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Fertility after implementation of long- and short-term progesterone-based ovulation synchronization protocols for fixed-time artificial insemination in beef heifers

R. Kasimanickam [a,*], S. Schroeder [a], J.B. Hall [b], W.D. Whittier [c]

[a] Department of Veterinary Clinical Sciences, Washington State University, Pullman, Washington, USA
[b] Department of Animal and Veterinary Science, Nancy M Cummins Research Extension and Education Center, University of Idaho, Carmen, Idaho, USA
[c] Department of Large Animal Clinical Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA

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ABSTRACT

Two experiments were conducted to evaluate the effect of long-term (LT; a 14-day controlled internal drug release insert [CIDR]–PGF2α [PGF]–GnRH) and short-term (ST; 5-day CO-Synch + CIDR) progesterone-based protocols on pregnancy rate to fixed-time artificial insemination (FTAI) in beef heifers. In experiment 1, Angus cross beef heifers (N = 1887) at nine locations received a body condition score and a reproductive tract score (RTS). Within the herd, heifers were randomly assigned to LT-72 and ST-56 protocol groups. Heifers in the LT-72 group received a CIDR from Days 0 to 14, followed by 25 mg of PGF 16 days later (Day 30). Heifers in the ST-56 group received a CIDR and 100 μg of gonadorelin hydrochloride (GnRH) on Day 25 followed by 25 mg of PGF at CIDR removal on Day 30 and a second dose of PGF 6 hours later (Day 30). Artificial insemination was performed at 56 hours (Day 32) after CIDR removal for the ST-56 group and at 72 hours (Day 33) after CIDR removal for the LT-72 group, and all heifers were given GnRH (100 μg, intramuscular) at the time of AI. In experiment 2, Angus cross beef heifers (N = 718) at four locations received a body condition score and an RTS. Within the herd, heifers were randomly assigned to LT-72 and ST-72 protocol groups. The protocol was similar to experiment 1 except that AI was performed at 72 hours after CIDR removal for both LT-72 and ST-72 groups. In experiment 1, no difference in AI pregnancy rates between the LT-72 and ST-56 groups was observed (54.5% [489 of 897] and 55.5% [549 of 990], respectively; P = 0.92) after accounting for the RTS. The AI pregnancy rates for heifers with RTS 3 or less, 4, and 5 were 52.6%, 53.6%, and 59.9%, respectively (P < 0.05). In experiment 2, controlling for the RTS, no difference in AI pregnancy rates was observed between the LT-72 and ST-72 groups, 56.9% (198 of 347) and 57.8% (214 of 371), respectively (P = 0.87). The AI pregnancy rates for heifers with RTS 3 or less, 4, and 5 were 49.3%, 58.4%, and 62.1%, respectively (P < 0.05). In conclusion, heifers synchronized for fixed-time AI with LT and ST protocols resulted in a similar AI pregnancy rate. Approximately, 55% of the herd was pregnant to one insemination in 33 days with the LT protocol compared with just 8 days with the ST protocol.

1. Introduction

Estrous synchronization and artificial insemination (AI) provide producers with management tools to maximize

* Corresponding author. Tel.: +1 509 335 6060; fax: +1 509 335 0880.
E-mail address: ramkasi@vetmed.wsu.edu (R. Kasimanickam).

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the reproductive potential of their herd by incorporating superior genetics into their beef operations. In addition, the use of fixed-time artificial insemination (FTAI) is attractive to many beef cattle producers as it eliminates the time and labor required for estrous detection. Recent improvements in our understanding of methods for synchronizing the time of estrus and ovulation in replacement beef heifers create the opportunity to significantly increase the use of AI [1]. Technology with many options now exists to successfully inseminate heifers at predetermined fixed times with pregnancy rates comparable with those achieved with estrous detection. Selection of a desirable protocol should consider evaluation of available resources and assessment of heifers intended for estrous synchronization. Consideration should also include the length of the protocol [2], number of times animals are handled [3], facility type [4], experience of operators, cost involved in the implementation of the protocol [5], and the ability to successfully deliver treatments.

Currently two estrous synchronization protocols, the 5-day CO-Synch + controlled internal drug release insert [CIDR] and the 14-day CIDR–PGF2α (PGF)–GnRH, have been recommended to implement for FTAI in beef heifers. Both protocols have resulted in greater AI pregnancy rates in beef heifers than have the 7-day CO-Synch + CIDR protocols [6–10]. However, both these protocols have practical limitations. The 5-day CO-Synch + CIDR (short term [ST]) protocol requires animals to be handled twice on Day 5 of the protocol to deliver two injections of PGF on the day of CIDR removal, whereas the duration of the 14-Day CIDR–PGF–GnRH (long-term [LT]) protocol (33 days) and the requirement to handle the animals five times may restrict its use. Although both protocols have limitations, both represent viable options for beef producers wanting to use estrus synchronization and AI. However, a direct comparison between these protocols has not been reported, making it difficult to reliably make recommendations to producers as to which protocol will deliver the greatest pregnancy rate. Therefore, the objective of this study was to evaluate the effect of LT (14-day CIDR–PGF–GnRH) and ST (5-day CO-Synch + CIDR) protocols on pregnancy rate to FTAI in beef heifers.

2. Materials and methods

2.1. Experiment 1

In experiment 1, Angus cross beef heifers (N = 1887) at nine locations included in 2012 fall and 2013 spring breeding seasons received a body condition score (BCS; 1–9; 1: emaciated; 9: obese) and a reproductive tract score (RTS; 1–5; 1: under developed; 5: cycling; N = 1639; heifers were not given the RTS in two locations). Within the herd, heifers were randomly assigned to LT-72 (n = 897) and ST-56 (n = 990) estrous synchronization protocol groups (Fig. 1A). Heifers in the LT-72 group received a CIDR (Eazi-Breed CIDR Cattle Insert; Pfizer Animal Health, New York, NY, USA) from Days 0 to 14, followed by 25 mg of PGF (dinoprost; 5 mL intramuscular [im]; Lutalyse sterile solution; Pfizer Animal Health) 16 days later (Day 30). Heifers in the ST-56 group received a CIDR and 100 μg of gonadorelin hydrochloride (GnRH; 2 mL, im; Factrel; Pfizer Animal Health) on Day 25 followed by 25 mg of PGF at CIDR removal on Day 30 and a second dose of PGF 6 hours later (Day 30). Artificial insemination was performed at 56 hours (Day 32) after CIDR removal for the ST-56 group and at 72 hours (Day 33) after CIDR removal for the LT-72 group. All heifers were given GnRH (100 μg, im) at the time of insemination. Artificial insemination sires differed among locations and were selected and assigned to heifers on the basis of sire traits and to avoid inbreeding. In six locations, the ranch used technicians from breeding companies, and in the other three locations, one clinician performed the inseminations. Experienced clinicians or trained veterinary students assigned the BCS and RTS for each heifer. The timing of CIDR insertion, CIDR withdrawal, interval to the second PGF injection, and timed AI were recorded for each animal.

2.2. Experiment 2

In the 2013 spring breeding season, Angus cross beef heifers (N = 718) at four locations were randomly assigned to LT-72 (n = 350) and ST-72 (n = 368) protocols within the herd (Fig. 1B). The protocol was similar to experiment 1 except that AI was performed at 72 hours after CIDR removal for both ST-72 and LT-72 groups. Additionally, each heifer received a BCS and an RTS (N = 499; heifers were not given the RTS in two locations). Artificial insemination sires differed among locations and were selected and assigned to heifers on the basis of sire traits and to avoid inbreeding. In all locations, the ranch used technicians from stud companies. The BCS and RTS were assigned by experienced clinicians or by trained DVM students. Two weeks later, intact Angus bulls were placed with heifers (approximately1:40–1:50), across treatments, for the remainder of the 60 to 70 days of the breeding season.

2.3. Pregnancy diagnosis

Heifers were examined for pregnancy status approximately 70 days after FTAI by ultrasonography (Aloka-500; Sysmed Lab Inc., Chicago, IL, USA) of the uterus and its contents to differentiate heifers bred by AI or natural service sires. The criteria considered were the size of the amniotic vesicle, fetus, and placentomes. The AI pregnancy rate was calculated as the number of heifers pregnant to AI divided by the total number of heifers inseminated.

2.4. Statistical analyses

Data were analyzed with a statistical software program (SAS Version 9.3 for Windows; SAS Institute, Cary, NC, USA). Differences in the mean BCS between the treatments were analyzed using one-way ANOVA (PROC GLM of SAS). Differences in the mean interval (hour) from CIDR insertion to CIDR withdrawal and the interval from CIDR removal to the time of insemination between the groups were analyzed by ANOVA; the Bartlett test was used to assess homogeneity of variance (PROC GLM of SAS). Because variances for the mean interval were heterogeneous, a log10 transformation was performed. The values are presented with nontransformed values.