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Estrous synchronization strategies to optimize beef heifer reproductive performance after reproductive tract scoring

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ABSTRACT

Three experiments comparing four estrous synchronization protocols were conducted to determine estrous expression rate and artificial insemination pregnancy rate (AI-PR) in heifers with a range (1–5) of reproductive tract scores (RTSs). At enrollment (Day 0), 1783 Angus cross beef heifers from six locations were given body condition score and RTS. The four protocols were: (1) HRTS-DPGF group—heifers with RTS 5 received prostaglandin F2α (PGF; Dinoprost 25 mg; im) on Days 0 and 14; (2) HRTS-CIDR-PGF group—heifers with RTS 5 received a CIDR (1.3-g progesterone) insert on Day 7, followed by CIDR removal and PGF on Day 14; (3) LRTS-CIDR-PGF group—heifers with RTS 4 or less received a CIDR insert on Day 7, followed by CIDR removal and PGF on Day 14; and (4) HRTS-Select-Synch group—heifers with RTS 5 received 100 μg of gonadorelin diacetate tetrahydrate (gonadotropin releasing homone; im) on Day 7 and PGF on Day 14. In all groups, heifers observed in estrus were artificially inseminated (within 120 hours after PGF) using the AM-PM rule. In Experiment 1, estrus expression rates were 82.2% (282/343) and 88.5% (184/208) for HRTS-DPGF and LRTS-CIDR-PGF, respectively ($P < 0.05$), whereas AI-PR were 51.3% (176/343) and 59.1% (123/208; $P < 0.1$). In Experiment 2, estrus expression rates were 79.6 (168/211), 86.9 (186/214) and 84.2% (176/209) for HRTS-DPGF, HRTS-CIDR-PGF, and LRTS-CIDR-PGF groups ($P > 0.1$) and AI-PR were 52.1 (110/211), 60.3 (129/214), and 58.4% (122/209; $P > 0.05$). In Experiment 3, estrus expression rates were 77.5 (131/169), 85.5 (142/166), and 83.3% (219/263) for HRTS-DPGF, HRTS-Select-Synch and LRTS-CIDR-PGF ($P > 0.05$) and AI-PR were 53.3 (90/169), 60.2 (100/166), and 58.6% (154/263; $P > 0.1$). Overall, estrus expression rates for HRTS-DPGF, HRTS-Select-Synch, LRTS-CIDR-PGF, and HRTS-CIDR-PGF groups were 80.4 (581/723), 85.5 (142/166), 85.1 (579/680), and 86.9% (186/214), respectively; higher for heifers in LRTS-CIDR-PGF and HRTS-CIDR-PGF groups compared to heifers in HRTS-DPGF group ($P < 0.05$). The AI-PR for heifers in HRTS-DPGF was lower (52.0 [376/723]) compared with HRTS-Select-Synch (60.2 [100/166]), LRTS-CIDR-PGF (58.7 [399/680]), and HRTS-CIDR-PGF (60.3 [129/214]); $P < 0.05$). In conclusion, heifers achieved greater AI-PR after CIDR-PGF or HRTS-Select-Synch estrous synchronization protocols. Even though acceptable AI-PRs achieved in heifers with RTS 5 that were subjected to a double PGF protocol, the reproductive performance was reduced compared with other protocols used in this study.

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1. Introduction

Replacement heifer selection on the basis of age at puberty is desirable because of its association with fertility outcomes and with lifetime production. Earlier age at puberty in relation to breeding ensures that a higher percentage of heifers are cycling. The ability to accurately determine sexual maturity as a predictor of future reproductive efficiency is important. As age at puberty in beef heifers is difficult to measure directly, the reproductive tract score (RTS) system, on the basis of transrectal palpation of the uterus and ovaries, was developed to estimate pubertal status [1]. Based on ovarian follicular development, presence of a CL, and estimated size of the reproductive tract, heifers are assigned a score of 1 (immature, anestrus/prepuberal) through 5 (mature, cycling/pubertal) [1]. Although heifers must reach puberty at 15 months of age or earlier if they are to conceive and calve by 24 months, as many as 35% fail to do so [2–4].

Synchronization protocols using prostaglandin F2α (PGF), gonadotropin releasing homone (GnRH), with or without a progestin, have been successfully used to control follicular and luteal dynamics and synchronize ovulation in beef heifers [5–8]. Although these protocols enable artificial insemination (AI) at a fixed time without estrous detection, beef cattle that displayed estrus were 3.3 times more likely to become pregnant than those that did not display estrus [9].

Physiological diversity of beef heifers at synchronization offers challenges and opportunities. For example, application of specific estrous synchronization protocols on the basis of pubertal status offers a chance to synchronize estrous with minimum use of hormones. In addition, it creates an opportunity to only inseminate females that express estrus, thereby minimizing semen use and maximizing conception rate.

The objective was to determine AI-PR after the application of estrous synchronization protocols in beef heifers with varying reproductive tract scores.

2. Materials and methods

Six beef farms that used synchronization protocols as part of their breeding strategies during the 2013 through 2015 spring breeding seasons, from the states of WA, ID, and OR, were included in the study. Evaluation of reproductive tract score (Table 1) by transrectal palpation was done on Angus cross beef heifers (n = 1835; age: 15.1 ± 0.7 months) at the time of synchronization. Heifers (n = 1793) with RTS 2–5 were included in the study, whereas heifers with RTS 1 or freemartin (n = 52) were excluded from the study. All of these participating farms wanted to have their heifers calve at 2 years of age. Heifers were fed to meet National Research Council recommendations [10].

In experiment 1, Angus cross beef heifers (n = 551) were given body condition score (BCS; 1-emaciated; 9-obese) and RTS (1-immature acyclic; 5-mature cyclic) at enrollment (Day 0). Heifers with RTS 5 (n = 343) were assigned to double PGF protocol (HRTS-DPGF group) and received 25 mg of dinoprost (im; 5 mL; Lutalyse sterile solution; Zoetis Animal Health, New York, NY, USA) on Days 0 and 14. Heifers with RTS 2 to 4 (n = 208) were assigned to controlled internal drug release (CIDR) protocol (LRTS-CIDR-PGF group), received a CIDR (1.3 g of progesterone; Eazi-Breed CIDR Cattle Insert; Zoetis Animal Health) insert on Day 7. On Day 14, CIDRs were removed and heifers were given 25 mg of dinoprost.

In experiment 2, Angus cross beef heifers (n = 634) were given BCS and RTS at enrollment (Day 0). Heifers with RTS 5 (n = 426) were randomly assigned either to a double PGF protocol (HRTS-DPGF group; n = 211) or to a CIDR protocol (HRTS-CIDR-PGF group; n = 215). Heifers with RTS 2 to 4 (n = 208) were assigned to CIDR protocol (LRTS-CIDR-PGF group). Heifers in HRTS-DPGF group received 25 mg of dinoprost on Days 0 and 14. On Day 7, heifers in HRTS-CIDR-PGF and LRTS-CIDR-PGF groups received a CIDR and on Day 14, CIDRs were removed and heifers were given 25 mg of dinoprost.

In experiment 3, Angus cross beef heifers (n = 598) were assigned a BCS and RTS at enrollment (Day 0). Heifers with RTS 5 (n = 335) were randomly assigned either to a HRTS-DPGF group; (n = 169) or to a HRTS-Select-Synch group (n = 166). Heifers with RTS 2 to 4 (n = 263) were assigned to a CIDR protocol (LRTS-CIDR-PGF group). Heifers in DPGF received 25 mg of dinoprost im on Days 0 and 14. Heifers in LRTS-CIDR-PGF groups received a CIDR on Day 7 and on Day 14, CIDRs were removed and they were given 25 mg of dinoprost. Heifers in HRTS-Select-Synch group were given 100 μg of gonadorelin diacetate tetrahydrate (GnRH; 2 mL; im; Cystorelin, Merial Inc., Duluth, GA, USA) on Day 7 and 25 mg of dinoprost on Day 14.

On Day 14 (concurrent with PGF treatment), heifers in all groups were fitted with estrus detection aids (Kamar Heatmount detector patches [Kamar, Inc., Steamboat Springs, CO, USA] or Estrus Alert patches [Western Point Inc., Apple Valley, MN, USA] or chalk). Heifers were observed thrice daily for standing estrus and estrus detector aid status indicating estrus. Heifers in estrus were artificially inseminated once (using AM-PM rule [11]) throughout 120 hours after PGF treatment.

Among locations, AI sires and AI technicians differed. After AI, heifers were either exposed to bulls starting 2 weeks later or observed for estrus to artificially inseminate heifers that were not pregnant to first AI. Pregnancy diagnosis was performed 70–110 days after AI using transrectal ultrasonography (Sonosite S8 with 5 MHz

Table 1
Description of reproductive tract scores[a] in heifers on the basis of uterine and ovarian characteristics.

Score	Uterine horns	Ovaries
1	Immature, <20 mm diameter, no tone;	no palpable structures
2	20–25-mm diameter, no tone	8-mm follicles
3	20–25-mm diameter, slight tone	8–10-mm follicles
4	30-mm diameter, no, slight or good tone	>10-mm follicles, possible CL
5	>30-mm diameter, no tone	CL present

[a] Assessed by transrectal palpation.
Adapted from the study by Kasimanickam RK et al.[8].