based breeding programs, often referred to as Target Breeding or Monday Morning Breeding Programs, groups of cows are injected with PGF as they reach the VWP and are bred to detected estrus for the next three to five days. Cows not inseminated after the first injection are reinjected 14 days later and observed for estrus for another five days. A set-up PGF injection 14

Figure 1. Prostaglandin-based breeding program.



days before the first breeding injection will help to improve estrous response at this first breeding opportunity.

Prostaglandin-based breeding has the advantage of being simple, inexpensive, and easiest to schedule and implement. Because cows are only bred to detected estrus, PGF-based breeding provides flexibility if circumstances dictate an injection must be moved up or back a day or two. However, disadvantages are that PGF is not effective in anestrous cows or cows in the early stage of the estrous cycle. In addition, considerable cow-to-cow variation in the interval to estrus after PGF is not conducive to fixed-time A.I. and success is dependent on good heat detection and high levels of cyclicity. All herds using PGF-based breeding programs should consider more effective GnRH-PGF based fixed-time A.I. options for cows that were not detected in estrus and bred within two to three weeks of the VWP.

GnRH-PGF Based Breeding Programs

Gonadotropin-releasing hormone (GnRH) is commonly recognized by its brand names of Cystorelin, Factrel, Fertagyl, and OvaCyst. Similar to the natural release of GnRH at initiation of standing estrus, an injection of GnRH (100 µg) causes an LH surge that ovulates or luteinizes most large follicles present in the ovaries. All cows then start a new follicular wave one to two days later. When GnRH is followed by a PGF injection seven days later, most cows will possess mature dominant follicles of similar size at CL regression, resulting in a more synchronous heat response (Wolfenson et al., 1994).

Additionally, the GnRH induced luteinization of dominant follicles will stimulate cyclicity in many anestrous cows (Stevenson et al., 2000). There are several variations of GnRH-PGF based breeding programs commonly used in dairy herds. Each system operates from the same basic framework of GnRH and PGF administered at seven-day intervals, but vary in how animals are handled for heat detection and A.I.

Ovsynch

Ovsynch is a fixed-time A.I. synchronization protocol that has been developed, tested and used extensively in lactating dairy cattle (Pursley et al., 1997 & 1998; Stevenson et al., 1999). The protocol builds on the basic GnRH-PGF format by adding a second GnRH injection 48 hours after the PGF injection. This second GnRH injection induces ovulation of the dominant follicle recruited after the first GnRH injection. Animals are inseminated at eight to 18 hours after the second GnRH injection. Cows expressing estrus early should be inseminated like any cow in heat and do not need to be injected with GnRH.

Across large numbers of dairy cattle, pregnancy rates to Ovsynch typically average in the 30 to 40 percent range. Although these numbers may not appear impressive at first, it is important to understand them in terms of an applied reproductive management program. Records from DHIA processing centers suggest that the average dairy producer only detects 40 percent of the eligible heats in the herd and then only gets a 40 percent conception rate. Thus, in a 21-day period, the effective pregnancy rate in the average dairy herd is only about 16 percent. In that context, a 30 percent pregnancy rate to a single fixed-time A.I. without heat detection doesn't sound so bad.

Although Ovsynch allows for acceptable pregnancy rates without heat detection, it does not necessarily eliminate the need for heat detection. Ovsynch-treated animals should be observed closely for returns to estrus 18 to 24 days later. Additionally, up to 20 percent of treated cows will display standing estrus between days six and nine of the Ovsynch protocol (Geary et al., 2000; DeJarnette et al., 2001a & 2001b). Conception rates of these animals will likely be compromised if bred strictly on a timed-A.I. basis.

CO-Synch

CO-Synch is an alternative to Ovsynch that is used more extensively in beef herds (Geary et al., 2001). CO-Synch eliminates one animal handling by breeding cows "coinciding" with the second GnRH injection. Most field trials indicate only a small reduction in conception rates when CO-Synch is compared to

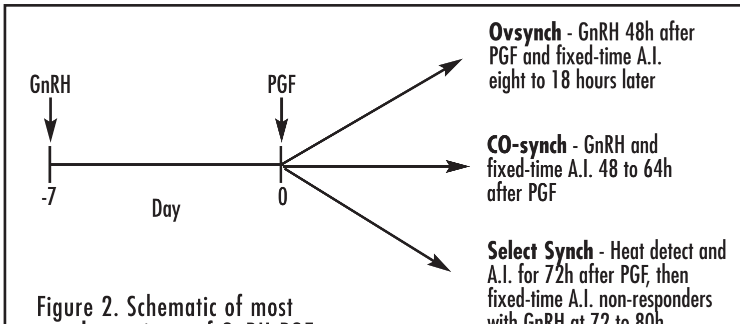
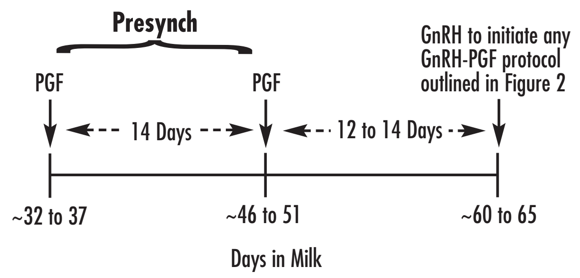


Figure 2. Schematic of most popular variants of GnRH-PGF based breeding programs.

Figure 3. Schematic diagram of Presynch protocol.



Ovsynch (Pursley et al., 1998; Geary et al., 2001; DeJarnette and Marshall, 2003). As with Ovsynch, pregnancy rates are maximized if early heats (± 24 hours of PGF) are visually detected and bred using the a.m.-p.m. rule.

Select Synch

Select Synch is a breeding option for those herds with good heat detection programs and that prefer to breed cows based to standing estrus. Cows are either bred to detected estrus for three to five days after PGF (Option 1; Geary et al., 2000) or bred to estrus for 72 hours after PGF with nonresponders time bred at 72 hours with a concurrent injection of GnRH (Option 2; DeJarnette et al., 2001a, 2001b; 2003). This approach allows most cows (50 to 70 percent) to be bred at standing estrus and gives all cows an opportunity to conceive with the clean-up A.I. at 72 hours.

The Select Synch approach saves on hormone costs because only those cows that fail to show estrus receive the second GnRH injection. Select Synch also facilitates more efficient use of expensive or genetically valuable semen by targeting its use in cows at estrus, whereas less expensive semen can be reserved for the timed-A.I. services.

Presynch

Although the initial GnRH injection is 90 percent effective at turning over follicles if cows are between days five and 12 of the estrous cycle, only 50 percent of cows between days 13 and 17 of the cycle have follicles that are capable of responding (Geary et al., 2000; Vasconcelos et al., 1999). Cows that fail to respond to the first GnRH injection may come into estrus early (36 to 48 hours before the PGF) or will have follicles that are "out of synch" at the time of PGF injection. Presynch, as the name implies, is a protocol that "pre-synchronizes" cows to the early stage of the estrous cycle for optimum response to GnRH, and thereby improves pregnancy rates to Ovsynch (Moreria et al., 2000; El-Zarkouny et al., 2004). Presynch involves the use of two PGF injections, given at 14 days apart, with the last injection given 12 to 14 days before initiation of any GnRH-PGF based breeding protocol previously described (Figure 3).

When considering a Presynch program, each herd manager must carefully consider and answer the following question: *Am I implementing a Presynch program for Ovsynch or a PGF-based breeding program followed by Ovsynch of all cows not detected in estrus?* With a true Presynch program, the set-up PGF injections will be given prior to the VWP. Breeding cows after these early heats will likely result in compromised conception due to incomplete uterine involution. Also, pregnancy rates to Ovsynch may be reduced due to a higher percentage on non-responding, problem cows remaining eligible for treatment. Thus, implementing Presynch, but actually practicing PGF-based breeding, may actually decrease rather than improve reproductive performance of the herd. As described previously, PGF-based breeding followed by Ovsynch is certainly a cost effective program to implement in many herds; however, producers must recognize the distinction and appropriately schedule PGF breeding injections to occur after the VWP.

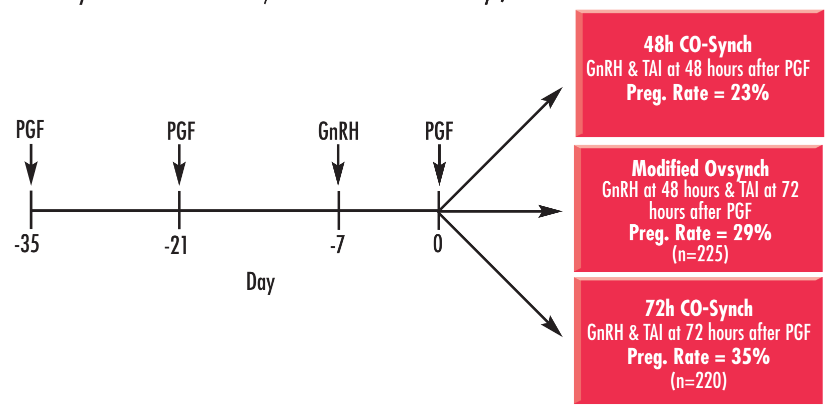
Recent Research in "User-Friendly" Applications

A major limitation to many synchronization protocols is the complexity and "hassle factor" associated with implementation. In many herds there is a single time during each day that is most convenient to handle or "lock-up" cows for routine management (injections, reading chalk rubs, A.I., etc.). The eight- to 18-hour interval from second GnRH to A.I. means cows must be handled when it may be inconvenient to do so.

Recognizing the "hassle factor" as a major limitation to successful implementation of programmed breeding, Dr. Jeff Stevenson of Kansas State University designed a project to investigate the fertility potential of several "user friendly" options. Each protocol evaluated was designed to keep the timings of all injections and/or A.I. in multiples of 24 hours so that a single daily lock-up could be used to administer all injections and A.I. The first treatment was the CO-Synch protocol, wherein all cows received both GnRH and timed A.I. at 48 hours after PGF. The second treatment was a modified Ovsynch that includes a GnRH injection at 48 hours after PGF and A.I. 24 hours later (72 hours after PGF). The third treatment was a 72-hour CO-Synch (GnRH and fixed-time A.I. at 72 hours after PGF). All cows also received the Presynch protocol as previouslu described. Across two herds with over 200 cows per treatment, the trends were the same and 72-hour CO-Synch achieved the greatest pregnancy rates (Figure 4).

Compared to Ovsynch, the 72-hour CO-Synch also eliminates one animal-handling event. Although many cows will display estrus during the 72-hour interval between PGF and timed A.I., by design of the experiment, these cows were only inseminated at the pre-assigned fixed time. In practice, Select Synch with the 72-hour time-breeding option will facilitate greater conception rates by

Figure 4. Schematic diagram of treatment protocols and results of fertility comparison of three "user-friendly" options of implementing a GnRH-PGF based timed A.I. (TAI) protocol. Each protocol was designed to keep all animal handling events scheduled at 24-hour intervals such that a single daily lock-up can be used to implement the protocol. (Adapted from unpublished data provided by Dr. Jeff Stevenson, Kansas State University.)



breeding these early cows to estrus and reduces hormone costs by omitting the second GnRH injection in cows detected in estrus. This approach would be very complimentary to implement in herds with a good heat detection or tail-chalk program. An important qualifier to this study is that all cows were "Presynched," which will tend to reduce the number of cows that display estrus "early" (less than 48 hours after PGF). Herds that want to breed cows exclusively to timed A.I. should not attempt to use the 72-hour CO-Synch approach without also implementing Presynch.

The Newest Synchronization Tool to the U.S. Market

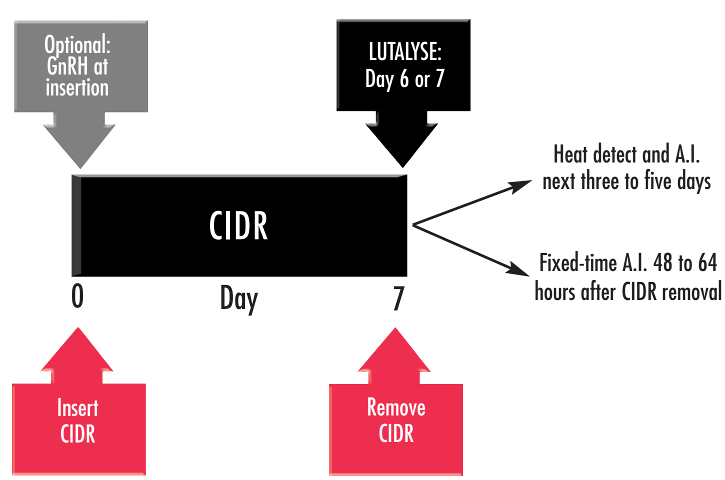
The EAZI-BREED™ CIDR® or as it's most commonly called, "CIDR," is the newest synchronization product to the U.S. market (Lucy et al., 2001). The CIDR is a T-shaped vaginal insert that delivers the natural hormone progesterone over a seven-day implant period. During the normal estrous cycle, progesterone is produced by the corpus luteum (CL) on the ovary and has two primary functions. In cycling cows, it prevents them from coming into estrus, whereas in pregnant cows, progesterone is the primary hormone responsible for pregnancy maintenance. Any use of the CIDR could be considered similar to placing an artificial CL in the cow. Progestin stimulation helps to induce cyclicity in anestrous cows and advances puberty in beef heifers.

Used with an injection of LUTALYSE® on day six or seven and insert removal on day seven (Figure 5), research has shown the CIDR to be a very effective means to synchronize estrus in both cycling and noncycling cows and heifers. Females are bred eight to 12 hours after observed estrus for the next three to five days or at a single fixed time 48 to 64 hours after CIDR removal. The extra animal handling to give LUTALYSE on day six versus day seven may reduce the average interval to estrus by about 12 hours with a slight improvement in synchrony of response, but will have no impact on the overall rate of estrus. Research in beef (Lamb et al., 2003; Stevenson et al., 2003b; Larson et al., 2004) and dairy cattle (Ryan et al., 1995) suggests pregnancy rates, especially among anestrous cows, may be improved by inserting the CIDR at GnRH injection and removing the CIDR at the LUTALYSE injection of the many popular GnRH-PGF protocols such Ovsynch, CO-Synch and Select Synch.

So You Synchronized the First Breeding, Now What?

Systematic breeding programs such as those previously described have greatly enhanced dairy producers' abilities to schedule and strategically control the interval to first service after calving. Reducing days to first service usually translates into improved reproductive performance, as measured by other traits such as average days open and calving interval. However, some herds have found that despite this improved timeliness and efficiency of first A.I., other barometers of reproductive performance may not have changed. This is often a symptom of a common misconception that systematic breeding programs eliminate the need for estrus detection. Although strate-

Figure 5. Schematic diagram of synchronization applications using the EAZI-BREED CIDR.



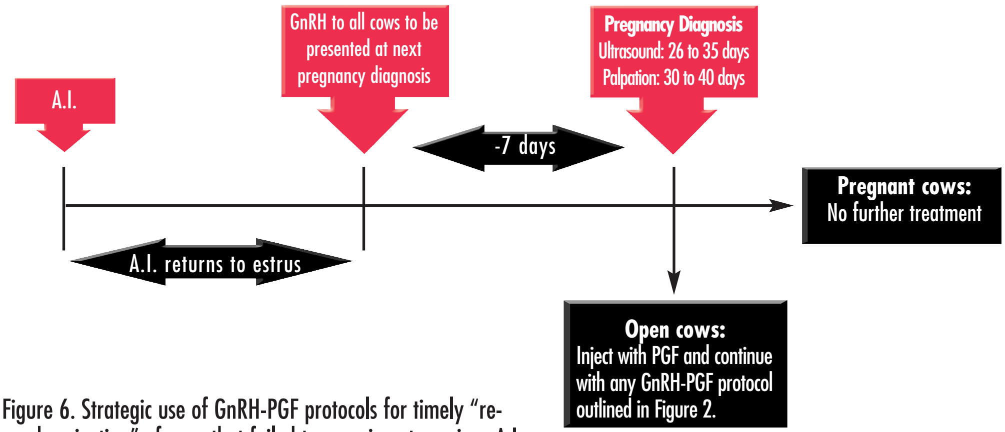


Figure 6. Strategic use of GnRH-PGF protocols for timely "re-synchronization" of cows that failed to conceive at previous A.I.

gic and systematic use of these programs ensures that 100 percent of the herd receives the first A.I. within a reasonable amount of time after calving and usually results in a 30 to 35 percent pregnancy rate at first A.I., 65 to 70 percent of the herd is still open! What happens to these cows now becomes the limiting factor to improved reproductive performance in the herd. Many producers are beginning to recognize tremendous opportunities for return on investment from adoption of systematic "rebreeding programs."

The quickest and most economical method to rebreed open cows is to take advantage of the synchrony created at first A.I. to strategically implement a targeted heat detection program to identify cows for breeding as they return to estrus. The efficiency of such a program is greatly enhanced by estrus-detection aids such as tail chalk, tail paint, KAMARs® or the new Estrus Alert® patches. Additionally, the EAZI-BREED CIDR is the only product approved for synchronization of the returns to estrus in lactating dairy cows (Chenault et al., 2003). In this application, the CIDR is inserted 14 ± 1 days after A.I. and is removed seven days later (day 21 ± 1 of the estrous cycle). Many of the open cows will have a synchronous return to estrus over the next three or four days. In the resynchronization application, cows should ***not*** be injected with Lutalyse, or any other prostaglandin, as this would cause pregnant cows to abort. Although several trials indicate improvement in various measures of reproductive efficiency, economic analysis of the return on investment from use of the CIDR in this manner are not available and will likely vary greatly from herd to herd depending on conception rates at initial A.I. and disparity in efficiency of detection of returns to estrus with or without CIDR resynchronization.

With conventional reproductive management, detection and re-insemination of open cows is accomplished by pregnancy diagnosis at 30 to 40 days after A.I. and injecting open cows with PGF. This is a least-cost approach that works fine ***if*** the heat detection program is sufficiently intense to detect cows as they respond to PGF. Unfortunately, despite best efforts in many herds, a high percentage of these open cows are ***not*** detected and rebred by three to five days after PGF which often results in extended intervals to rebreeding and excessive days open. A recent study indicates open cows bred to estrus for 72 hours after PGF followed by fixed-time A.I. at 72 to 80 hours had an interval from calving to conception that was more than 20 days shorter than open cows bred only to observed estrus following PGF at open diagnosis (Stevenson et al., 2003a).

Alternatively, opens cows can be treated with Ovsynch or any of the time-breeding programs previously described. These open cows can be treated immediately as a separate group or simply included with the next group of cows scheduled for first service, synchronized breeding. This ensures 100 percent of the open cows will be re-inseminated ten days from initiation of treatment. A downside to this approach is the accumulating cost of days during the re-synchronization period. Using a typical value of $3 per day for cost of day open, your open cows may cost you $30 each in unrealized income during the 10-day treatment interval to rebreeding. These costs may be reduced by initiating the GnRH injection of the rebreeding protocol seven days prior to the pregnancy diagnosis (Chebel et al., 2003; Fricke et al., 2003; Figure 6). At pregnancy diagnosis, pregnant cows receive no further treatment, whereas open cows continue with the rebreeding protocol and are rebred three days later. Although this resynchronization approach requires some GnRH to be "wasted" in pregnant cows, the cost is usually easily offset by the seven-day reduction in the interval to repeat insemination for open cows (approximately $21 savings per open cow). The timeliness of all re-breeding protocols can be further optimized by use of ultrasound to diagnose pregnancy as early 25 or 26 days after breeding. Regardless of the re-synchronization option chosen, it is extremely important to keep and use accurate records and procedures to ensure pregnant cows are not inadvertently injected with prostaglandin and/or re-inseminated as either will result in an abortion.

Deciding What's Best

Although systematic breeding protocols can be somewhat complicated and cumbersome to implement, they have proven time and again to be an effective means to manage and control the intervals to first and repeat service. The argument that systematic breeding is "too expensive" seldom "holds water" because the alternative usually means even greater losses in unrealized income as a function of poor heat detection and excessive days open. Few herds would not benefit from implementation of some form of systematic breeding. Which system is best for your herd depends on numerous factors including: estrus-detection efficiency, conception rates, herd cyclicity, and competency of employees and management to implement program requirements. However, complacency or lack of commitment to comply with protocol specifications will usually result in increased breeding cost with little or no improvement in reproductive performance. Thus, the question each dairy producer must ask is not "Which system works best?" but rather, "Which system can my herd management implement most efficiently?"

Deciding what's best means working past the point of thinking of estrus-synchronization protocols as being too many or too complicated, but instead, simply tools in your reproductive toolbox. Work with your veterinarian and reproductive management team to determine which tool is most likely to optimize reproductive performance and profitability in your herd.

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