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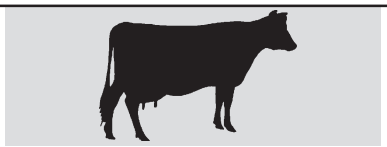

Ovarian and Estrous Response of Suckled Beef Cows to the Select Synch Estrous Synchronization Protocol[1]

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Abstract

This study evaluated ovarian and estrous responses as affected by day of the estrous cycle at initiation of treatment among cows synchronized with the Select Synch protocol. Fifty-six suckled Hereford x Red Angus multiparous cows were fitted with HeatWatch® electronic estrous detection monitors 22 d before initiation of treatment. Thirty-two percent of cows were not detected in estrus during this 22-d period, and were classified as anestrus. Treatment included an injection of Gonadotropin releasing hormone (GnRH; 100 µg) on d 7, followed by an injection of Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$; 25 mg) on d 0. Ovaries of cows were scanned daily via ultrasound from d 12 until the time of insemination to evaluate follicular and luteal response to the GnRH and $PGF_{2\alpha}$ injections. Cows were visually observed for signs of estrus twice daily from d 0 to d 5 for approximately 2 h to compare visual detection of estrus with electronic detection. There was no difference (P>0.5) in the percentage of cows detected in estrus between visual (85%) and electronic (88%) observation. Ovarian and estrous responses to the GnRH and $PGF_{2\alpha}$ injections were dependent on day of the estrous cycle when the protocol was initiated. Ovulation resulting in formation of a new corpus luteum (CL) and follicular turnover occurred following the injection of GnRH in 66 and 70% of cows, respectively. Only 14% of cows that were between d 15 and 17 of their estrous cycle responded to either GnRH or $PGF_{2\alpha}$ administration. Additionally, these cows exhibited estrus 11 ± 19 h (mean ± SD) before injection of $PGF_{2\alpha}$. Anestrous cows exhibited estrus earlier (P<0.05) than cyclic cows (40.2 ± 16 h and 56.3 ± 39 h, respectively). Synchronized pregnancy rate was 71% for the 5 d breeding period, and included a 61% pregnancy rate among anestrous cows. We conclude that the Select Synch protocol is capable of synchronizing estrus among the majority of cows in a herd, and we emphasize that accurate estrous detection beginning 24 to 30 h before the $PGF_{2\alpha}$ injection is important.

(Key Words: Synchronization of Estrus, Gonadotropin Releasing Hormone, Prostaglandin, Follicular Turnover, Estrous Detection.)

Introduction

Previous estrous synchronization protocols (6) relied on induced regression of the corpus luteum (CL) to allow for increased follicular growth and estradiol production that resulted in estrus. Increased precision of estrous synchronization is dependent on manipulation of both the CL and follicular development (2). Cows have two or three waves of follicular growth during each estrous cycle (4, 5, and 12). During a follicular wave, a group of follicles begins to grow, and one becomes dominant, whereas the others undergo atresia. Presence of a functional CL is ultimately responsible for regression of the dominant follicle, which allows a new follicular wave to occur (5). Gonadotropin releasing hormone (GnRH) and its analogs have been used to synchronize follicular waves in dairy cattle by inducing ovulation and initiating a new follicular wave

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TABLE 1. Number and synchronization, conception, and pregnancy rate of cows classified as anestrus or cyclic and day of the estrous cycle at initiation of synchronization.

		Cyclic (estimated day of estrous cycle at GnRH[a])					
Item	Anestrus	0–3	4–5	6–9	10–14	15–17	18–20
Cows, no.	18	10	3	10	5	7	3
Synchronization rate, %	89	100	100	100	100	14	100
Conception rate, %	69	100	100	60	100	N/A[b]	100
Pregnancy rate, %	61	100	100	60	100	N/A[b]	100

[a]GnRH = Gonadotropin-releasing hormone.

[b]Five of these cows exhibited estrus prior to the prostaglandin $F_{2\alpha}$ injection and were not inseminated.

(16, 17, 19, and 7). Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) administration 6 to 7 d after injection of GnRH, or its analog, caused luteolysis. The GnRH/ $PGF_{2\alpha}$ protocol has been used to synchronize estrus, and has been termed the Select Synch protocol by the AI industry.

In recent studies, only 64% of beef cows that received the Select Synch protocol exhibited estrus within 6 d following the administration of $PGF_{2\alpha}$ (3). The poor estrous response may have been a result of insufficient progesterone production prior to estrus (1), or anestrus among the majority of cows used, or perhaps there are days of the estrous cycle when initiation of the Select Synch protocol is ineffective. Additionally, cattle may be exhibiting an estrus that is not detected. The objective of this study was to determine the ovarian and estrous response to the Select Synch protocol, as affected by day of the estrous cycle at the initiation of treatment.

Materials and Methods

Fifty-six suckled Hereford x Red Angus multiparous cows with a mean body condition score (8) of 4.9 ± 0.4 were utilized to evaluate the estrous and ovarian response to the GnRH and $PGF_{2\alpha}$ injections that make up the Select Synch protocol (Figure 1). Cows were 83 ± 8 d postpartum at initiation of treatment. A single i.m. injection of GnRH (100 µg, Cystorelin®; Merial Limited, Shawnee Mission, KS) was given on d 7, followed by an i.m. injection of $PGF_{2\alpha}$ (25 mg, Lutalyse® Pharmacia & Upjohn, Kalamazoo, MI) on d 0.

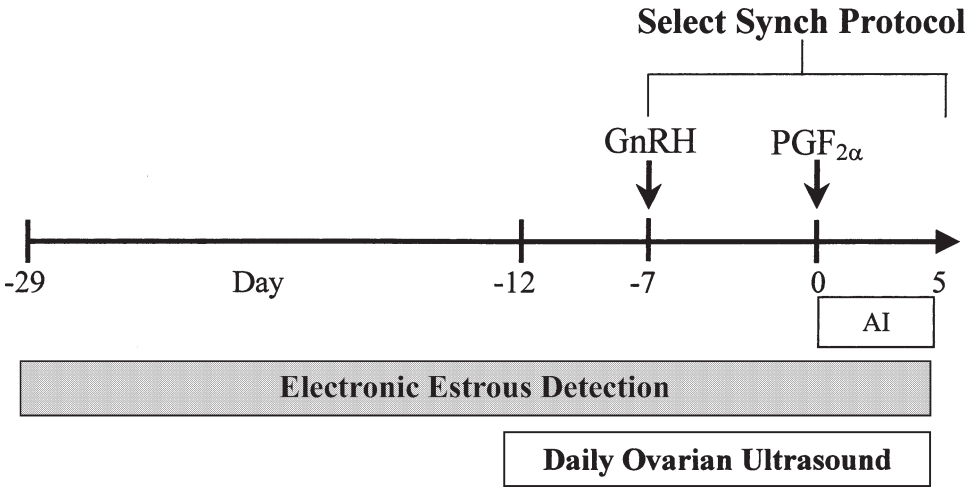


Figure 1. Illustration of the experimental timeline that included HeatWatch® (electronic estrous detection, daily ovarian ultrasound, and the Select Synch protocol.

Electronic transmitters (HeatWatch®, DDx, Inc., Denver, CO) were secured to the tailheads of all cows on d 29 to identify anestrous cows and day of the estrous cycle at the initiation of synchronization (Figure 1). Cows not detected in estrus between d –29 and –7 were classified as anestrus at the beginning of treatment. The HeatWatch® system was also used to pinpoint the onset of estrus following initiation of treatment. Criteria established for identification of cows in estrus by HeatWatch® included cows that received a single mount greater than 2 s in length, or two or more mounts recorded within 1 h. Electronic estrous detection was compared with visual estrous detection during the synchronized period (d 0 to 5). Visual estrous detection was performed twice daily for 2 h each morning and evening (approximately 0700 and 1900). Cows that were observed in estrus from 0 to 120 h following $PGF_{2\alpha}$ administration were artificially inseminated approximately 12 h following their first electronically recorded or visually observed mount (whichever came first). Differences between the percentage of cows detected in estrus visually or electronically were analyzed by ANOVA in SAS (10, 14). Cows were exposed to clean-up bulls from d 6 to 78.

Daily transrectal ultrasonography (Aloka, model SSD-500V, 5-MHz rectal probe; Aloka, Wallingford, CT) was used to monitor follicular size, initiation of new follicular waves, ovulation, and CL development (ovarian response) from d 12 until 120 h post-$PGF_{2\alpha}$ (Figure 1). Corpora lutea and follicles larger than 2 mm in diameter were recorded, and approximate locations mapped for each ovary. New follicular waves were measured as the appearance of two to four larger follicles (≥ 4 mm) on an ovary that grew until one became

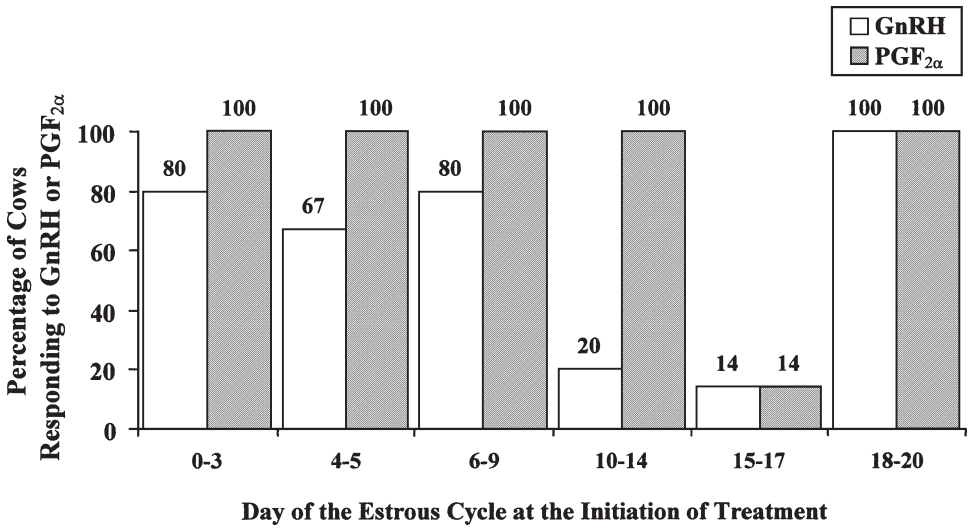


Figure 2. Percentage of cows responding to the gonadotropin releasing hormone (GnRH) and(or) prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) injection by day of the estrous cycle at the time of GnRH administration. Response to GnRH denotes ovulation, new corpus luteum (CL) formation, and a new follicular wave initiated. Response to $PGF_{2\alpha}$ denotes CL regression and display of estrus following the $PGF_{2\alpha}$ injection.

noticeably larger (≥ 8 mm) and the others began to shrink. Ovulation was measured as the sudden disappearance of a large follicle (> 10 mm) and the emergence of a new CL within a few days. Since a CL was visible on an ovary by ultrasound after functional luteolysis, regression of the CL was measured by exhibition of standing estrus. Cows were examined for pregnancy via rectal palpation on d 60 by a trained technician. Pregnancies resulting from AI were validated by rectal palpation on d 90 by a second technician, and by calving dates. Differences in response to the GnRH and $PGF_{2\alpha}$ injections by day of the estrous cycle at initiation of synchronization were analyzed with chi-square goodness of fit test in SAS (10, 14). Differences in the time interval from the $PGF_{2\alpha}$ injection until the onset of estrus were analyzed using ANOVA in SAS (10, 14).

Results and Discussion

The GnRH injection induced ovulation and formation of a new CL in 66% of all cows. This injection also initiated a new follicular wave, or was coincidental with the spontaneous emergence of a new follicular wave, in 70% of the cows. Luteal regression and estrus occurred in 88% of cows following the $PGF_{2\alpha}$ injection. Response to the injection of GnRH was variable and dependent on the stage of the estrous cycle at the time of administration (Figure 2). These results are consistent with follicular response to GnRH administration in dairy heifers reported by Silcox et al. (13), who found that GnRH administration during the follicular growth, plateau, and regression phases resulted in ovulation 100, 33, and 0% of the time, respectively. Luteinizing hormone receptor numbers decrease as the dominant follicle starts to regress, decreasing the response of that follicle to GnRH (9).

Cows that were between d 10 and 17 of their estrous cycle were in the plateau or regression phase of follicular growth, or had recently initiated a new wave of follicular growth, at the time of GnRH administration. Large variations in follicular growth have been reported previously for cows at this stage of their estrous cycle (4, 12). Cows (n = 7) that were between d 15 to 17 of their estrous cycle at the initiation of synchronization did not respond well to either GnRH or $PGF_{2\alpha}$ (Figure 2). Six of these seven cows showed no ovarian response following the GnRH injection. None of these six cows had a follicle ≥ 10 mm on their ovaries at the time of GnRH administration, and all were between two waves of follicular growth, based on ovarian maps. Others have suggested that mid-cycle would be the most difficult time to stimulate follicular growth because of ovarian changes during the estrous cycle (4, 11, and 12). Cows (n = 18) not detected in estrus by HeatWatch® during the 22-d period before initia-

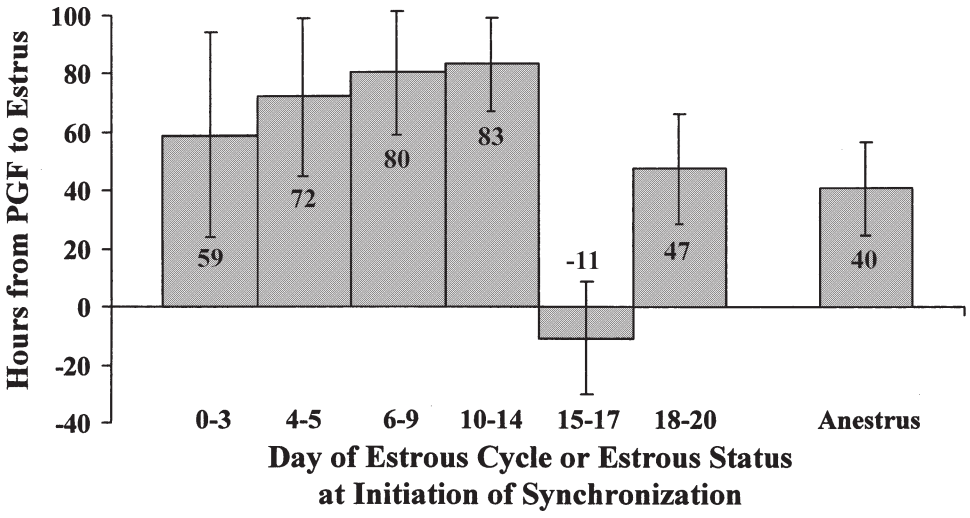


Figure 3. Hours (mean ± SD) from prostaglandin F_{2a} ($PGF_{2\alpha}$) injection to estrus among cows grouped by day of the estrous cycle when gonadotropin releasing hormone GnRH was administered.

tion of treatment were presumed to be anestrus. None of these cows had luteal structures on their ovaries before treatment. Eighty-nine percent (16/18) of anestrous cows ovulated in response to the GnRH injection. Ninety-four percent (17/18) of anestrous cows exhibited estrus following the $PGF_{2\alpha}$ injection, indicating that a CL was either not detected on the ovaries of one cow, or she displayed a spontaneous estrus that was coincidental with the synchronized estrus.

Figure 3 illustrates the average time interval from $PGF_{2\alpha}$ to estrus by day of the estrous cycle at initiation of synchronization. The mean ± SD time from $PGF_{2\alpha}$ to estrus for all cows was 51.5 ± 35 h. Anestrous cows exhibited estrus earlier ($P<0.05$) than the cows with estrous cycles (40.2 ± 16 h and 56.3 ± 39 h, respectively). Seven out of fifty-six cows did not exhibit estrus following the $PGF_{2\alpha}$ injection. Five of these seven cows were between d 15 to 17 of their estrous cycle at the time of the GnRH injection, and these five cows were the only cows to exhibit estrus before the $PGF_{2\alpha}$ injection. These five cows likely underwent normal luteolysis and displayed estrus early because they did not ovulate and form a new CL in response to the GnRH injection. This is the first study to demonstrate that the small percentage of cows receiving the Select Synch protocol that exhibit estrus before the $PGF_{2\alpha}$ injection are in the late luteal phase of their estrous cycle at initiation of synchronization. Producers who choose to use the Select Synch protocol should be aware of this finding, and should be advised to initiate estrous detection 24 to 30 h before the $PGF_{2\alpha}$ injection.

The cumulative estrous response of all cows to the Select Synch protocol is illustrated in Figure 4. The 9% of cows that were found to be in heat prior to the $PGF_{2\alpha}$ injection are included in Figure 4. Thatcher et al. (16) reported that 10% of heifers that received the same protocol with Receptal® (a synthetic GnRH agonist, Buserelin; Hoechst-Roussel, Sommerville, NJ) were in estrus between the GnRH agonist and $PGF_{2\alpha}$ injections. In the study by Thatcher et al. (16), 87% of heifers exhibited estrus during the 120 h following the $PGF_{2\alpha}$ injection. Ninety-six percent of the cows in our study exhibited estrus by 120 h post-$PGF_{2\alpha}$, when estrous detection began 1 d prior to $PGF_{2\alpha}$ administration. Cows that were detected in estrus before the $PGF_{2\alpha}$ injection were not inseminated. Subsequent data (T.W. Geary, unpublished data) has confirmed that breeding cows that exhibit estrus within 30 h prior to $PGF_{2\alpha}$ injection results in normal fertility.

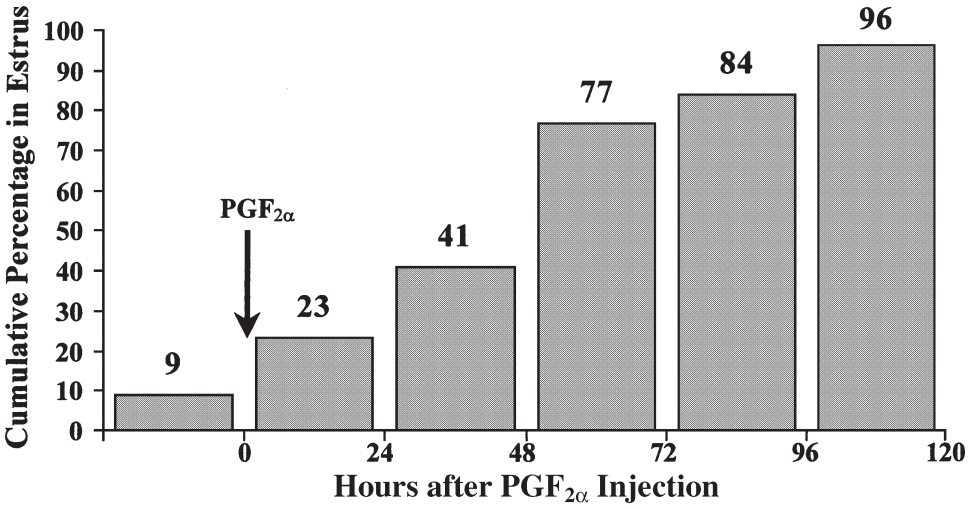


Figure 4. Cumulative estrous response following prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) administration on d 0.

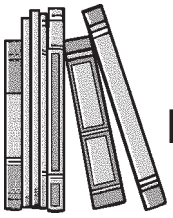
Whittier et al. (18) reported that approximately 3% of synchronized cows exhibited estrus only during the dark hours (2100 to 0500), and approximately 20 to 25% initiated estrus during darkness, which may have decreased the number of cows visually detected in estrus the next morning. In the present study, electronic detection of estrus during the 120 h following the $PGF_{2\alpha}$ injection did not identify more ($P>0.5$) cows in estrus than 4 h of visual observation of estrus per day (88 *vs* 85%, electronic *vs* visual, respectively). Thus, electronic estrous detection is not essential to accurate detection of estrus. Whittier et al. (18) concluded that electronic estrous detection was superior to visual estrous detection when visual observation was limited to 2 h/d (0600 and 1800 h, 1 h each). Combined, these data suggest that more cows will be detected in estrus if more time is spent observing them.

Eighty-eight percent of cows exhibited estrus during the 120-h period following $PGF_{2\alpha}$ administration (synchronization rate). Conception rate (percentage of cows inseminated that were pregnant at d 60) to AI was 82%, and the synchronized pregnancy rate (percentage of treated cows that were pregnant on d 60) was 71%. These high conception and pregnancy rates may be the result of accurate detection of estrus, coupled with the optimal timing of insemination. In addition, since the GnRH injection caused dominant follicle turnover in the majority of cows, this protocol may have resulted in the ovulation of a more viable ovum (15). The synchronization, conception, and pregnancy rates of anestrous and cyclic cows by day of the estrous cycle at initiation of synchronization is shown in Table 1. Comparing the conception rates of anestrous and estrous cycling cows demonstrates that fertility of the induced estrus in anestrous cows was quite good (79% of cyclic cows). It should be noted that all of the cows used in this study were multiparous cows in good condition with an 83 d

average postpartum interval. These factors may have improved the estrous and pregnancy responses to this treatment.

Implications

Estrous detection needs to begin 24 h before the $PGF_{2\alpha}$ injection with the Select Synch protocol, as most cows in the later stages of their estrous cycle at initiation of treatment will exhibit estrus before this injection. When this recommendation was followed, the Select Synch protocol was effective in synchronizing estrus in anestrous cows, as well as cows at all stages of their estrous cycle. In addition, artificial insemination resulted in high conception and pregnancy rates, compared with industry standards. Also, intense observation of cows for signs of estrus (4 h/d) for 6 d can be as effective as continuous (electronic) detection of estrus.



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