Influence of Biostimulation on Reproduction in Postpartum Beef Cows

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ABSTRACT: Three experiments were conducted to evaluate the effects of biostimulation (exposure to bulls or androgenized females) on various reproductive variables in suckled beef cows. Bulls or testosterone-treated cows (TTC) were introduced to cows, randomly allotted to one of four groups, within 72 h postpartum. In Exp. 1, Groups 1 and 3 were exposed to bulls and Groups 2 and 4 were exposed to TTC. In Exp. 2, Groups 1 and 3 were exposed to bulls and Groups 2 and 4 served as controls (isolated from biostimulation). In Exp. 3, Groups 1 and 3 were exposed to TTC and Groups 2 and 4 served as controls. Mean postpartum intervals to estrus were not different between cows exposed to either bulls or TTC in Exp. 1 ($P > .10$). However, in Exp. 2 and 3, cows exposed to either bulls or TTC had reduced postpartum intervals to estrus (44 and 41 d, respectively) compared with control cows ($52 \text{ d}; P < .05$). Fewer control cows were in estrus at either 40 d ($P < .05$; Exp. 2 and 3) or 60 d ($P < .05$; Exp. 3) postpartum than were cows exposed to bulls or TTC. No differences were observed between groups in any experiment for postpartum intervals to pregnancy ($P > .10$). These data indicate that cows exposed to biostimulation from either bulls or TTC immediately after calving return to estrus earlier than do cows isolated from biostimulation.

Key Words: Beef Cows, Postpartum Interval, Estrus

Introduction

Cows that calve early wean heavier calves and breed back earlier in the breeding season (Burris and Priode, 1956; Lesmeister et al., 1973; Spitzer et al., 1975; Dunn and Kaltenbach, 1980). It is therefore essential that cows be cycling prior to or early in the breeding season to achieve early pregnancy. However, postpartum intervals to estrus range from 46 to 168 d in suckled beef cows (Dunn and Kaltenbach, 1980). With such a large variation in interval to estrus, many cows may not be cycling at the start of or early in a breeding season.

In many species, males play important roles in reproduction in addition to mating. The presence of males hastens the onset of puberty in female rats (Vandenberg, 1967), ewe lambs (Dyrmundsson and Lees, 1972), and gilts (Brooks and Cole, 1970; Kirkwood et al., 1981). In heifers, however, males had no effect on age of puberty (Berardinelli et al., 1978; Macmillan et al., 1979; Roberson et al., 1987). In adult females, males hasten onset of estrous activity in seasonally anestrous ewes (Knight et al., 1978), goats (Shelton, 1960), and lactating sows (Rowlinson and Bryant, 1974). Several recent studies have shown that exposure to bulls reduced postpartum interval to estrus in primiparous (Gifford et al., 1989; Custer et al., 1990) and multiparous (Zalesky et al., 1984; Alberio et al., 1987; Naasz and Miller, 1990) suckled beef cows. However, there is a void of information regarding androgenized females as a possible source of biostimulation during the postpartum period of the suckled beef cow.

Biostimulation is a term that has been coined to describe the stimulatory effect of a male on estrus and ovulation through genital stimulation, or possibly through pheromones (Chenoweth, 1983).
In this study, the objective was to determine whether androgenized females would elicit biostimulatory effects similar to those elicited by bulls in reducing postpartum interval to estrus in suckled, postpartum beef cows.

Materials and Methods

Between 1984 and 1987, multiparous, spring-calving Angus, Brangus, and Angus crossbred beef cows were used to evaluate effects of biostimulation on various reproductive variables. By 72 h postpartum, cows were randomly allotted to one of four groups in a study replicated within year. In Exp. 1 (1984, n = 70; 1985, n = 116), Groups 1 and 3 were exposed to bulls and Groups 2 and 4 were exposed to testosterone-treated cows (TTC). In Exp. 2 (1986, n = 108), Groups 1 and 3 were exposed to bulls and Groups 2 and 4 served as controls (isolated from biostimulation). In Exp. 3 (1987, n = 78), Groups 1 and 3 were exposed to TTC and Groups 2 and 4 served as controls. Beginning in November of each year, cows were monitored for body condition score (BCS) every 28 d to ensure calving with BCS > 5 on a scale of 1 = emaciated to 9 = extremely fat (Richards et al., 1986; Spitzer, 1986). Cows grazed fescue pastures and were supplemented with corn and corn silage to ensure reaching this target BCS at parturition. Calving began on approximately January 15 and ended by March 31 each year. Cows were allowed ad libitum access to a mineral supplement (12% P and 12% Ca) and two million IU of vitamin A was injected i.m. just before the breeding season. Beginning 14 d after initiation of calving, cows were observed for estrus for a minimum of 30 min at both dusk and dawn. Bulls (penile deviated and epididymectomized) and TTC (received 2 g of testosterone enathate 2 wk before use and a 1-g booster every 2 wk thereafter) were fitted with chin-ball markers to aid in estrus detection. Bull or TTC to cow ratio never exceeded 1:29 in any experiment. Animals were considered to be in estrus when they stood to be mounted by a bull, a TTC, or a herdmate or when paint marks indicated that an animal had been mounted.

A 60-d breeding season began approximately April 15 each year. Cows that were in estrus during the first 30 d were artificially inseminated 12 h after they were observed to be in estrus. Several technicians were used each year and semen was from numerous bulls randomized between treatments. After a satisfactory breeding soundness examination (Ball et al., 1983), bulls (fitted with chin-ball markers to ascertain natural service dates) were then turned in for the remaining 30 d to breed cows that did not conceive after AI. At that time, cows were combined into two herds with Angus cows exposed to a single bull and Angus crossbred and Brangus cows exposed to a single bull. Pregnancy was determined by rectal palpation 15 to 20 d after AI ceased and again 30 d after the end of the breeding season. Conception dates were verified by calving dates. The experimental design was considered a completely random design with treatment replicated within year. In Exp. 1, replication was nested within year. Postpartum intervals to estrus and pregnancy and cumulative percentages in estrus by 20-d intervals from parturition were analyzed for effects of treatment, replication, and year (Exp. 1) using ANOVA techniques. Cumulative percentages in estrus and pregnant during a 60-d breeding season were analyzed as were the preceding variables, except that the model included calving date as a covariate (Steel and Torrie, 1980). Calculations were made using the GLM procedure of SAS (1985).

Estrus detection efficiency was determined to ensure that effects observed were due to biostimulation rather than failure to detect cows in estrus. This was calculated as proportion of nonpregnant cows with a detected second estrus before or during the AI breeding season within 25 d of first observed estrus. These proportions were analyzed using a chi-square test (Steel and Torrie, 1980).

Results

Estrus detection efficiencies in Exp. 1 were 79 and 85% for cows exposed to bulls or TTC, respectively (P > .10). Estrus detection efficiencies were 68% for cows exposed to bulls and 75% for control cows in Exp. 2 (P > .10) and 78% for cows exposed to TTC and 83% for control cows in Exp. 3 (P > .10).

Experiment 1. Mean postpartum intervals to estrus were 43 d for cows exposed to bulls or TTC (P > .10; Table 1). Cows returned to estrus 9 d earlier in 1984 than in 1985 (P < .05), but there was no year × treatment interaction. Cumulative percentages in estrus by 20-d postpartum intervals were not different between cows exposed to bulls or TTC (Table 2). Cumulative percentages in estrus at the start of and by 20-d intervals of a 60-d breeding season did not differ between cows exposed to bulls or TTC (Table 3). Mean postpartum intervals to pregnancy were 80 and 85 d for cows exposed to bulls or TTC, respectively (P > .10; Table 1). Cumulative percentages pregnant by 20-d intervals of a 60-d breeding season did not differ between cows exposed to bulls or TTC (Table 3).
respectively, 92 and 100% of cows exposed to bulls or TTC. Estrus detection was not affected by biostimulation (Table 1). By 40 d postpartum, 55% of cows exposed to bulls were observed in estrus, compared with 26% of control cows (P < .05; Table 2). However, cumulative percentages in estrus at the start of and by 20-d intervals of a 60-d breeding season were not affected by biostimulation (Table 3). Mean postpartum intervals to estrus were 81 and 85 d for cows exposed to bulls or control cows, respectively (P > .10; Table 1). Cumulative percentage pregnant by 20-d intervals of a 60-d breeding season was not affected by biostimulation (Table 3).

Experiment 3. Mean postpartum intervals to estrus were 41 and 52 d for cows exposed to TTC or control cows, respectively (P < .05; Table 1). By 40 and 60 d postpartum, respectively, 62 and 87% of cows exposed to TTC were observed to be in estrus, compared with 31 and 64% of control cows (P < .05; Table 2). At the start of the breeding season, 92% of cows exposed to TTC were observed to be in estrus, compared with 61% of control cows (P < .05; Table 3). However, by 20-d intervals of a 60-d breeding season, cumulative percentage in estrus was not affected by biostimulation (Table 3).

Discussion

A major concern in these experiments was that cows isolated from biostimulation (controls) would not be detected in estrus as efficiently as cows pastured with bulls or TTC. Estrus detection efficiency was not different between groups in any experiment. Therefore, observed effects in these experiments were due to biostimulation rather than failure to detect cows in estrus.

Previous work has shown that primiparous (Gifford et al., 1989; Custer et al., 1990) and multiparous (Zalesky et al., 1984; Alberio et al., 1987; Naasz and Miller, 1990) suckled beef cows exposed to bulls early postpartum return to estrus earlier than cows isolated from bulls. In this study, we observed that cows exposed either to bulls or to TTC had similar postpartum intervals to estrus (Exp. 1). However, in Exp. 2, cows exposed to bulls had an 8-d earlier return to estrus than did cows isolated from biostimulation, which substantiates previous studies in multiparous, suckled beef cows (Zalesky et al., 1984; Alberio et al., 1987; Naasz and Miller, 1990). More importantly, in Exp. 3 cows exposed to TTC had a 12-d earlier return to estrus than did cows isolated from biostimulation. It can be concluded from these results that androgenized females and bulls elicit similar biostimulatory effects in reducing postpartum interval to estrus in suckled, postpartum beef cows.

Biostimulation exerted its stimulatory effects early postpartum. By 40 d postpartum, 29 and 31% more cows exposed to bulls or TTC, respectively, were observed to be in estrus compared with cows isolated from biostimulation (Exp. 2 and 3, respectively). By 60 d postpartum, 23% more cows exposed to TTC were observed to be in estrus compared with cows isolated from biostimulation (Exp. 3). After 60 d postpartum, biostimulation had no effect on percentage of cows in estrus.

With the fixed breeding season used in these experiments, a majority of cows were cycling before the start of the breeding season regardless of treatment. By 20 d of breeding, 97% of cows

Table 1. Effects of biostimulation on postpartum intervals to estrus (ITE) and pregnancy (ITP)

<table>
<thead>
<tr>
<th>Exp. and group</th>
<th>ITE</th>
<th>ITP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bull exposure</td>
<td>43 ± 2</td>
<td>80 ± 2</td>
</tr>
<tr>
<td>TTC exposure</td>
<td>43 ± 2</td>
<td>85 ± 2</td>
</tr>
<tr>
<td>2 Bull exposure</td>
<td>44 ± 2</td>
<td>81 ± 3</td>
</tr>
<tr>
<td>Control</td>
<td>52 ± 2</td>
<td>85 ± 3</td>
</tr>
<tr>
<td>3 TTC exposure</td>
<td>41 ± 3</td>
<td>87 ± 3</td>
</tr>
<tr>
<td>Control</td>
<td>52 ± 3</td>
<td>81 ± 3</td>
</tr>
</tbody>
</table>

*Mean number of days ± SEM.

Testosterone-treated cows.

Isolated from biostimulation.

Within experiment, means with different superscripts differ (P < .05).

Experiment 2. Mean postpartum intervals to estrus were 44 and 52 d for cows exposed to bulls or control cows, respectively (P < .05; Table 1). By 40 d postpartum, 55% of cows exposed to bulls were observed in estrus, compared with 26% of control cows (P < .05; Table 2). However, cumulative percentages in estrus at the start of and by 20-d intervals of a 60-d breeding season were not affected by biostimulation (Table 3). Mean postpartum intervals to pregnancy were 87 and 91 d for cows exposed to bulls or control cows, respectively (P < .05; Table 1). By 40 and 60 d of breeding, respectively, 92 and 100% of cows exposed to TTC were pregnant, compared with 69 and 82% of control cows (P < .05; Table 3).

Table 2. Effects of biostimulation on cumulative percentages in estrus by days postpartum

<table>
<thead>
<tr>
<th>Exp. and group</th>
<th>Cumulative % in estrus</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>20 d</td>
</tr>
<tr>
<td>1 Bull exposure</td>
<td>2</td>
</tr>
<tr>
<td>TTC exposure</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
</tr>
<tr>
<td>2 Bull exposure</td>
<td>4</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
</tr>
</tbody>
</table>

Testosterone-treated cows.

Isolated from biostimulation.

Within experiment, means with different superscripts differ (P < .05).
exposed to biostimulation and 94% of cows isolated from biostimulation were observed to be in estrus. Therefore, biostimulation had no effect on postpartum interval to pregnancy. However, biostimulation would seem to be beneficial in reducing postpartum interval to estrus in late-calving cows to ensure cyclicity at the start of a breeding season.

In Exp. 2, biostimulation had no effect on cumulative percentage pregnant during a 60-d breeding season. However, in Exp. 3, by 40 and 60 d of breeding, respectively, 28 and 18% more cows exposed to TTC were pregnant compared with cows isolated from biostimulation. Although 31% more cows exposed to TTC were observed to be in estrus at the start of the breeding season compared with cows isolated from biostimulation, by 20 d of breeding biostimulation had no effect on cumulative percentage in estrus, and by 40 d of breeding, 100% of cows in both groups were observed to be in estrus. Therefore, differences in cumulative percentage pregnant at 40 and 60 d of breeding in this study were due to an unidentified variable(s) rather than to biostimulation.

The mechanism(s) by which bulls or TTC reduce postpartum interval to estrus is unknown. Puberty occurred earlier in heifers when bull urine was placed directly in the vomeronasal organ than in heifers having water placed in the vomeronasal organ (Izard and Vandenberg, 1982). Androgens in the urine may act as pheromones (compounds that are perceived by the vomeronasal organ to elicit endocrine and behavioral responses (Doty, 1976)) to reduce postpartum interval to estrus. However, one cannot rule out possible auditory, visual, or tactile stimuli. Further work is needed to determine exact mechanism(s) involved with biostimulation effects on postpartum reproduction.

### Implications

Cows calving in moderate to good body condition and exposed to biostimulation (either bulls or testosterone-treated cows) immediately postpartum returned to estrus earlier than cows isolated from biostimulation. Testosterone-treated cows had the same magnitude of effect on postpartum reproduction as sterile bulls. Biostimulation had its effect prior to d 60 postpartum, after which no effects were observed. Therefore, biostimulation would be a useful management tool for increasing reproductive performance in late-calving cows by reducing postpartum interval to estrus and having these cows cycling at the start of or early in a breeding season to ensure early pregnancy.

### Literature Cited


effects of running bulls with suckling cows or heifers during the premating period. N. Z. J. Exp. Agric. 7:121.