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2014

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Vraspir, Rebecca A.; Summers, Adam F.; O'Hare, Doug Hare; Rowden, Larry D.; and Funston, Rick N., "Comparison of Long-term Progestin-Based Synchronization Protocols on Fixed-time AI Pregnancy Rate in Beef Heifers" (2014). *Nebraska Beef Cattle Reports*. 759.
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Comparison of Long-term Progestin-Based Synchronization Protocols on Fixed-time AI Pregnancy Rate in Beef Heifers

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Summary

Yearling Angus heifers at a commercial ranch in the Nebraska Sandhills were randomly assigned to one of two progestin-based fixed-time AI protocols (MGA or 14-day CIDR) to compare pregnancy rates. Heifers had similar fixed-time AI pregnancy rates between MGA and 14-day CIDR. A similar proportion of MGA and 14-day CIDR heifers displayed a second estrus; however, heifers previously synchronized with MGA tended to have a greater second AI pregnancy rate. Overall pregnancy rate was similar between MGA and 14-day CIDR treatments. The MGA system was the more cost effective synchronization protocol in this study.

Introduction

Yearling beef heifers are the future of the cowherd and their lifetime reproductive success is dependent on conceiving early in the first and subsequent breeding seasons. Heifers that conceive early in the breeding season and calve within the first 21days of the calving season have increased lifetime reproductive performance and produce progeny with greater overall productivity than those born later in the calving season (*2012 Nebraska Beef Cattle Report*, pp. 18-19). Estrous synchronization and AI are reproductive procedures that can produce a greater proportion of heifers that reach puberty and achieve pregnancy early in the breeding season. Fixed-time AI (FTAI) protocols can reduce time and labor by eliminating estrus detection and minimizing the number of times heifers are handled. Progestin-based estrous synchronization, such as those utilizing melengestrol actetate (MGA) and controlled internal drug release (CIDR), have been documented to induce estrous cyclicity in heifers failing to reach puberty prior to administration. Therefore, the objectives of this study were to evaluate the pregnancy rates and compare monetary costs of MGA and 14-day CIDR FTAI protocols in beef heifers.

Procedure

The University of Nebraska–Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in this experiment.

Heifers and Diet

Nulliparous, predominately Angus, yearling beef heifers (n = 1,385) purchased from livestock auctions in Nebraska and South Dakota were utilized in this study, which took place on a commercial ranch in the Nebraska Sandhills. Upon arrival, heifers were vaccinated with Express® 3 FP3 VL3 and de-wormed with Safe-Guard. Pelvic area was measured and the presence of a significant ovarian structure (follicle and/or corpus luteum) was identified via rectal palpation by a single technician. Heifers with a small pelvic area or underdeveloped reproductive tract, and any freemartins were culled (n = 15). Heifer average BW was 725 lb at assignment to treatment. Prior to estrous synchronization treatment, heifers were placed in a drylot and offered 15.7 lb/day DM of a diet containing wet distillers grains plus solubles (26.9% DM), mixed hay (66.9% DM), and a supplement (6.2% DM) during a 14-day adaptation period. After heifers were assigned to treatment groups, they were offered 19 lb/day DM of the same diet (Table 1).

Table 1. Composition and nutrient analysis of drylot diet fed to heifers[1]

Item	% DM
Wet distillers grain	26.9
Mixed hay	66.9
Supplement[2]	6.2
Diet nutrient analysis, %	
CP	15.7
TDN	65.3
Fat	4.8

[1]Nutrient analysis performed by Cattlemen's Nutrition Services, LLC (Lincoln, Neb.).
[2]Supplement included 10.0% dried distillers grain plus solubles, 48.8% wheat middlings, 39.9% vitamins and minerals, 0.9% urea, 0.4 % trace mineral premix, and 200 mg·heifer^{-1}·d^{-1} Rumensin.

Treatments

Heifers from varying sources were randomly subdivided into four groups, and each group was randomly assigned to one of two treatments (Figure 1): MGA (n = 688) or 14-day CIDR (n = 697). Heifers assigned to MGA received melengestrol acetate (0.5 mg·heifer^{-1}·d^{-1}) from day 0 through 13, were administered $PGF_{2\alpha}$ (25 mg i.m.) 19 days after MGA withdrawal (day 32), and AI approximately 72 hours after $PGF_{2\alpha}$ (day 35). Heifers assigned to 14-days CIDR received an Eazi-Breed CIDR insert (1.38 g progesterone) from day 2 to 16, followed by administration of $PGF_{2\alpha}$ 16 days after CIDR removal (day 32) and AI approximately 66 hours after $PGF_{2\alpha}$ (day 35). Both treatment groups received GnRH (100 µg i.m.) at FTAI.

Artificial Insemination, Natural Service, and Pregnancy Diagnosis

Heifers were inseminated by 10 AI technicians using semen from a single

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Table 2. Reproductive measurements prior to treatment and effect of controlled internal drug release (14-day CIDR) and melengestrol acetate (MGA) synchronization systems on pregnancy rates.

	Treatment			
Item	MGA[1]	14-day CIDR[2]	SEM	*P*-value
n	688	697		
Significant structure,[3] %	99	97	1	0.08
Pelvic area, cm^2	159	157	1	0.50
Fixed-time AI pregnancy rate,[4] %	62	61	2	0.56
Heifers receiving second AI, %	26	26	2	0.83
Second AI pregnancy rate,[5] %	66	56	4	0.06
Natural service pregnancy rate,[6] %	66	65	4	0.85
Final pregnancy rate,[6] %	93	90	1	0.27

[1]Received MGA day 0 to 13, followed by $PGF_{2\alpha}$ day 32, GnRH was administered at fixed time-AI, approximately 72 hours after $PGF_{2\alpha}$ (day 35).
[2]Received CIDR day 2 to 16, followed by $PGF_{2\alpha}$ day 32, GnRH was administered at fixed time-AI, approximately 66 hours after $PGF_{2\alpha}$ (day 35).
[3]Presence of a palpable follicle and/or corpus luteum.
[4]Determined via transrectal ultrasound 45 days following FTAI.
[5]Determined via transrectal ultrasound approximately 50 days following second AI.
[6]Determined via transrectal ultrasound 36 days following bull removal.

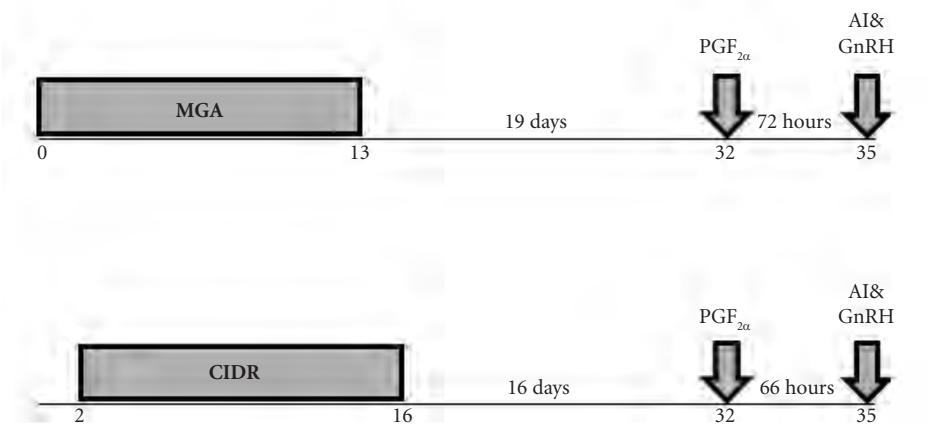

Figure 1. Treatment schedule for heifers assigned to MGA (n = 688) or 14-days CIDR (n = 697); MGA = melengestrol acetate, CIDR = controlled internal drug release, $PGF_{2\alpha}$ = prostaglandin, GnRH = gonadotropin releasing hormone.

bull to reduce variation in pregnancy rates due to semen quality. Following FTAI, heifers remained in the drylot and were observed twice daily for signs of estrus from day 15 to 25. Heifers observed in estrus were AI 12-18 hours later and placed on summer pasture. Heifers not observed in estrus remained in the drylot until pregnancy diagnosis 45 days after FTAI via transrectal ultrasonography. Bulls were placed with heifers approximately 32 days after FTAI for 50 days with a bull to heifer ratio of 1:25. Repeat AI heifers were examined for pregnancy approximately 50 days after second AI. Diagnosis of natural service pregnancy occurred approximately 36 days following removal of bulls.

Economic Analysis

A partial budget analysis was conducted using the procedure by Feuz (*Journal of the American Society of Farm Managers and Rural Appraisers*, 1992, 56(1): 61-66). The budget analysis was evaluated for the FTAI, second AI, and overall pregnancy. Costs associated with each treatment (MGA, CIDR, and additional pharmaceuticals) were derived from the Estrus Synchronization Planner (Beef Reproduction Task Force, 2011); semen and labor costs were based on actual costs. The value of the heifers at the beginning of the study (purchase value) and at pregnancy diagnosis (cull value) was calculated from the Nebraska and South Dakota average price reported by the USDA Agricultural Marketing Service (2012) for each corresponding date. Total breeding costs included progestin source, pharmaceuticals, semen, and labor cost per heifer. Total treatment cost per heifer was calculated by adding the purchase price and total breeding cost. The net cost of 1 pregnant heifer was calculated as the difference between total treatment cost per heifer and cull value, divided by pregnancy rate.

Statistical Analysis

The statistical model included estrous synchronization protocol as the fixed effect. Heifer origin and AI technician were included as random variables. Continuous and binomial data were analyzed using the MIXED and GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, N.C.) 9.2, respectively. Means were separated by LSD, and declared different at $P \leq 0.05$.

Results

Pregnancy Rates

Fixed-time AI pregnancy rates did not differ ($P = 0.56$) between MGA and 14-day CIDR (62 vs. 61 ± 2%, respectively; Table 2). These FTAI pregnancy rates were similar to those reported by Busch et al. (*Journal of Animal Science*, 2007, 85:1933-1939) when comparing a 14-day CIDR to a 7-day CIDR (CIDR Select vs. CO-Synch + CIDR). The final pregnancy rates in this study ranged from 47 to 62% across three locations, with the 14-day CIDR consistently yielding greater pregnancy rates.

Second AI occurred 15 to 25 days following FTAI. Throughout this

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period a similar number of heifers from each treatment ($P = 0.83$) were observed in estrus and AI; however, heifers previously synchronized with MGA tended ($P = 0.06$) to have greater second AI conception rate (66 vs. 56% ± 2% for MGA and CIDR, respectively).

Natural service pregnancy rate (66 vs. 65 ± 4%) and overall pregnancy rate (93 vs. 90 ± 1%) were similar ($P > 0.27$) between the MGA and 14-day CIDR groups, respectively. Similar pregnancy rates have been reported in heifers when comparing 14-day progestin-based synchronization protocols (MGA and CIDR), with a period of estrus detection. Similar pregnancy rates were reported when comparing MGA and 14-day CIDR in heifers detected for estrus for 60 hours and AI 12 hours later, followed by a clean-up FTAI at 72 hours for heifers not detected in estrus (66% MGA vs. 62% CIDR; *Theriogenology*, 2007, 68:162-167) and when utilizing estrus detection for 144 hours and AI 12 hours later (43 to 54% MGA vs. 49 to 53% CIDR; *Journal of Animal Science*, 2010, 88: 3568-3578). From the present study it appears FTAI has the capability to yield similar pregnancy rates when compared with estrus detection and AI utilizing similar synchronization protocols.

Economic Analysis

When comparing MGA or 14-day CIDR utilizing strictly FTAI, the MGA estrous synchronization protocol resulted in approximately a $15 decrease in cost per pregnant heifer. This can be attributed mostly to the difference in breeding cost and partially to the number of cull heifers. Comparing overall costs for each synchronization method (FTAI and second AI), the MGA system cost approximately $19 less to produce a pregnant heifer compared with 14-day CIDR, primarily due to differences in breeding costs between treatments. Therefore, it was more cost effective to synchronize with MGA, which resulted in similar pregnancy rates compared with 14-day CIDR.

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