Variation in Timed Artificial Insemination Pregnancy Rates in Specific Groups of Suckled Beef Cows

S.L. Hill and J.S. Stevenson

Introduction

Insemination of beef cows at a predetermined time is a management tool to reduce labor costs associated with conventional heat detection available to cattle producers. Multiple research trials have examined the timing of the administration of the individual components of the developed protocols associated with timed artificial insemination (TAI). In the current research, we examined various classifications of postpartum beef cows and analyzed their reproductive performance when submitted to TAI protocols. The 7-day CO-Synch + controlled internal drug release (CIDR) insert protocol and the 5-day CO-Synch + CIDR protocol have been shown to effectively initiate ovulation in cycling and non-cycling suckled beef cows, producing pregnancy rates at or greater than 50% in beef cows. We hypothesized that uniformly selected groups of cows based on their progesterone status at CIDR insertion, days postpartum, body condition score, and/or parity would demonstrate improved reproductive performance compared with non-grouped cows.

Experimental Procedures

A total of 1,277 primaparous and 5,676 multiparous cows in 14 states were included in this analysis. All cows were submitted to either a 5- or 7-day CO-Synch + CIDR TAI procedure. Both of these procedures were initiated with 100 μg gonadotropin-releasing hormone (2 mL Factrel, Pfizer Animal Health, Whitehouse Station, NJ) and a simultaneous vaginal insertion of a new CIDR insert (Pfizer Animal Health, Whitehouse Station, NJ) containing 1.38 g progesterone, followed in either 5 or 7 days with CIDR insert removal and concurrent intramuscular administration of 25 mg prostaglandin $F_{2\alpha}$ (5 mL Lutalyse; Pfizer Animal Health, Whitehouse Station, NJ). Insemination was performed from 56 to 72 hours after CIDR insert removal, and a second gonadotropin-releasing hormone treatment was administered concurrent with AI. Body condition scores (1 = thin; 9 = very fat) were assigned 10 days before the initial gonadotropin-releasing hormone injection. Blood samples were collected via caudal vessel puncture 10 days before and at the initial gonadotropin-releasing hormone treatment and CIDR insertion. Blood samples were assayed for progesterone by radioimmunoassay. Cows were classified at both sampling times according to the serum progesterone concentration. The labels of H ($\geq$4 ng/mL), MH (2 to 3.99 ng/mL), LM (1 to 1.99 ng/mL), and L (< 1 ng/mL) were assigned according to progesterone concentration at each sampling time. Days postpartum was calculated as the number of days from calving until the day of TAI.

Cows were either exposed to cleanup bulls beginning 10 to 12 days after TAI or reinseminated at subsequent estrus. At 35 days after AI, pregnancy was confirmed by transrectal ultrasonography (5MHz transrectal transducer, Aloka 500V, Wallingford, CT). A positive pregnancy outcome required presence of a corpus luteum and uterine

fluid or uterine fluid and an embryo with a heartbeat. A final pregnancy diagnosis was determined 35 days after the end of the breeding season via transrectal ultrasonography.

Results

Progesterone concentrations by classification had no influence ($P = 0.66$) on pregnancy when sampled at the time of CIDR insert insertion (Figure 1). The initial sampling of progesterone 10 days earlier, however, indicated that cows in the MH classification were more ($P < 0.05$) likely to become pregnant than the cows in the LM classification, and MH cows tended ($P < 0.10$) to have better pregnancy outcomes than the L cows (Figure 2).

Parity, days postpartum, and body condition score all affected pregnancy outcomes ($P = 0.0001$, 0.0001, and 0.021, respectively; Table 1). None of the two-way interactions among body condition score, parity, and days postpartum resulted in differences in TAI pregnancy rates, but the three-way interaction of body condition score, parity, and days postpartum tended ($P = 0.06$) to differ. This tendency indicated that cows with a body condition score >5 that were more than 73 days postpartum at TAI and had calved at least twice had the greatest pregnancy rate (Table 2). Conversely, cows that had calved only once, were 73 days or less postpartum, and had a body condition score ≤5 were least likely to become pregnant to TAI. All other combinations of body condition score, parity, and days postpartum resulted in TAI pregnancy rates that were intermediate to the previous combinations (Table 2).

Implications

The likelihood of pregnancy success is increased for cattle producers when cows in certain categories are subjected to TAI compared with using the same procedure on all cows in a herd. By sorting cows using easily distinguishable criteria such as body condition and days postpartum, limited economic and labor resources may be utilized more efficiently. For example, a producer might eliminate the CIDR and use only the CO-Synch programs in older, early calving cows in good body condition, which would reduce the per-cow cost of the hormones by more than 50%. Older cows in good body condition that calved early in the breeding season had an 8% greater TAI pregnancy outcome than other older cows in poorer body condition, fewer days postpartum, or both, and all primiparous cows regardless of days postpartum or body condition.

Table 1. Analysis of variance (PROC GLIMMIX[1])

Source of variation	d.f.[2]	F-value	P-value
Parity (P)	1	14.50	0.0001
Days postpartum (D)	1	15.06	0.0001
Body condition (BCS)	1	5.33	0.0210
D × P	1	0.61	0.4336
D × BCS	1	0.16	0.6863
BCS × P	1	0.13	0.7179
D × P × BCS	1	3.48	0.0620
PCAT20[3]	3	1.46	0.2241
PCAT10[3]	3	0.53	0.6634
PCAT20 × PCAT10	9	1.37	0.1968

[1] SAS Institute, Inc., Cary, NC.
[2] Degrees of freedom.
[3] Four progesterone concentration categories at 20 or 10 days (day of CIDR insert) before timed artificial insemination: L = 0.01 < progesterone < 1.0 ng/mL; LM = 1.0 ≤ progesterone < 2.0 ng/mL; MH = 2.0 ≤ progesterone < 4.0 ng/mL; and H = progesterone ≥ 4.0 ng/mL.

Table 2. Influence of parity, days postpartum, and body condition on artificial insemination (AI) pregnancy rates per timed AI in suckled beef cattle[1]

Parity	Days postpartum	Body condition score	n	Proportion of total	Raw means	Adjusted means
2	>73	>5	1,066	15.3	59.0	61.2[a]
2	>73	≤5	1,466	21.1	51.5	53.7[b]
2	≤73	>5	1,399	20.1	51.0	53.0[b]
1	>73	≤5	556	8.0	50.2	52.0[b]
2	>73	>5	361	5.2	48.8	51.6[b]
1	≤73	≤5	1,745	25.1	48.8	50.6[b]
1	≤73	>5	139	2.0	43.5	47.2[bc]
1	≤73	≤5	221	3.2	39.4	39.5[c]
	Overall		6,953	100.0	51.1	

[1] Treatment × herd (year) was a random effect in the model. All cows were treated with either the 5-day or 7-day CO-Synch controlled internal drug release (CIDR) program.
[a, b, c] Means within column with different superscript letters differ ($P < 0.05$).
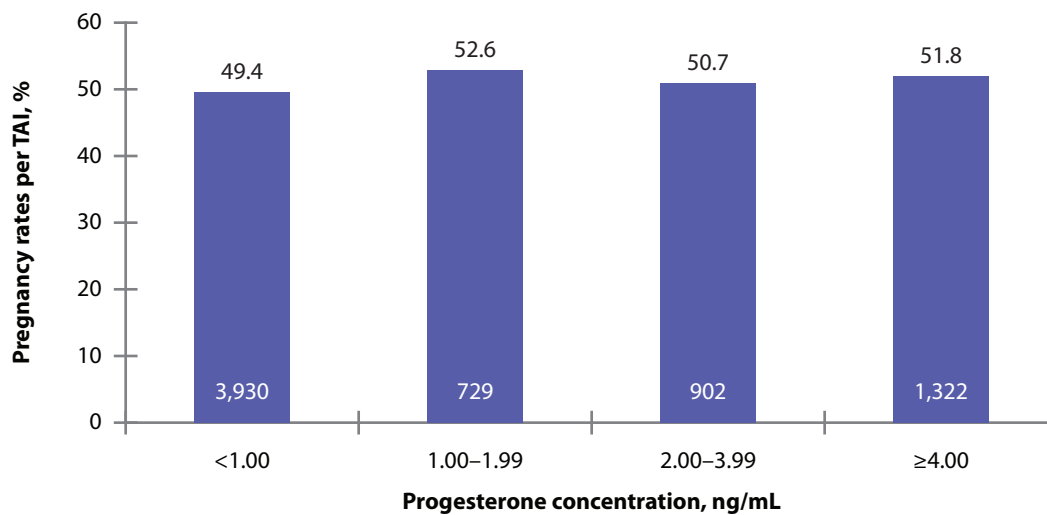
Figure 1. Timed artificial insemination (TAI) pregnancy rates based on progesterone concentration at controlled internal drug release (CIDR) insertion.
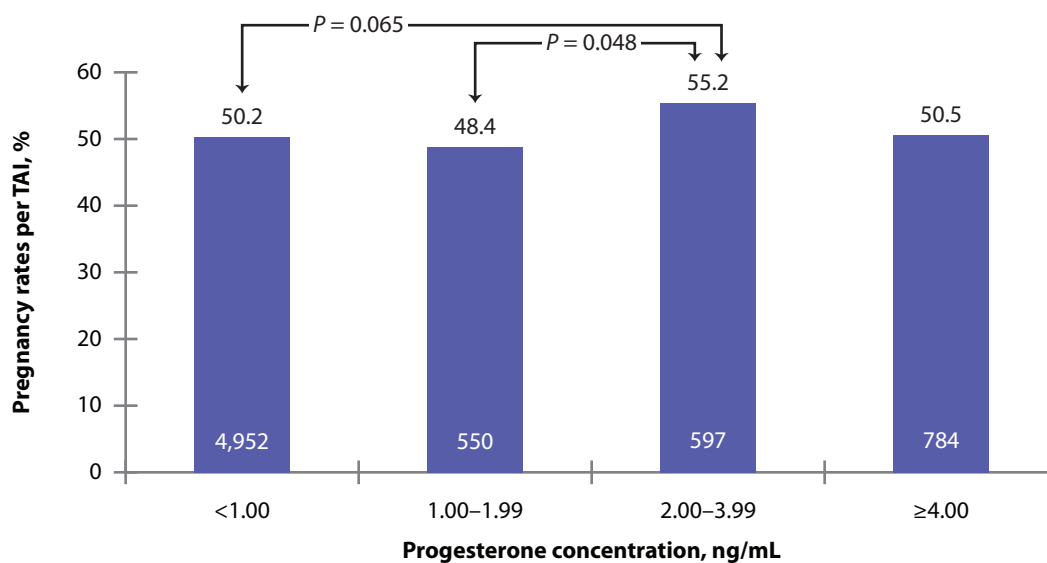

Figure 2. Timed artificial insemination (TAI) pregnancy rates based on progesterone concentration at 10 days before controlled internal drug release (CIDR) insertion.