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Optimizing a new 5-day CIDR-CO-Synch timed artificial insemination program

Abstract

The 7-day CO-Synch + CIDR protocol is a popular ovulation-synchronization program used by cow-calf producers to facilitate artificial insemination (AI). A progesterone-impregnated controlled internal drug release (CIDR) insert is placed intravaginally and an injection of gonadotropin-releasing hormone (GnRH) is given. After 7 days, prostaglandin F₂α (PGF₂α) is administered and the CIDR insert is removed. Between 58 and 72 hours after insert removal, cows are inseminated after another injection of GnRH to induce ovulation. Timed AI pregnancy rates generally have ranged from 40 to 60% when suckled cows are treated with the 7-day CO-Synch + CIDR protocol.

Keywords

Kansas Agricultural Experiment Station contribution; no. 11-171-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1047; Cattlemen's Day, 2011; Beef; CIDR-CO-Synch; Time artificial insemination

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Optimizing a New 5-day CIDR-CO-Synch Timed Artificial Insemination Program

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Introduction

The 7-day CO-Synch + CIDR protocol is a popular ovulation-synchronization program used by cow-calf producers to facilitate artificial insemination (AI). A progesterone-impregnated controlled internal drug release (CIDR) insert is placed intravaginally and an injection of gonadotropin-releasing hormone (GnRH) is given. After 7 days, prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) is administered and the CIDR insert is removed. Between 58 and 72 hours after insert removal, cows are inseminated after another injection of GnRH to induce ovulation. Timed AI pregnancy rates generally have ranged from 40 to 60% when suckled cows are treated with the 7-day CO-Synch + CIDR protocol.

Reducing the period of follicular dominance in a 5-day compared with a 7-day CIDR insert program resulted in a new follicular wave producing a younger dominant follicle. When a CIDR insert is placed at the beginning of the protocol and removed after 7 days at the same time $PGF_{2\alpha}$ is injected, the newly developed dominant follicle is approximately 5 days old. In contrast, when the CIDR insert is removed after 5 days, the newly developed dominant follicle is smaller in diameter and 2 days younger. Concentrations of progesterone decline when the corpus luteum regresses in response to $PGF_{2\alpha}$ and the exogenous source of progesterone in the CIDR insert is removed. The dominant follicles then mature in both scenarios and secrete sufficient estradiol to cause estrus. The younger and smaller follicle must develop longer in a low-progesterone proestrous environment that is more favorable to produce a more fertile egg. Actual comparisons of fertility of 5- vs. 7-day CIDR programs have generally shown improved fertility for the 5-day program when applied to suckled beef cattle.

The disadvantage of the 5-day program is the corpus luteum that develops in response to the GnRH injection given at CIDR insertion is less responsive to $PGF_{2\alpha}$ because it is younger and less mature. Therefore, to make a 5-day program successful, a second or larger dose of $PGF_{2\alpha}$ must be given. The objective of this study was to determine whether a single large or double dose of $PGF_{2\alpha}$ would be as effective as two doses given 8 hours apart. The control was a single dose of $PGF_{2\alpha}$ at CIDR insert removal.

Experimental Procedures

This study was part of a multi-location study in which more than 2,420 cows were treated in 13 different locations in 8 states. The study was conducted in lactating postpartum beef cows. Three locations of cows were treated in Kansas: (1) Purebred Angus, Hereford, and Simmental cows at the Kansas State University Purebred Beef Unit; (2) Angus x Hereford cows at the Kansas State University Commercial Cow-Calf Unit; and (3) Angus cows at the Kansas State University Agricultural Research Center—Hays. Cows were allotted randomly to treatments based on breed, age (primiparous vs.

multiparous), and days postpartum at the onset of the treatment scheme. In total, we treated 591 cows at our Kansas locations.

Treatments

On day -5, cows were assigned a body condition score (1 = thin; 9 = very fat), were administered 100 µg GnRH (Factrel; Pfizer Animal Health, New York, NY), and received an intravaginal progesterone-releasing CIDR insert (Pfizer Animal Health; Figure 1). On day 0, CIDR inserts were removed and cows received 1 of 3 treatments of PGF_{2α} at the time of CIDR insert removal: (1) two doses (2 x 5 mL) of Lutalyse (Pfizer Animal Health) 8 hours apart with the initial injection administered at CIDR insert removal (2 x 8 hours), (2) double dose (10 mL) of Lutalyse (Double dose), or (3) one dose (5 mL) of Lutalyse (Single dose). All cows were inseminated 72 hours after CIDR removal concurrent with another 100-µg injection of GnRH. Cleanup bulls were placed with cows no sooner than 12 days after timed AI or cows were observed for estrus and reinseminated (Purebred Beef Unit). The breeding season averaged 65 days in duration, but ranged from 45 to 96 days across locations.

Cyclicity

Blood samples were collected on day -15 and -5 (CIDR insertion) to determine concentrations of progesterone (Figure 1). At the Purebred Beef Unit, additional blood samples were collected on days 0 and 3 to determine if the corpus luteum regressed (luteolysis) in response to treatment.

Tail paint scoring

At CIDR insert removal all cows were marked with tail paint (Aerosol Tell Tail, FIL Agritech, Homer, NY). At timed AI, tail paint scores were assessed: 1 = tail paint was completely gone; 2 = tail paint was partially gone, obvious signs of mounting; 3 = tail paint was undisturbed, no signs of mounting.

Pregnancy diagnosis

Pregnancy rates were determined via transrectal ultrasonography (Aloka 500V, 5 MHz rectal transducer, Wallingford, CT) between 33 and 35 days after timed AI. Overall breeding season pregnancy rates and embryonic losses after the initial positive pregnancy diagnosis were determined between 35 and 45 days after the end of the breeding season via ultrasonography.

Results and Discussion

Only 42.8% of the cows enrolled in the study had previous elevated concentrations of progesterone on either day -15, day -5, or both, and were considered to be cycling by day -5 when the timed AI program was initiated. Pregnancy rates per AI were greater for cows that were cycling compared with noncycling cows (53.4% vs. 45.6%, respectively). Cycling cows (n = 249) were 1.5 times (95% confidence intervals = 1.17 to 2.3) more (P=0.02) likely to become pregnant after the timed AI than noncycling cows (n = 335). Cows 3 or more years old (n = 419) were 1.6 times (95% confidence intervals = 1.0 to 2.4) more (P=0.035) likely to conceive after timed AI than 2-year-old cows (n = 165).

Proportion of cows having luteolysis after treatment did not differ (Table 1). Tail paint score did not differ among treatments, indicating that cows likely came into estrus at similar intervals after treatment and before AI. Timed AI pregnancy rates were greater ($P=0.02$) for cows receiving the two doses of $\text{PGF}_{2\alpha}$ administered 8 hours apart compared with a single dose (Table 1). Timed AI pregnancy rates in cows receiving the double dose of $\text{PGF}_{2\alpha}$ was intermediate and did not differ from the other 2 treatments. Pregnancy loss after the timed AI and final breeding-season pregnancy rates did not differ among treatments (Table 1).

More cows 3 or more years of age were pregnant at the end of the breeding season (2-year-olds = 79.4% vs. 3+year-olds = 93.8%). Cows 3 or more years old ($n = 419$) were 3.9 times (95% confidence intervals = 2.2 to 6.7) more ($P<0.001$) likely to be pregnant at the end of the breeding season than 2-year-old cows ($n = 165$). In addition, cows having body condition scores of 6 or more tended ($P=0.07$) to have had greater end-of-breeding season pregnancy rates at 90.9% compared with 88.6% for cows having body condition scores of 5 or less.

Our Kansas results were similar to those in the full study. Timed AI pregnancy rates were 55% ($n = 800$), 51% ($n = 806$), and 48% ($n = 800$) for the cows receiving the 2 doses (8 hours apart) of $\text{PGF}_{2\alpha}$, the double dose, and the single dose, respectively. Timed AI pregnancy rates were greater for cows receiving the two doses of $\text{PGF}_{2\alpha}$ administered 8 hours apart compared with a single dose. Timed AI pregnancy rates in cows receiving the double dose of $\text{PGF}_{2\alpha}$ was intermediate and did not differ from the other 2 treatments.

Implications

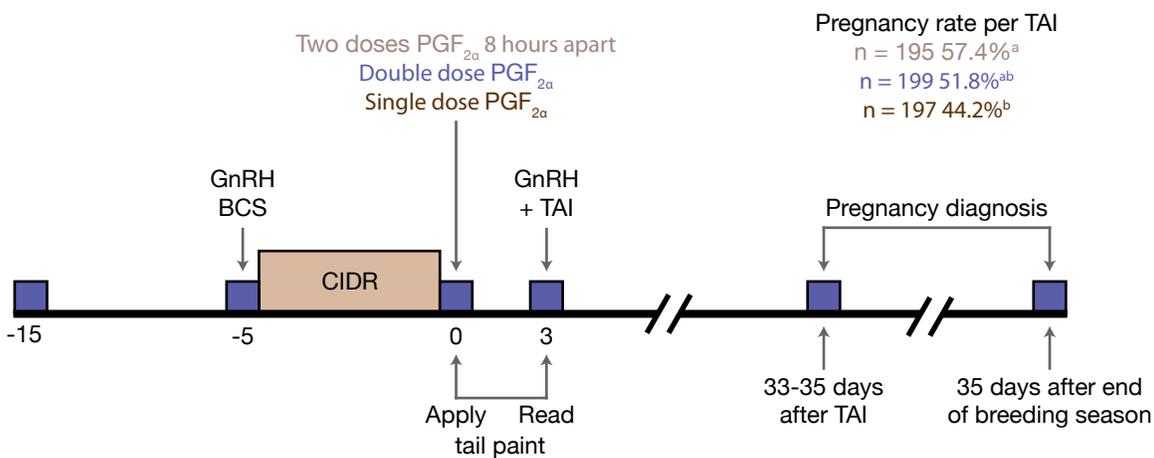
These results indicate that two doses of $\text{PGF}_{2\alpha}$ administered 8 hours apart are required to maximize timed AI pregnancy rates, but pregnancy rates were not different from those when the double dose of $\text{PGF}_{2\alpha}$ was given. The disadvantage of the 5- vs. 7-day CIDR-CO-Synch programs is the necessity of injecting the extra dose of $\text{PGF}_{2\alpha}$. Timed AI pregnancy rates may not justify the extra expense, but the 5-day program does offer a viable alternative to the 7-day program to produce timed AI pregnancy rates in excess of 50%.

Table 1. Responses to PGF_{2α} treatments in a 5-day CIDR-CO-Synch ovulation-synchronization program

Treatment	Luteolysis	Pregnancy rate	Pregnancy loss ¹	Final
				pregnancy rate
		Number/total (%)		
2 doses (8 hours apart)	49/51 (96.1 ^a)	112/195 (57.4 ^a)	4/112 (3.6 ^a)	176/193 (91.2 ^a)
Double dose	50/51 (98.0 ^a)	103/199 (51.8 ^{ab})	5/104 (4.8 ^a)	175/198 (88.4 ^a)
Single dose	46/51 (92.0 ^a)	87/197 (44.2 ^b)	2/84 (2.4 ^a)	173/193 (89.6 ^a)

^{ab} Means having different superscript letters within traits differ (P<0.05).

¹ Loss of the timed artificial insemination (AI) pregnancy after a positive pregnancy diagnosis was made between 33 and 35 days after AI.



GnRH = gonadotropin-releasing hormone (Factrel); PGF_{2α} = prostaglandin PGF_{2α} (Lutalyse);
 CIDR = intravaginal progesterone-releasing controlled drug release (EAZI-BREED CIDR);
 BCS = body condition score.

^{abc} Means having a different superscript differ (P<0.05)

Figure 1. Five-day timed artificial insemination (TAI) program testing the appropriate mode of treatment of PGF_{2α} to induce death of the corpus luteum before TAI.