Split-Time AI

Using Estrus Detection Aids to Optimize Timed Artificial Insemination

Photo by Shawn Dunagan, Montana Stockgrowers Association

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Overview

Timed AI pregnancy rates can be optimized through use of a split-time AI approach following administration of the 14-day CIDR-PG protocol for heifers and the 7-day CO-Synch + CIDR protocol for mature cows. Using split-time AI, insemination of non-estrous females is delayed until 20 to 24 hours after the scheduled time for fixed-time AI. Estrotect estrus detection aids applied at the time of PG administration allow producers to determine the estrous status of females and inseminate at the optimal time.

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The development of protocols that effectively facilitate synchronization of estrus and ovulation has enabled producers to increase the use of fixed-time artificial insemination (FTAI) in beef heifers and cows, rather than performing artificial insemination (AI) on the basis of detected estrus. In this approach, AI is performed at a predetermined time following prostaglandin $F_{2\alpha}$ (PG) administration. Previous research efforts have evaluated several protocols to determine the appropriate time at which to perform FTAI. For example, following the 14-day CIDR-PG protocol for heifers, the pregnancy rate to FTAI is highest when FTAI is performed 66 hours after PG administration. Acceptable pregnancy rates can be obtained using FTAI following several protocols; however, a proportion of females undergoing estrus synchronization do not express estrus prior to FTAI. To account for these non-estrous animals, all cows and heifers are administered gonadotropin-releasing hormone (GnRH) at FTAI to ensure that ovulation is induced. However, endocrine changes associated with estrus expression are known to positively influence fertility, and pregnancy rates are on average 27 percent lower among females that fail to express estrus prior to FTAI (Perry and Smith, 2015).

Split-time AI

Can timed AI pregnancy rates be improved for females not expressing estrus prior to the appointment time for FTAI? Researchers at the University of Missouri developed an alternative approach to manage timed insemination of cows and heifers that have not expressed estrus prior to fixed-time AI. This approach, known as split-time AI, delays insemination of non-estrous females until 20 to 24 hours after the scheduled time. Split-time AI improved timed AI pregnancy rates among beef replacement heifers following the 14-day CIDR-PG protocol (Thomas et al., 2014a) and among mature beef cows following the 7-day CO-Synch + CIDR protocol (Thomas et al., 2014b; Bishop et al., 2016c). Use of split-time AI following these protocols is diagrammed in Figures 1 and 2.

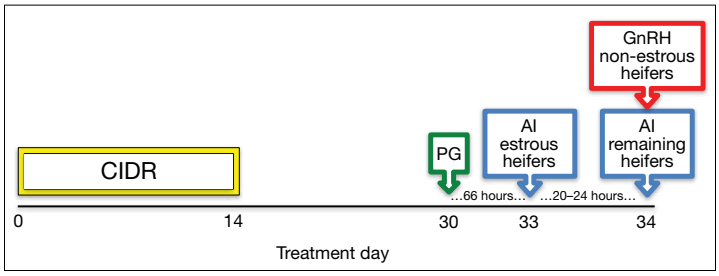

Figure 1. The 14-day CIDR-PG protocol for heifers with split-time AI.

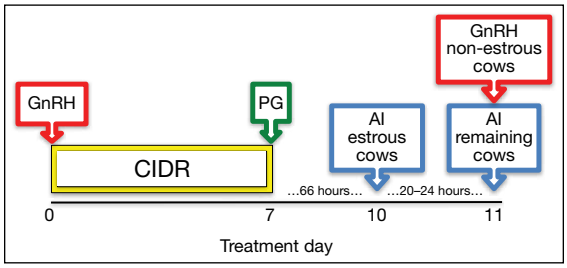

Figure 2. The 7-day CO-Synch + CIDR protocol for cows with split-time AI.

Estrus detection aids

To identify animals that have not expressed estrus, Estrotect estrus detection aids can be applied at the time of the final PG administration. Estrotect patches are designed with a scratch-off coating that is removed progressively as an estrous animal stands to be mounted. Because of this design, producers can have a high degree of confidence about the estrous status of females. In split-time AI, an animal is considered as having expressed estrus when more than 50 percent of the scratch-off coating has been removed from the Estrotect patch (Figure 3).

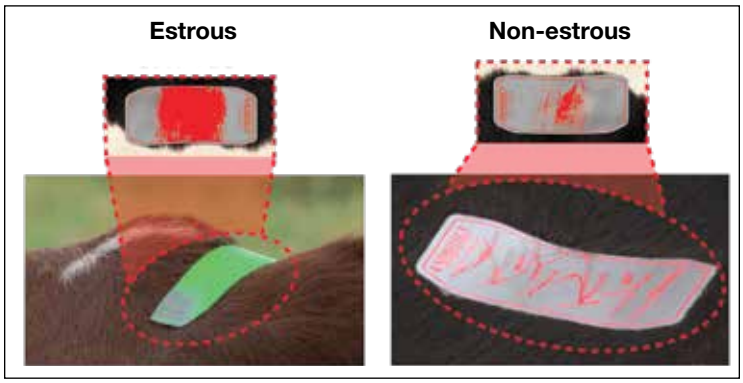

Figure 3. Determining estrus expression using Estrotect patches.

Split-time AI and GnRH

In addition to offering improved pregnancy rates compared to FTAI, split-time AI allows for a reduction in GnRH use. Administration of GnRH was not found to be required for cows or heifers with activated Estrotect patches at AI (Bishop et al., 2016a). Therefore, insemination can be performed without GnRH administration for cows and heifers that have expressed estrus prior to the standard time of appointment breeding, as well as for cows and heifers that expressed estrus prior to the delayed time point. Questions still remain as to the efficacy of GnRH administration in non-estrous heifers (Bishop et al., 2016b); however, it is currently recommended that GnRH be administered to both cows and heifers that have not expressed estrus by the delayed time point.

Anticipated improvements

The 14-day CIDR-PG and 7-day CO-Synch + CIDR protocols have been extensively evaluated in heifers and cows, respectively, and timing of estrus expression following these protocols is very consistent. However, the proportion of heifers and cows expressing estrus prior to the time of appointment breeding is somewhat variable, as estrus expression is influenced by the cyclicity rate of the herd and other factors, such as weather. The extent to which pregnancy rates are improved using split-time AI compared to fixed-time AI likely varies based on the proportion of cows and heifers expressing estrus prior to 66 hours. Typically, 30 to 50 percent of mature cows and 20 to 40 percent of heifers fail to express estrus prior to 66 hours after PG following the 7-day CO-Synch + CIDR and 14-day CIDR-PG protocols, respectively. In field trials conducted by the University of Missouri, pregnancy rates of non-estrous females were improved 16 percentage points by delaying insemination 20 to 24 hours. Tables 1 and 2 compare data from field

Table 1. Pregnancy rates of heifers following the 14-day CIDR-PG protocol.

	Pregnancy rate	
Estrous response	**Fixed-time AI**	**Split-time AI**
Estrous by 66 hours	52% (161/311)	56% (183/328)
Non-estrous by 66 hours	34%[a] (54/157)	49%[b] (66/135)
Estrous by 90 hours	—	66% (48/73)
Non-estrous by 90 hours	—	29% (18/62)
Total	46% (215/468)	54% (249/463)

Source: *Thomas et al., 2014a.*

a,b. Percentages within a row with different superscripts differ (P < 0.05).

Table 2. Pregnancy rates of mature cows following the 7-day CO-Synch + CIDR protocol.

	Pregnancy rate	
Estrous response	**Fixed-time AI**	**Split-time AI**
Estrous by 66 hours	58% (116/200)	58% (135/231)
Non-estrous by 66 hours	35%[a] (47/133)	51%[b] (55/107)
Estrous by 90 hours	—	63% (37/59)
Non-estrous by 90 hours	—	38% (18/48)
Total	49% (163/333)	54% (190/338)

Source: *Bishop et al., 2016c.*

a,b. Percentages within a row with different superscripts differ (P < 0.05).

trials using split-time AI and FTAI in heifers (Thomas et al., 2014a) and cows (Bishop et al., 2016c).

Potential improvements in pregnancy rates appear to be dependent on estrus expression occurring during the 20- to 24-hour delay period. Large data sets for timing of estrus expression in heifers following the 14-day CIDR-PG protocol suggest a sizable proportion of the synchronized group of heifers express estrus during this delay period (Figure 4). Interestingly, further consideration of these results suggested that pregnancy rates achieved using split-time AI were similar to those achieved when AI was performed based on detected estrus over a six-day period.

In results from the University of Missouri, 55 percent of both heifers and cows that had failed to express estrus by 66 hours after PG went on to express estrus by the time delayed AI was performed. Split-time AI has not been evaluated extensively with protocols other than those described here. Because the timing of estrus expression varies from protocol to protocol, it is unknown whether pregnancy rates to split-time AI are improved over FTAI following the administration of other protocols.

Economic impact

When using split-time AI rather than fixed-time AI, two additional costs are incurred: the cost of the Estrotect estrus detection aids and the cost of the additional labor for animal handling at the delayed time point. However, cost savings are realized on GnRH product because animals with activated estrus detection aids do not require GnRH administration. Total estrous response when using split-time AI is frequently 85 percent or higher (see cumulative response by 90 hours after PG in Figure 4). Therefore, the cost associated with GnRH administration is likewise reduced by 85 percent or more. This GnRH cost savings alone typically offsets the Estrotect and additional labor costs. Most importantly, the increase in pregnancy rates (generally an increase of 5 percentage points or more for the synchronized group overall) using split-time

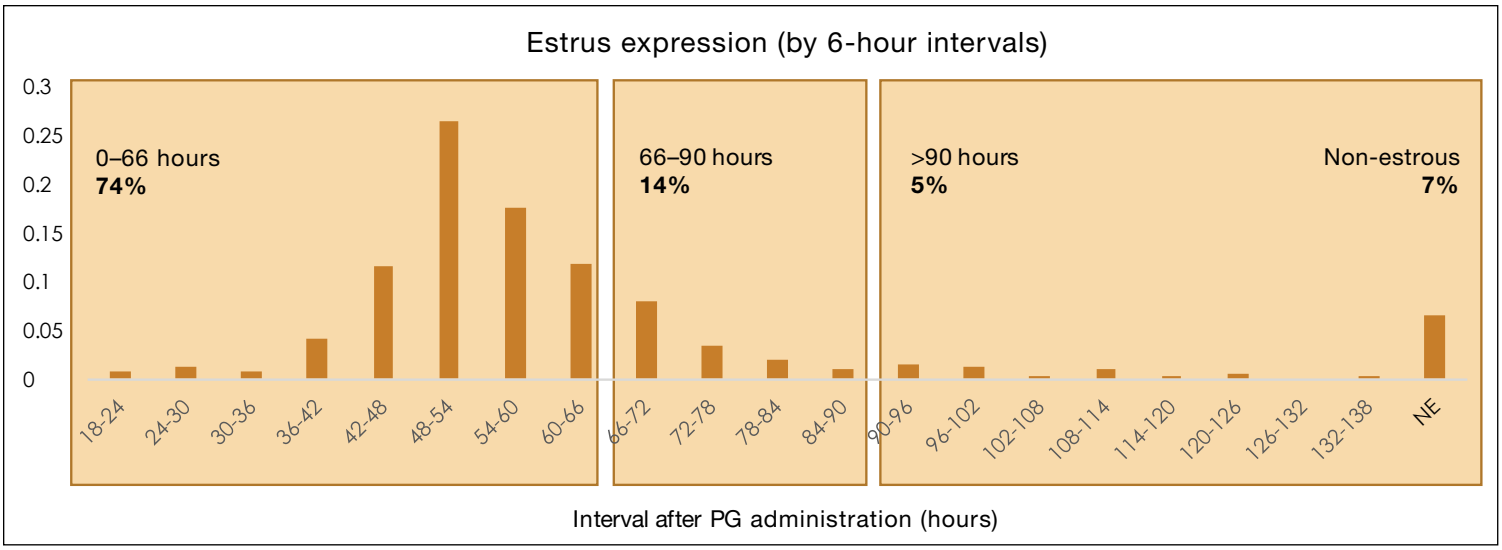

Figure 4. Timing of estrus for beef heifers following the 14-day CIDR-PG protocol. (Source: Leitman et al., 2009a; Leitman et al., 2009b; Mallory et al., 2010. Adapted from Bishop et al., 2016a.)

Table 3. Example cost scenario of the value of split-time AI versus fixed-time AI for a group of 100 heifers.

Item	Value/Unit	Units	Value
Estrotect cost	($1.30)	100	($130)
Labor cost	($10.00)	8	($80)
GnRH cost-savings	$3.00	85	$255
Additional AI pregnancies	$211.00	5	$1,055
Net value			$1,100

AI offers additional value to producers, as markets have shown heifers carrying an AI pregnancy command higher prices than those carrying a natural service pregnancy

Table 3 presents a cost scenario in which split-time AI rather than fixed-time AI is used for 100 heifers. For the additional animal handling, labor costs are estimated based on four people working two hours at $10 per hour, for a total of eight man-hours. Estrus detection aids can range in price based on the quantity purchased but are estimated at $1.30 per patch in this analysis. Cost of GnRH product likewise varies based on manufacturer and quantity purchased, but is estimated at $3 per dose in this analysis. Conservatively, use of split-time AI can be expected to achieve five or more additional AI pregnancies per 100 head. In this analysis, the value of an AI pregnancy is assumed to be $211, based on the average premium associated with heifers carrying an AI versus natural service pregnancy among heifers selling in the Missouri Show-Me-Select Replacement Heifer Program from 2010 to 2015.

Summary

Timed AI pregnancy rates can be optimized through use of a split-time AI approach following administration of the 14-day CIDR-PG protocol for heifers and the 7-day CO-Synch + CIDR protocol for mature cows. Estrotect estrus detection aids applied at the time PG is administered allow producers to determine the estrous status of females and inseminate at an optimal time. Moreover, split-time AI facilitates a reduction in GnRH use, as producers can limit GnRH administration to only those females that have not expressed estrus by the time of delayed insemination.

For further information, contact David J. Patterson, State Beef Reproductive Specialist, Division of Animal Sciences, University of Missouri, Columbia, MO 65211.

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