Synchronization and AI
Tools and Systems
Sample Oklahoma Enterprise Budget Summaries

The crop and livestock enterprise budget files listed below are cost and return summaries only. Some are offered in both PDF and editable Excel format. The PDF files were created separately from OSU Enterprise Budget Software. The Excel files are essentially “simple” budget summaries that allow producers to quickly customize for their operations. However, they do not include the advanced interactive budget building features found in the Enterprise Budget Software package (described here).

Information contained in budget samples reflect expected income and costs based on typical production practices and should only be used as a guide. Individuals should use farm records to identify values specific to their land productive capabilities and farming system when determining the potential costs and returns for their operations.

http://www.agecon.okstate.edu/budgets/
Southern Missouri Beef Cow-Calf Planning Budget

This budget presents information useful to beef farmers. Table 1 provides estimates for the 2020 year on a cow-calf operation (50-cow herd size and purchased replacements) in Southern Missouri for a fall and spring calving season. Assumptions were based on price forecasts as of October 2019. Detailed assumptions and feed requirements are summarized in Tables 2, 3 and 4. The production practices used to develop these cost estimates are common for beef farms in Missouri. Farmers are encouraged to modify this budget to fit their operation.

https://extension.missouri.edu/g679/
Table 1. Southern Missouri beef cow-calf planning budget for 2021.

<table>
<thead>
<tr>
<th></th>
<th>Fall calving</th>
<th>Spring calving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income over operating costs</td>
<td>-116.62</td>
<td>-77.99</td>
</tr>
<tr>
<td>Income over total costs</td>
<td>-238.47</td>
<td>-201.43</td>
</tr>
</tbody>
</table>
### Cow Carrying Costs vs Fed Cattle Prices

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Round Hay Baler</td>
<td>$4,200</td>
<td>$22,050</td>
<td>$40,000</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>$0.17 / gal</td>
<td>$0.89 / gal</td>
<td>$3.46 / gal</td>
</tr>
<tr>
<td>Nitrogen Fertilizer</td>
<td>$0.09 / lb</td>
<td>$0.47 / lb</td>
<td>$0.63 / lb</td>
</tr>
<tr>
<td>Farm Labor</td>
<td>$1.50 / hr</td>
<td>$7.87 / hr</td>
<td>$10 - 15 / hr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed Cattle Price</td>
<td>$54 / cwt</td>
<td>$248 / cwt</td>
<td>$148 / cwt</td>
</tr>
</tbody>
</table>

Gerrish, 2019

1. We have to be more efficient converters of energy into pounds of calf

2. Old sunlight is getting more and more expensive
Long hay feeding seasons and long calving seasons: What’s the root cause?

Why do we allow our operations to carry on with these bad habits when there are lower-cost strategies out there?

By Jordan Thomas, Ph.D., State Cow-Calf Extension Specialist - University of Missouri

Sep 17, 2020

Opportunities

• High profit producers have a lower cost and a higher gross income

How?

2012-2016 KFMA Beef Cow-Calf Enterprise Returns Over Variable Costs

<table>
<thead>
<tr>
<th></th>
<th>All Farms</th>
<th>High 1/3</th>
<th>Low 1/3</th>
<th>Absolute difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Income</td>
<td>$ 972</td>
<td>$ 1064</td>
<td>$ 893</td>
<td>$ 171</td>
</tr>
<tr>
<td>Total Variable Cost</td>
<td>$ 767</td>
<td>$ 697</td>
<td>$ 849</td>
<td>$ -152</td>
</tr>
<tr>
<td>Return over variable costs</td>
<td>$ 205</td>
<td>$ 366</td>
<td>$ 44</td>
<td>$ 322</td>
</tr>
</tbody>
</table>

Kansas Farm Management Association, 2016
Challenge to U.S. Beef Producers

• Increasing units of production (cows) is likely not a worthwhile goal

• Instead, increase gross margin per unit
  • Moderating annual cow carrying costs (e.g. feed, depreciation, development)
  • Increasing productivity per unit of production (e.g. total pounds of calf produced per standard animal unit or per acre)
  • Increasing value of product (e.g. price per pound of calf marketed)

Reproduction affects most parts of this equation!
What are the major determinants of gross margin per cow in a commercial cow-calf enterprise?

1. **Feed costs**: How much does it cost to carry the cow in terms of feed and supplementation, particularly in the winter months?

2. **Cow depreciation**: How many years does she conceive, calve, and wean a calf before being culled?

3. **Age of calves weaned**: How early does she conceive during the breeding season and how old, and therefore heavy, are calves at weaning?

4. **Quality of calves weaned**: How much value do her calves capture based on health, growth, performance, carcass merit, visual appearance, etc?
Which cow falls out of the herd faster? (i.e. has a higher annual cost of depreciation)
Cows Falling Out of the Herd

Effect of calving date on the number of cows calving the subsequent year

(Burris and Priode, 1958)
Commercial beef heifers on producer operations that were retained by producers as replacement heifers ($n = 2,195$).

Heifers that calved during the first 21-d period with their first calf remained in the herd longer than heifers that calved later ($P < 0.01$)

(Cushman et al., 2013)
Which cow brings in the most revenue?
(i.e. weans heavier calves and more total calves over lifetime)
Earlier Conception = Increased Calf Age

Calf weaning weights based on heifer calving period for the U.S. Meat Animal Research Center (USMARC) cows.

Heifers that calved in the first 21 d of their first calving season weaned a heavier calf in each of their first 6 calving seasons (*$P < 0.05$).

(Cushman et al., 2013)
What is the most valuable reproductive technology?
What does the word “technology” mean?

Technology is not just inventions.
What does the word “technology” mean?

“Systematic application of knowledge for practical purposes”
Shorten the Calving Season

• Use a shorter breeding season and/or market late-conceiving females based on a pregnancy diagnosis

• Culling cows is an opportunity not a failure on our part
  • Free up equity that is currently tied up in animals that are poor investments

• The cow herd will never reach a level of productivity that you do not cull for
  • Calving seasons do not spontaneously get shorter
Shorten the Calving Season

• “Grass sells a lot better wrapped in calf hide than it does wrapped in cow hide”
  • Allocate forage (let alone equity) to more profitable enterprises

• Better strategies than carrying late-conceiving or open cow
  • Extending length of the grazing season, feeding less hay/supplement
  • Adding additional weight to calves post-weaning
  • Increasing number of highly productive, early-conceiving cows
  • Adding a stocker enterprise during months of peak forage availability
Front-Load the Calving Distribution

**Figure 3.** This illustration compares the calving distribution produced by two herds in which the breeding period had been managed differently. In Example A, all cows received a fixed-time artificial insemination on Day 0 of the breeding period, followed by exposure to natural service bulls for two full estrous cycles after AI. In Example B, all cows were exposed to natural service bulls from Day 1 to Day 84. In both examples, the same final pregnancy percentage or calving rate of 90% is assumed. However, the calving distributions illustrate herds with very different levels of reproductive performance.
Table 2. Illustration of the impact of calving distribution on age and weight of calves at weaning.

<table>
<thead>
<tr>
<th>Example A</th>
<th>Front-Loaded, Short Calving Distribution</th>
<th>Calving Period</th>
<th>Number of Calves</th>
<th>Age at Weaning</th>
<th>Weaning Weight</th>
<th>Pounds of Calf Weaned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calved as a result of fixed-time AI</td>
<td>63</td>
<td>220 days</td>
<td>510 lbs</td>
<td>32,130 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calved as a result of natural service, Days 1 - 21</td>
<td>19</td>
<td>199 days</td>
<td>468 lbs</td>
<td>8,892 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calved as a result of natural service, Day 22 - 42</td>
<td>8</td>
<td>178 days</td>
<td>426 lbs</td>
<td>3,408 lbs</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>90</td>
<td>212 days</td>
<td>494 lbs</td>
<td>44,430 lbs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example B</th>
<th>More Typical, Long Calving Distribution</th>
<th>Calving Period</th>
<th>Number of Calves</th>
<th>Age at Weaning</th>
<th>Weaning Weight</th>
<th>Pounds of Calf Weaned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calved as a result of natural service, Days 1 - 21</td>
<td>35</td>
<td>210 days</td>
<td>490 lbs</td>
<td>17,150 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calved as a result of natural service, Day 22 - 42</td>
<td>35</td>
<td>189 days</td>
<td>448 lbs</td>
<td>15,680 lbs</td>
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<tr>
<td></td>
<td>Calved as a result of natural service, Day 43 - 63</td>
<td>15</td>
<td>168 days</td>
<td>406 lbs</td>
<td>6,090 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calved as a result of natural service, Day 64 - 84</td>
<td>5</td>
<td>147 days</td>
<td>364 lbs</td>
<td>1,820 lbs</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>90</td>
<td>191 days</td>
<td>453 lbs</td>
<td>40,740 lbs</td>
<td></td>
</tr>
</tbody>
</table>

This illustration compares the age and weight at weaning for the calf crops produced by the two herds presented in Figure 3. Herd size is assumed to be 100 cows for each example. In Example A, cows conceiving to natural service are assumed to have conceived at the end of each 21-day period, as estrus was synchronized in this example to occur prior to fixed-time AI on Day 0. In Example B, cows conceiving to natural service are assumed to have conceived at the midpoint of each 21-day period on average, as no estrus synchronization was used. These calculations assume a 70 lb birth weight and an average daily gain of 2 lbs from birth to weaning. Weaning was assumed to have occurred on Day 220 after the start of the calving season. Despite identical pregnancy percentages obtained overall, the front-loaded, shorter calving distribution from Example A produces nearly 10% more total pounds of calf weaned.
Why Use Estrus Synchronization?

Cumulative Calf Crops at the MU Thompson Research Center Over 12 Years

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean calving day</td>
<td>79.2</td>
<td>80.9</td>
<td>59.2</td>
<td>56.2</td>
<td>53.7</td>
<td>47.2</td>
<td>39.5</td>
<td>38.7</td>
</tr>
<tr>
<td>Difference from 2006/2007</td>
<td>0</td>
<td>0</td>
<td>21.7</td>
<td>24.7</td>
<td>27.2</td>
<td>33.7</td>
<td>41.4</td>
<td>42.2</td>
</tr>
<tr>
<td>Per calf increase in value</td>
<td>0</td>
<td>0</td>
<td>$87</td>
<td>$99</td>
<td>$109</td>
<td>$135</td>
<td>$166</td>
<td>$169</td>
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<tr>
<td>Herd increase in value</td>
<td>0</td>
<td>0</td>
<td>$19,100</td>
<td>$29,700</td>
<td>$32,700</td>
<td>$40,500</td>
<td>$49,800</td>
<td>$50,700</td>
</tr>
</tbody>
</table>

Economic Impact of Decreasing Length of the Calving Season in a Beef Herd

(Patterson, 2008)

(Lamb et al., 2015)
Guide to Estrus Synchronization Products

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https://extension.missouri.edu/publications/g2022

Estrus synchronization of beef cows and heifers is simple and easy, due to extensive research efforts at the University of Missouri and other institutions. Several protocols and other resources have been developed to allow beef producers to effectively synchronize estrus and ovulation among the herd.

Estrus synchronization will involve use of one or more of the following compounds: prostaglandin F2α (PG,

Reviewed June 2019

Guide to Estrus Synchronization Products

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Feedback
Estrus Synchronization Recommendations for Artificial Insemination of Beef Cows

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Select Synch: This protocol requires heat detection and will require performing AI over multiple days. Note that heat detection needs to begin on the day prior to administration of PG. Because it does not involve a CIDR, this protocol has a lower overall pharmaceutical cost but is less effective in inducing cyclicity in anestrus cows. Because of this, Select Synch is not a commonly recommended protocol. It may, however, be a cost-effective option for producers who are very comfortable with heat detection and AI, have plenty of time and labor, and are managing herds in which the majority of cows are cycling prior to the start of the protocol.

7-Day: The 7-Day CD-Synch + CIDR protocol is one of the most commonly used protocols across the industry for fixed-time AI of beef cows. It is a single-protocol involving only two anestrous events before fixed-time AI is performed. If fixed-time AI is not feasible or desired, AI can be performed based on heat detection. Because this protocol has been found to be reasonably effective among both anestrous and cycling cows, it is a good option for typical cow groups when a minimal number of animal handlings is desired.

7 & 7 Synch: The 7 & 7 Synch protocol results in a greater proportion of cows exhibiting standing estrus as well as a significant increase in pregnancy rates to fixed-time AI in comparison with the 7-Day CD-Synch + CIDR protocol. The treatment schedule is similar to the 7-Day CD-Synch + CIDR protocol, but cows are handled one additional time, a week prior to GnRH administration. At the start of the protocol, a CIDR is inserted and PG is administered. This results in a greater proportion of cows ovulating in response to GnRH, ultimately improving uniformity among cows in stage of the estrous cycle at the end of the protocol. If maximum pregnancy rates to AI are desired and producers are willing to handle cows three times prior to fixed-time AI, this protocol is recommended. 7 & 7 Synch is also highly recommended if using serum PG or fixed-time AI. If using serums and consider applying estrus detection aids at the time of CIDR removal and PG administration on Day 14 in order to identify cows that are the best candidates to receive semen.

5-Day: The 5-Day CD-Synch + CIDR protocol is similar to the 7-Day CD-Synch + CIDR but involves a shorter period of CIDR treatment. As a result, it requires administering two doses of PG approximately 8 hours apart. Because of the additional handling of cows and the additional pharmaceutical cost, the 5-Day protocol is a less commonly recommended protocol. However, research suggests a modest improvement in pregnancy rates to AI following the 5-Day CD-Synch + CIDR protocol in comparison with the 7-Day CD-Synch + CIDR protocol.

PG 6-Day CIDR: This protocol works very well for producers who are comfortable with heat detection and AI but also want the benefits associated with use of a CIDR. This protocol may also be used in heifers. Females expressing estrus and receiving AI from days 0 to 3 do not receive the subsequent GnRH, CIDR, or additional dose of PG. As a result, these costs are not incurred for all females. Although it does require more time and labor, the PG 6-Day CIDR protocol may be a good option for producers who are comfortable with heat detection and would like to avoid having large numbers of females to AI on any one day.

Bos indicus PG 5-Day CIDR: This protocol, also sometimes referred to as Bee-Synch II, has been found to be advantageous in Bos indicus and Bos indicus cross cows. This protocol is therefore recommended for producers with purebred Bos indicus (e.g., Brahman or Angus crosses of Bos indicus and Bos taurus (e.g., Brahman x Angus crosses, Brahman x Hereford crosses, etc.). Currently, it is unclear whether this protocol or other options should be preferred among Bos indicus-influenced cows when the percentage of Bos indicus-influence is very low. However, it is a simple protocol that has been effective in Bos indicus and Bos indicus cross cows, particularly in...
Estrus Synchronization Recommendations for Artificial Insemination of Beef Heifers

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1-Shot PG: This protocol is simple, consisting only of administration of PG. However, this protocol requires heat detection and will require performing AI over multiple days. Because it does not involve a CIDR, MGA, or GnRH, it has a lower overall pharmaceutical cost. However, this protocol will not be effective among heifers that have not yet reached puberty. Also note that this protocol involves a significant time commitment for heat detection and AI, and heat detection needs to begin 5 days prior to PG. This protocol is an option for producers who are comfortable with heat detection and AI, have plenty of time and labor, and know that heifers are already cycling.

7-Day: The 7-Day CO-Synch + CIDR protocol involves only two animal-handlings prior to fixed-time AI, and it offers acceptable results in heifers. Note that the recommended timing of fixed-time AI following the 7-Day CO-Synch + CIDR is earlier for heifers (54 hours after CIDR removal) than cows (66 hours after removal). This protocol works best among heifers that already have reached puberty. For mixed groups of pubertal and prepubertal heifers, longer presynchronization-based protocols like the 14-d CIDR-PG protocol are preferred. However, the 7-Day CO-Synch + CIDR protocol is a good option if heifers have reached puberty prior to the start of the protocol and scheduling issues will not allow use of long-term protocols.

5-Day: The 5-Day CO-Synch + CIDR protocol is similar to the 7-Day CO-Synch + CIDR but involves a shorter period of CIDR treatment. As a result, it requires administering two doses of PG approximately 8 hours apart. Research suggests a modest improvement in pregnancy rates in comparison to the 7-Day CO-Synch + CIDR protocol. However, because of the additional handling of animals and the additional pharmaceutical cost, this is a less commonly recommended protocol for heifers. Like the 7-Day CO-Synch + CIDR protocol, this protocol works best among heifers that already have reached puberty. For mixed groups of pubertal and prepubertal heifers, longer presynchronization-based protocols like the 14-Day CIDR-PG protocol are recommended.

14-Day CIDR-PG: A very effective protocol commonly used across the United States, this protocol involves treatment with a CIDR for 14 days. A subtitled period of heat activity will occur in the days after CIDR removal, but AI should not be performed at this time. Instead, PG is administered 16 days after CIDR removal, followed by heat detection, split-time AI, or fixed-time AI. This protocol is highly recommended for heifers due to the pregnancy rates obtained in mixed groups of pubertal and prepubertal heifers. In addition, the longer protocol schedule provides an opportunity to perform other tasks at CIDR insertion, such as prebreeding exams and vaccinations. Sexed semen can be used effectively with this protocol with heat detection or split-time AI. If using sexed semen, consider using estrus detection aids to identify heifers that are the best candidates to receive sexed semen.

MGA-PG: This protocol involves inclusion of megestrol acetate (MGA) in a feed mixture for a period of 14 days. A subtitled period of heat activity will occur in the days after removal of MGA from the feed, but AI should not be performed at this time. Instead, PG is administered 19 days after the last feeding of MGA. This protocol works well with heat detection, split-time AI, or fixed-time AI. Compared to CIDR-based protocols, this protocol requires less handling of animals and is also very cost-effective. However, there are several important factors to consider in designing a feeding program that works well with MGA. These considerations include the addition of a feed carrier to the feed. The inclusion rate of MGA in the feed (0.5 mg per head per day), the total amount of the feed carrier fed to achieve the required daily dose of MGA, the feeding schedule, and the bunk space allotted to each animal. This protocol is usually recommended only for experienced cattle feeders and for situations in which heifers are already being fed during the development program. Note
Sexed Semen for Artificial Insemination: Recommendations and AI Approaches

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Sexed Semen: Sexed semen contains an enriched proportion of either X or Y chromosome-bearing sperm cells. The bovine X chromosome is larger than the Y chromosome, resulting in X chromosome-bearing sperm cells containing approximately 3.8% more total DNA content. By staining sperm cells with a dye that incorporates proportionally with DNA content, sperm cells can be differentiated as X or Y chromosome-bearing. This difference in DNA content is the basis for generating sexed semen using one of two commercial processes. 

SexedULTRA 4M: SexedULTRA and SexedULTRA 4M are trademarks of Ingerum LLC and refer to sexed semen produced using a USDA-developed and patented process now licensed to Sexing Technologies. Stained sperm can be effectively sorted using this flow cytometry-based sorting procedure. Flow cytometry-based sexed semen has undergone a number of improvements, increasing its efficiency and viability over the last few decades. The sex-sorted semen product using this technology is presently available and marketed commercially for both beef and dairy breeds under the trade name SexedULTRA 4M. The "4M" refers to 4 million sperm cells per unit, an increase from the 2 million cells per unit that was previously standard for sex-sorted semen.

Sexcel Sexed Genetics: Sexcel is a recently developed sexing technology produced by ABS Global (Genus plc) using their patented technology. This sexing process also involves staining of sperm cells and differentiation of X and Y chromosome-bearing sperm based on DNA content. To produce a sexed product, however, a laser ablation process is used to selectively destroy sperm cells carrying the undesired chromosome. Sexcel is currently marketed for X-sorted semen for a variety of breeds.

Differences from Conventional Semen: Due to the sexing procedure and subsequent cryopreservation, sexed semen can result in reduced pregnancy rates compared with conventional semen. This reduction appears to be more severe for some bulls than others. Production of sexed semen may simply not be possible for some bulls if their sperm cells are found to be incapable of sorting and staining. Sexed semen from these bulls may appear to have a shorter fertility lifespan after insemination. To mitigate this, some researchers suggest that sexed semen requires more precise timing of insemination relative to ovulation. If AI is performed after heat detection, optimal timing of AI is estimated to occur within 48 hours of onset of estrus.

Considerations for Using Sexed Semen: In any planned mating of cattle, one sex of calf is usually preferred over the other. Either a bull or heifer calf may be preferred from a given mating, either due to genetic merit for certain traits or simply the needs of the operation for calves of a certain sex. For seedstock operations, using sexed semen may allow a production of heifer or sire lines that are easier to manage, leading to greater numbers of high-quality replacements or in marketing larger quantities of uniform high-quality feeder steers. However, sexed semen costs more per unit than conventional semen. A higher cost per unit for a lower pregnancy rate translates to a higher cost per pregnancy. This cost also increased when considering the missed opportunity for greater pregnancy rates early in the breeding season through use of conventional semen. Before deciding to use sexed semen, consider the value of the difference between the two sexes. Make both the sexed differences an economic analysis with a financial analysis to determine the feasibility of using sexed semen.
Estrus Synchronization Recommendations for Natural Service Bull Breeding

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Introduction: While artificial insemination is an excellent choice for an increasing number of producers, it is not the only option after a synchronization program. A variety of simple synchronization programs can be used effectively with natural service. This can allow producers to capture some of the benefits of estrus synchronization without making the full jump to an AI program. Adding in a synchronization program in bull-bred herds provides many of the benefits seen by producers who are implementing AI, but with less out-of-pocket costs, labor, and time commitment. This is also an excellent tool to progressively shorten an extended-calving season in order to prepare to use AI in future years.

Goals and Gains: The goal of any estrus synchronization program is to increase the number of females bred early in the season. This results in increased age, uniformity, and value of calves at weaning. Increasing the proportion of the herd pregnant early in the season can also help to shorten the length of the calving season in the cow herd, resulting in reproductive improvements in future breeding seasons.

Bull Considerations: Natural service programs are dependent on bulls for success, and synchronization will result in a larger proportion of females in heat during a shorter window of time. Any bull used for breeding should receive a breeding soundness exam by a veterinarian prior to turnout. As well as evaluating the semen quality and structural circumference of the bull, the veterinarian will also assess the bull’s overall condition and physical structure. Individual bulls vary widely in their ability to cover cows. If using synchronization, it is advisable to err on the conservative side with respect to the bull-to-cow ratio used. Most recommendations are to stock mature bulls at a rate of 1 bull to no more than 25 cows. Use of young, inexperienced sires after synchronization is discouraged due to the concentrated breeding window, but bull-to-cow ratios should be reduced if young bulls are used (e.g., 12 cows per a yearling bull and 18 cows for a 3-year-old bull). Single sire breeding pastures also inherently involve more risk. Periodic observation of breeding groups is recommended to ensure mating is taking place and females do not continue to return to estrus throughout the breeding season.

Cow and Heifer Considerations: No technology will replace good management or make up for cows or heifers that are in poor condition. Heifers should be developed to 55-65% of their expected mature body weight prior to breeding. Also consider having heifers evaluated by a veterinarian to ensure adequate pelvic area and reproductive maturity. For best results in a synchronization program, cows should be at least 45 days post-calving and at a body condition of 5 or greater. Consider culling animals that aren’t meeting these criteria; this ensures that the expense and effort of synchronization and bull power will not go to waste.

Selecting a Protocol: Depending on the group of cows or heifers receiving synchronization, protocols vary in their level of potential impact. For example, the 1-Shot PG protocol is simple, but PG is only effective at mating cows and heifers that are already cycling. Synchronization protocols that utilize prostaglandins, like MGA or a CIDR, have proven effective at hastening puberty attainment in heifers if some of the heifers in the group are not yet cycling. A CIDR or MGA is an excellent tool to drive late-calving bulls and estrus to mature quickly. Note that MGA is FDA-approved only for use in heifers and should therefore not be used in protocols for mature cows. It is important to adhere to the suggested timing of each protocol. Longer term protocols like the 14-Day PG and MGA protocols require a waiting period between prostaglandin removal and bull exposure. Heat activity will occur in the period of time after prostaglandin removal; however, exposing animals for breeding on this heat results in subfertility. Instead, plan on waiting approximately 10 days before introducing bulls, and expect the breeding season to start as those heifers begin to come in heat again. Make a calendar and ensure

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1-Shot PG

1-Shot PG Natural Service: This protocol involves only a single administration of PG. Animals that exhibit standing heat in the 4 to 5 days leading up to PG will not respond. Therefore, bulls should be introduced 4 to 5 days in advance of PG. This results in greater pregnancy rates early in the breeding season compared with simply introducing bulls on the day of PG administration. Animals bred in the days following PG may still be safely administered PG without risking abortion. This protocol does not involve a CIDR, MGA, or GnRH and therefore has a lower pharmaceutical cost. However, this protocol is not effective for inducing cyclicity among anestrous cows or among heifers that have not yet reached puberty. If a large proportion of animals are not cycling, protocols involving a CIDR or MGA are better alternatives.

7-Day CIDR

7-Day CIDR + Natural Service: This protocol involves treatment with a CIDR for 7 days, with bulls introduced on the day of CIDR removal. Although this protocol does involve the cost of a CIDR, it can effectively induce cyclicity among a proportion of anestrous cows and heifers that have not yet reached puberty.

14-Day CIDR

14-Day CIDR + Natural Service: This protocol involves treatment with a CIDR for 14 days. A subtler period of heat activity will occur in the days after CIDR removal, and bulls should not be introduced into the group. Instead, bulls should be introduced approximately 10 days after CIDR removal. Heat activity occurring in the days immediately after bull introduction will likely be minimal, and the majority of heat activity will begin a full estrous cycle length (18 to 24 days) after the initial subtelfer heat activity that followed CIDR removal. This protocol is highly recommended for heifers due to the pregnancy rates obtained in mixed groups of puberal and prepuberal heifers. In addition, the longer protocol schedule provides an opportunity to perform other tasks at CIDR insertion, such as prebreeding exams and vaccinations. This protocol can also be used in postpartum cows, but length of the protocol schedule can make implementation difficult depending on the length of the previous calving season.

MGA

MGA + Natural Service: This protocol involves inclusion of melengestrol acetate (MGA) in a feed mixture for a period of 14 days. A subtelfere period of heat activity will occur in the days following removal of MGA from the feed, and bulls should not be introduced during this period. More bulls should be introduced approximately 10 days days after the last feeding of MGA. Some heat activity may occur in the days immediately after bull introduction, but the majority of heat activity will begin a full estrous cycle length (18 to 24 days) after the initial subtelfer heat activity that followed MGA withdrawal. Compared to CIDR-based protocols, this protocol requires less

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2021 Protocols for Natural Service Bull Breeding

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Natural Service

Intravaginal progesterone Controlled Internal Drug Release (CIDR) Intrauterine contraceptive device Controlled Internal Drug Release (CIDR) Menestrogen lactate, a progesterone feed additive MGA, melengestrol acetate (injectable and feed)

Pharmaceutical products used for estrus synchronization should be administered at the label dose. Consult product labeling. Label-approved applications vary from product to product, and the products may be used in the context of an ongoing veterinarian-client-patient relationship.
7 & 7 Synch: An Estrus Synchronization Protocol for Postpartum Beef Cows

Overview
Researchers at the University of Missouri recently evaluated a new protocol for synchronization of estrus among postpartum beef cows. This protocol was found to be highly effective both for cows receiving embryo transfer (ET) and cows receiving fixed-time artificial insemination (AI). Extensive field trials with the 7 & 7 Synch observed improvements in the proportion of cows expressing estrus and in the proportion of cows becoming pregnant to embryo transfer or to AI.

Introduction
Estrus synchronization is a widely applicable reproductive technology that allows producers to improve

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Relationship between Follicular Waves and GnRH

In cows, response rate to GnRH is only 65% at a random time point.

(Vasconcelos et al. 1999, Geary et al. 2000)
Physiology of the Bovine Estrous Cycle

Ovarian Structures:
- Recruitment
- Selection
- Dominance
- Atresia
- CL
- Ovulation

Hormone Profile:
- LH
- Estrus
- E2
- FSH
- Progesterone
- PGF<sub>2α</sub>

Day of cycle:
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 0
Physiology of the Bovine Estrous Cycle

### Hormone Profile
- **LH**, **Estrus**, **E2**, **FSH**, **Progesterone**, **PGF$_2\alpha$**

### Ovarian Structures
- **CL**

### Day of cycle
- 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 0
7 & 7 Synch
(Bonacker et al., 2020a and 2020b; Andersen et al., 2020)

• Research trials with > 3,000 beef cows on >20 producer locations across Missouri, Kansas, and South Dakota
  • Full range of cow age, parity, condition, and postpartum intervals

• University of Missouri Agricultural Experiment Station beef herds
  • Southwest Research Center (Mount Vernon)
  • South Farm Beef Research and Teaching Farm (Columbia)

• Cross Country Genetics, Westmoreland, Kansas
  • Kirk Gray, DVM, MS; Clay Breiner, DVM; Joel Anderson, DVM

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Induced Luteolysis

Subluteal P4 Inhibits Atresia

PG

Induced Ovulation of Persistent Follicle

GnRH

Emergence of New Follicular Wave and Newly Formed CL

PG

Induced Luteolysis of Newly Formed CL

...66 h...

GnRH

AI

Estrus

CIDR

Estrus

PG
7 & 7 Synch

(Bonacker et al., 2020a and 2020b; Andersen et al., 2020)

Estrus Expression Before Fixed-Time AI

<table>
<thead>
<tr>
<th></th>
<th>Estrus Expression</th>
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<tbody>
<tr>
<td><strong>7 &amp; 7 Synch</strong></td>
<td>82%(^{a})</td>
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<tr>
<td>(631/773)</td>
<td></td>
</tr>
<tr>
<td><strong>7 Day CO-Synch + CIDR</strong></td>
<td>64%(^{b})</td>
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<tr>
<td>(495/776)</td>
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https://extension2.missouri.edu/g2023
### 7 & 7 Synch

(Bonacker et al., 2020a and 2020b; Andersen et al., 2020)

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</table>

### Pregnancy Rates to Fixed-Time AI

<table>
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<tr>
<th></th>
<th>Conventional</th>
<th>Sexed Semen</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 &amp; 7 Synch</td>
<td>72%&lt;sup&gt;a&lt;/sup&gt; (280/389)</td>
<td>52%&lt;sup&gt;c&lt;/sup&gt; (199/380)</td>
</tr>
<tr>
<td>7 Day CO-Synch + CIDR</td>
<td>61%&lt;sup&gt;b&lt;/sup&gt; (233/383)</td>
<td>44%&lt;sup&gt;d&lt;/sup&gt; (171/386)</td>
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</tbody>
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Tools vs Context

• Estrus synchronization has no value in and of itself
  • Tool to achieve earlier conception within breeding period

• Artificial insemination has no value in and of itself
  • Tool to generate more calves sired by specific sire(s)

• Value comes from the reproductive management context in which the right tools are used appropriately together
  • Increase total value of calves weaned across the ranch
  • Decrease costs associated with cow depreciation
  • Decrease costs associated with inefficient use of labor, facilities, feed, or other resources