Historically, estrus synchronization has been promoted as a labor saving tool for those producers who want to capitalize on the superior genetics available through use of AI. However, the labor saving aspect is peanuts compared to the economic returns available when estrus synchronization is used as a “reproductive management tool”.

Before we delve too deeply into discussion, it’s important to get dairy and beef producers speaking the same language. Beef producers typically breed cows during “breeding seasons” while dairy producers attempt to get cows pregnant shortly after a “voluntary waiting period.” Breeding season and voluntary waiting period are different ways of saying the same thing. In each case, we want all animals to conceive within a reasonable amount of time after calving (45 to 90 days). This is essential to maintenance of a short (12 to 13 month) calving interval and is a primary factor affecting the profitability of any cattle breeding enterprise. In order to lend some unbiased consistency, we’ll use the term “breeding period” to refer to that window of time within which you begin your attempts to achieve pregnancies in your cows.

Because the estrous cycle is 21 days long, you (or the herd bull) can only expect to catch about 1/3 of the cycling animals in heat during the first week of the breeding period if you don’t use estrus synchronization. Regardless of whether the animals are inseminated naturally or artificially, you can only expect 65 to 70% of them to conceive to a given insemination. Thus, after a week of breeding to natural heats, only 21% of the eligible animals could possibly be pregnant (33% in heat x 65% conception). Because many animals may not have resumed normal cycling activity, the actual pregnancy rate during the first week of the breeding period will likely be considerably less.

Many estrus synchronization protocols can induce 75 to 90% of the cycling animals to display estrus within a 5 day period. Additionally, many protocols can induce a fertile heat in as much as 50% of the anestrous cows. Thus, it is typical for many of these synchronization protocols to result in 45 to 55% of the animals being pregnant by the end of the first week of the breeding period (Figure 1). Several fixed-time AI options can result in 40 to 50% of the cows pregnant following one single day of breeding with zero hours spent for heat detection.

Cows that display estrus during the first week of the breeding period will have 3 opportunities to conceive during the first 45 days while those who don’t will have 2 or less. Also, cows that do not respond to estrus synchronization may be problem animals. Early identification of problem cows allows appropriate veterinary therapy to be administered in a timely fashion and reduces the potential for excessive days open.
the next breeding season begins. Also, synchronization of virgin heifers facilitates the use of high reliability, calving ease, AI sires. Calving assistance labor is then more efficiently utilized because the heifers will calve within a narrow window of time. Thus, estrus synchronization of virgin heifers is particularly important to reduce calving problems, subsequent breeding problems, and calf mortality rates.

The economic benefits of estrus synchronization apply to every herd, regardless of how the animals are bred (AI or natural service). However, estrus synchronization with natural service is usually cost prohibitive because of the number of bulls required to breed cows during this short period of time. AI becomes the logical, cost-effective alternative and, yes, estrus synchronization will help you save on the labor required for heat detection. The added benefit of superior genetics from proven AI sires is “icing on your cake.” In reality, the economic benefits available through AI alone pale in comparison to the return on investment when estrus synchronization and AI are used together as “a reproductive management tool”.

**ESTRUS SYNCHRONIZATION PROTOCOLS**

**PROSTAGLANDINS**

Prostaglandin (PGF) is a naturally occurring hormone. During the normal estrous cycle of a non-pregnant animal, PGF is released from the uterus 16 to 18 days after the animal was in heat. This release of PGF functions to destroy the corpus luteum (CL). The CL is a structure in the ovary that produces the hormone progesterone and prevents the animal from returning to estrus. The release of PGF from the uterus is the triggering mechanism that results in the animal returning to estrus every 21 days. Commercially available PGF (Lutalyse, Estrumate, Prostamate) gives the herd owner the ability to simultaneously remove the CL from all cycling animals at a predetermined time that is convenient for heat detection and breeding.

The major limitation of PGF is that it is not effective on animals that do not possess a CL. This includes animals within 6 to 7 days of a previous heat, prepubertal heifers and postpartum anestrous cows. Despite these limitations, prostaglandins are the simplest method to synchronize estrus in cattle.

**TWO-SHOT PGF PROTOCOL**

The most common method of synchronization with PGF is to inject all animals and breed those that come into heat over the next 5 to 7 days. Animals not detected is estrus after the first injection are re-injected 14 days later and bred over the next 5 to 7 day period (Figure 2; Option 1). Animals detected in standing heat should be inseminated 8-12 hours later. If labor availability is a limitation, all heat detection and breeding can be delayed until after the second PGF injection (Figure 2; Option 2). This allows the producer to breed a high percentage of the herd during a single 5-7 day period, but requires two doses of PGF/head versus 1.3 to 1.5 doses/head if animals are bred after each injection. Overall estrus response rates may be slightly reduced (~5%) when animals are bred only after the second injection as some animals that responded to the first injection may not respond again to the second.

Although historic recommendations were to inject PGF at 11-day intervals, from a scheduling consideration, the 14-day interval is much easier to implement. The second injection is always 2 weeks down on the calendar from the first and all activities (injections, heat detection, breeding) are conducted on the same days of the week from one week to the next. This can be particularly important in dairy herd reproductive management programs (See Select Sires brochure “Prostaglandin Based Breeding Programs For Dairy Cattle”). Also, animals that respond to the first injection, but are not detected in estrus, will be between days 7 and 9 of the cycle at the next injection using the 11-day interval. These “early” CLs typically do not respond to PGF as well as older more mature ones. Using a 14-day interval, a missed heat from the first injection will be on days 10 to 12 of the cycle at the second injection. This 3-day difference significantly improves the probability of the animal responding again.

**6-DAY HEAT DETECTION PLUS PGF**

A lower cost alternative is to breed animals to natural heats for 6 days and then inject the unbred animals with PGF and breed over the next 5 to 7 days. This system allows all cycling animals to be bred during a two week period and requires only 0.75 PGF injections/head. Although this system is conservative in terms of hormone usage, it is probably one of the more labor intensive synchronization options. If <20% of the animals have been inseminated following 6 days of heat detection, you may have a cyclicity problem. Don’t waste your time and money trying to synchronize a herd of cows that are not cycling. Instead, re-evaluate the body condition, herd health and nutrition program in your herd.

**PGF LIMITATIONS**

**Fixed-time AI** - Fixed-time insemination after single or double injections of PGF alone seldom yields acceptable results and in general, is not recommended.

**Suckled beef cows** - A major limitation of PGF is that it only works in cycling animals. Therefore, PGF-based protocols work very well in properly managed beef or dairy heifers and in many dairy herd systemic breeding programs. However, even in the best of management scenarios, research suggests as many as 50% of postpartum, suckled beef cows may still be anestrous at the beginning of the breeding season. For these reasons, use of PGF alone for estrus synchronization is not recommended for beef herds or in any situation wherein the herd cyclicity status is in question. In such situations, use of PGF in combination with GnRH and/or a progestin source are much more effective options.
estrus and ovulation is highly variable due to differences between cows in the stage of follicular development at the time of PGF injection.

**FOLLICULAR WAVES AND GnRH**

An injection of GnRH causes a release of Luteinizing Hormone (LH) from the pituitary gland in the brain. This LH “surge” results in ovulation or luteinization of most large dominant follicles (Figure 5). A new “synchronized” follicular wave is initiated in these animals 2 to 3 days later. Because GnRH stimulates development of luteal tissue in place of the dominant follicle, a higher percentage of cows will possess sufficient luteal tissue to respond to PGF 7 days later. Injecting cows with PGF 7 days after a GnRH injection synchronizes luteal regression in animals with previously synchronized follicular development. The result is a higher estrus response rate and much tighter synchrony of estrus when compared to PGF alone.

Although GnRH synchronizes follicular development in most cows, some cows do not respond to the first GnRH injection. If the GnRH injection fails to luteinize a follicle in animals that were due to show heat naturally around the time of the PGF injection, the treatment fails to prevent those animals from displaying estrus as they normally would. Select Sires’ research in both beef and dairy cows has consistently revealed that 5 to 10% of cows treated with GnRH will display standing estrus 6 to 7 days later (9,11). These natural heats should be bred when detected and subsequent injections are not administered.

Because they do not respond to GnRH injections as consistently as do mature cows, GnRH-based synchronization protocols are not currently recommended in virgin heifers.
Select Synch

With the Select Synch System (Figure 6), cows are injected with GnRH and PGF 7 days apart. Heat detection begins 24-48 hours before the PGF injection and continues for the next 5-7 days. The PGF injection is excluded for cows detected in estrus on day 6 or 7. Animals are inseminated 8 to 12 hours after observed in standing estrus. Alternatively, heat detect and A.I. until 48 to 60 hours after PGF and then mass-AI the rest of the herd at 72 hours and give GnRH to those cows that have not exhibited estrus.

Figure 6. The Select Synch System

The figures below compare estrus response, conception and pregnancy rates for Select Synch and the two-shot PGF system in beef cows that were cycling (Figure 7) or not cycling (Figure 8) at the beginning of treatment (31). In each comparison, Select Synch resulted in more cows in standing estrus, equal or better conception rates and ultimately more cows pregnant during the synchronized breeding period. These benefits were particularly evident in the anestrous cows where estrous response rates were improved by 25% and conception rates (66%) were comparable to those of cycling cows. The Select Synch system more than doubled the percentage of anestrous cows that became pregnant during the synchronized breeding period.

Select Synch followed by heat detection and 72 hour fixed-time A.I. allows producers to maximize potential pregnancy rates while minimizing labor requirements for estrus detection (7,8). Heat detection is used to catch the early cows and to breed the majority of the herd (60 to 70%) to standing heats. Estrous detection can be terminated at 48 to 60 hours after PGF followed by mass-AI of the non-responders at 72 hours with GnRH. This option gives all cows an opportunity to conceive and, compared to strict fixed-time A.I options such as Ovsynch and Cosynch, drug costs are reduced as only 30 to 40% of the herd will receive the second GnRH injection. Additionally, if less than 40 to 50% of the herd is detected in estrus by 72 hours, the mass mating can be aborted, saving drugs, money and semen that might otherwise be wasted on anestrous cows.

Figure 7. Effects of Select Synch or 2 PGF injections 14 days apart on estrus detection, conception and pregnancy rates in cycling beef cows.

Figure 8. Effects of Select Synch or 2 PGF injections 14 days apart on estrus detection, conception and pregnancy rates in anestrous beef cows.

Figure 9. Synchrony of estrus in cycling cows treated with Select Synch or 2 PGF injections 14 days apart.

Major benefits of the Select Synch system are simplicity and tighter synchrony of estrus. Most animals will display standing estrus 2 to 4 days after the PGF injection (Figure 9). Overall, estrus response rates in well-managed beef herds average ~70 to 75% with no adverse effect on conception rates (60 to 70%), resulting in synchronized pregnancy rates that average between 45 and 50%.
OVSYNCH

Ovsynch is a fixed-time AI synchronization protocol that has been developed, tested, and used extensively in dairy cattle (23, 24, 29). The protocol builds on the basic GnRH-PGF format by adding a second GnRH injection 48 hours after the PGF injection (Figure 10). This second GnRH injection induces ovulation of the dominant follicle recruited after the first GnRH injection. All cows are mass inseminated without estrous detection at 8 to 18 hours after the second GnRH injection.

Across large numbers of dairy cattle, pregnancy rates to Ovsynch generally average in the 30 to 40% 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 dairyman achieves less than 20% pregnancy rates for each 21 days of estrus detection. In that context, a 30 to 40% pregnancy rate to a single fixed time A.I. with no heat detection doesn’t sound so bad.

Recent research (17) suggests Ovsynch pregnancy rates in dairy herds can be significantly improved if cows are set-up or “pre-synchronized” to be in the early luteal phase of the estrous cycle at the time of the first GnRH injection. This can be accomplished with 2 injections of PGF given at 14-day intervals with the last injection administered 12 to 14 days prior to starting Ovsynch.

Although Ovsynch allows for acceptable pregnancy rates with no heat detection, it does not eliminate the need for heat detection. Ovsynch treated animals should be observed closely for returns to estrus 18 to 24 days later. Additionally, natural heats can occur on any given day and as many as 20% of cows will display standing estrus between days 6 and 9 of the Ovsynch protocol. Conception rates in these animals will be compromised if bred strictly on a timed AI basis.

COSYNCH

Although Ovsynch has proven to be a reliable timed AI program for beef cows as well (11), Ovsynch requires four trips through the working chute. Research at Colorado State University demonstrated that comparable pregnancy rates can be achieved with only animal handlings by breeding all cow coinsiding with the second GnRH injection (12). Thus, the name Cosynch (Figure 10). As with any fixed time AI protocol, results to Cosynch can be variable, but in general range from 40 to 50%. As with Ovsynch, pregnancy rates are maximized if the early heats are visually detected and bred using the AM/PM rule.

THE MGA® - PGF SYSTEM

The MGA-PGF system (Figure 11) is a time tested, proven method for synchronizing estrus in beef and dairy heifers. Melengestrol Acetate (MGA) is a synthetic form of the naturally occurring hormone, progesterone. For best results, mix MGA with 3 to 5 lbs of a grain supplement and feed at a rate of 0.5 mg/head/day for 14 days. Topdressing or mixing MGA in a TMR can work, but intake (and thus results) tends to be more variable. Within 3 to 5 days after MGA feeding, most heifers will display standing heat. DO NOT BREED at this heat as conception rates are reduced. Wait 17 to 19 days after the last day of MGA feeding, and inject all heifers with a single dose of PGF. For the next 5 to 7 days, inseminate animals 8 to 12 hours after detected estrus.

Success of the MGA system depends on adequate bunk space and proper feeding rates so the appropriate dosage is consumed by each heifer on a daily basis. In addition to stimulating cyclicity, researchers at the University of Kentucky (18) found the MGA-PGF system to result in higher estrus response and conception rates when compared to synchronization using PGF alone (Figure 12). With good heat detection of well-managed heifers at the proper age, weight and body condition, you can expect to achieve synchronized pregnancy rates of 50 to 70%.

Figure 10. Ovsynch and Cosynch synchronization protocols.

Figure 11. The MGA-PGF synchronization protocol.

Figure 12. Effects of MGA-PGF or a single PGF injection on estrus detection, conception and pregnancy rates.

Because the synchrony of heats following the MGA-PGF protocol can be variable, pregnancy rates to single, fixed time inseminations are also variable. However, very acceptable pregnancy rates (45 to 55%) have been achieved to a single insemination at 72 hours or by double inseminating at 60 and 96 hours following the PGF injection.
The MGA-Select system superimposes the MGA heifer protocol on the Select Synch protocol. Cows are fed MGA (0.5 mg/head/day) for 14 days and treated with Select Synch starting 12 days after the last day of MGA feeding (Figure 13). As with Select Synch, cows are bred to observed heats for 72 to 80 hours after PGF and non-responders are mass-mated with a concurrent injection of GnRH (Option 1). Alternatively, cows may be mass-mated with a concurrent GnRH injection at 72 to 80 hours after PGF (Option 2).

The MGA feeding helps to “jump start” cyclicity in many anestrous cows and presynchronizes cycling cows for optimum response to Select Synch. Numerous studies indicate the MGA-Select system yields outstanding synchronized A.I. pregnancy rates ranging from 55 to 65% with both heat detection and fixed-time A.I. breeding options (Table 1). As with the heifer protocol, DO NOT breed cows detected in estrus within 10 days of MGA feeding.

### Table 1. Pregnancy rates to the MGA-Select protocol in published research trials.

<table>
<thead>
<tr>
<th>Reference:</th>
<th>Pregnant</th>
<th>Pregnancy rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat detection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patterson et al., 2000</td>
<td>39/60</td>
<td>65</td>
</tr>
<tr>
<td>Patterson et al., 2001</td>
<td>67/103</td>
<td>65</td>
</tr>
<tr>
<td>Patterson et al., 2002</td>
<td>67/101</td>
<td>66</td>
</tr>
<tr>
<td>Stegner et al., 2004</td>
<td>61/109</td>
<td>56</td>
</tr>
<tr>
<td>DeJarnette et al., 2004</td>
<td>378/648</td>
<td>58</td>
</tr>
<tr>
<td>Combined total</td>
<td>612/1021</td>
<td>60</td>
</tr>
</tbody>
</table>

| Fixed-time A.I. at 72 hours | | |
| Perry et al., 2002 | 70/115 | 61 |
| Stegner et al., 2003 | 69/108 | 64 |
| Bader et al., 2003 | 142/213 | 67 |
| Combined total | 281/436 | 64 |

Numerous research trials (Table 2) indicate an injection of GnRH at CIDR insertion may further improve synchronized reproductive performance, especially among anestrous cows. In other words, pregnancy rates of the many popular GnRH-PGF protocols such Ovsynch, CO-Synch and Select Synch are improved by inserting the CIDR at GnRH injection and removing the CIDR at the Lutalyse injection on day 7. Breeding cows and heifers to detected estrus for 72 hours after CIDR removal, followed by timed AI of non-responders with GnRH appears to minimize the herd to herd variation in pregnancy rates by breeding most cows to standing estrus with a minimum investment in estrus detection labor, while the timed AI gives all females the opportunity to conceive.
Management Tips to Maximize Success

Nutrition - The major factor affecting the success of any estrus synchronization protocol is the percentage of animals cycling at the initiation of treatment. The single most important factor affecting cyclicity is nutrition. Feed cows to achieve a moderate or better body condition score by the time of calving and increase energy levels in rations to minimize the body condition loss. Body condition score your cows regularly to ensure that your nutrition program is allowing for optimum reproductive performance in your herd.

Herd Health - Work with your veterinarian to maintain an intensive herd health and vaccination program that addresses all diseases of relevant concern to your geographic region. Perform all vaccinations at least three weeks ahead of the synchronization and breeding period to provide ample time for the immune system to respond and provide protection from the disease in question.

Bull Exposure - Exposure of females to bulls in the early postpartum period has been shown to decrease the number of days to the first postpartum ovulation and to increase the percentage of cows cycling at the beginning of the breeding season (5, 6, 9, 32). Bulls should be surgically altered to prevent insemination and disease transmission. Androgenized females also have a biostimulatory effect equal to that of bulls (2, 4) and are inexpensive to produce.

Calf Removal - The suckling stimulus of a nursing calf extends the duration of postpartum anestrus in cattle (13, 28). While not commonly practiced, early weaning of calves provides an excellent means to improve the cycling status of the average beef herd (3). Temporary calf removal (48 hours) initiated concurrently with the PGF injection of any synchronization protocol is a more common and easily implemented procedure (12).

Miscellaneous Details - First-calf heifers, late calving cows, difficult births, and retained placentas are all associated with reduced fertility. Group these “high risk” animals separately so maximum nutrition, veterinary care and TLC can be efficiently provided.

Estrus detection aids applied at the time of PGF injection improve heat detection efficiency and facilitate identification of cows that should also receive GnRH at 72 hour timed-AI.

Make sure adequate labor will be available for heat detection and breeding and that each person is adequately trained for their assigned task. Recheck the semen tank and breeding kit to ensure adequate quantities of semen and all breeding supplies are in your possession before you synchronize. Make sure all handling facilities are in proper working order and safe for both man and beast.

If you have further questions regarding use of estrus synchronization as a reproductive management tool in your herd, contact your local Select Sires member co-op. Our experienced and knowledgeable sales force is eagerly waiting to serve your needs.

Table 2. Effects of GnRH & CIDR protocols on pregnancy rates of lactating cows.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Treatment</th>
<th>N</th>
<th>% Preg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan et al., 1995</td>
<td>CIDR + EAI</td>
<td>522</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>GNRH+CIDR+EAI</td>
<td>517</td>
<td>51</td>
</tr>
<tr>
<td>Lamb et al., 2001</td>
<td>CO-Synch</td>
<td>287</td>
<td>48</td>
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<tr>
<td></td>
<td>CO-Synch+CIDR</td>
<td>273</td>
<td>59</td>
</tr>
<tr>
<td>Stevenson et al., 2003</td>
<td>CO-Synch</td>
<td>92</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>CO-Synch+CIDR</td>
<td>95</td>
<td>66</td>
</tr>
<tr>
<td>Larson et al., 2004</td>
<td>CIDR + EAI</td>
<td>511</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>GnRH+PGF+EAI</td>
<td>513</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>GNRH+CIDR+EAI</td>
<td>508</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>CO-Synch</td>
<td>551</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>CO-Synch+CIDR</td>
<td>547</td>
<td>54</td>
</tr>
</tbody>
</table>

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*TMEAZI-BREED is a trademark of InterAg, Hamilton, New Zealand
REFERENCES


