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Growth, reproductive development, and estrous behavior of beef heifers treated with growth promotants

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ABSTRACT

Charolais × Balancer heifers (n = 65; BW = 179 ± 30 kg; 255 ± 12 d of age) were used to determine the influence of growth-promoting implants on growth, reproductive development, estrous behavior, and pregnancy rate. Heifers were assigned to 1 of 4 implant treatment groups: (1) control, no implant (n = 16); (2) trenbolone acetate (TBA; 200 mg of TBA; n = 15); (3) trenbolone acetate plus estradiol (TBA+E2; 40 mg of TBA and 8 mg of E2; n = 17); or (4) zeranol (ZER; 36 mg of ZER; n = 17). Reproductive-tract scores (RTS) were determined via ultrasonography on d 106 and 195 (d 0 = implant treatment). Estrous behavior was monitored by radiotelemetry. Average daily gain was greater ($P < 0.03$) for TBA+E2 heifers compared with other treatment groups. A lower percentage ($P < 0.03$; 18%) of heifers treated with ZER were classified with cyclic reproductive-tract scores on d 106 compared with control (53%) and TBA heifers (67%); heifers treated with TBA+E2 (35%) were similar to all treatments. Heifers treated with TBA had increased mounts received ($P < 0.05$; 60.1 ± 10.4 mounts) during estrus compared with all other treatments (27.0 ± 8.2 mounts). Overall pregnancy rate did not differ ($P > 0.10$) among treatments (72%). Implanting with TBA+E2 after weaning resulted in heavier heifers at breeding, and reproductive development was delayed in ZER heifers. Implant strategies after weaning may alter heifer growth and development on forage systems, but overall fertility was not affected in this experiment.

Key words: estrous behavior, growth implant, heifer, reproductive-tract score

INTRODUCTION

Efficient beef cattle production requires replacement heifers that conceive early in the breeding season, calve as 2-yr-olds, and continue calving at 12-mo intervals. Heifers that calve as 2-yr-old cows maximize their lifetime productivity potential (Lesmeister et al., 1973), and age at puberty is one of the most important factors when heifers are targeted to calve at 2 yr of age (Ferrell, 1982). Heifers must reach puberty at an early age to ensure high conception rates in their first breeding season (Lesmeister et al., 1973). Body weight is a major factor affecting age at puberty, and heifers fail to reach puberty until significant BW gains are made (Patterson et al., 1992); lighter-BW heifers will be older at puberty than heifers with heavier BW (Wiltbank et al., 1985).

Growth-promoting implants have been used extensively in beef production for many years to increase BW gain in animals destined for slaughter. However, few are recommended for use in heifers that may be retained for replacements. Previous research involving the use of growth-promoting implants in heifers has shown that reproductive performance of implanted heifers is determined by dosage of the growth promotant and timing of implantation (Heitzman et al., 1979; Staigmiller et al., 1983; Deutscher et al., 1986; Moran et al., 1990). Minimal data exist on the influence of growth-promoting implants on estrous behavior determined by radiotelemetry in beef heifers.

Beef producers need options to meet the increasing demands of beef production under the current United States cow-herd situation and may want to consider adding value to low-BW heifers. Therefore, our objective was to determine the influence

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of growth-promoting implants on growth, reproductive development, estrous behavior, and pregnancy rate of beef heifers.

MATERIALS AND METHODS

Management

This experiment was conducted at the University of Arkansas North Farm, Fayetteville, with 65 spring-born Charolais × Balancer heifers (BW = 179 ± 30 kg; 255 ± 12 d of age) from the University of Arkansas System, Division of Agriculture, Livestock and Forestry Research Station, Batesville. The University of Arkansas's Institutional Animal Care and Use Committee approved the animal procedures used in this experiment. Ear notches were collected from each heifer before the initiation of the experiment and submitted to a commercial laboratory (Cattle Stats LLC; Oklahoma City, OK) for determination of persistent infection with bovine viral diarrhea virus; all heifers were negative for bovine viral diarrhea virus. Heifers rotationally grazed pastures with orchard grass, novel endophyte-infected tall fescue, and mixed grass as a single group for the duration of the experiment (307 d). Heifers were supplemented with alfalfa haylage (0.50 kg/heifer per d; as-fed basis) for 50 nonconsecutive days in the winter months when available forage was limited.

Treatments

Heifers were blocked by BW and assigned to 1 of 4 implant treatment groups: (1) control, no implant (**CON**; n = 16); (2) trenbolone acetate (**TBA**; 200 mg of TBA; n = 15); (3) trenbolone acetate plus estradiol (**TBA+E2**; 40 mg of TBA and 8 mg of E2; n = 17); or (4) zeranol (**ZER**; 36 mg of ZER; n = 17). Heifers were implanted once according to treatment group on d 0. Growth-measurement data including BW, hip height (**HH**; determined by Altitude Stick, NASCO, Fort Atkinson, WI), and BCS (scale from 1 = very thin to 9 = obese; Wagner et al., 1988) were determined at d 0, 106, and 195 of the experiment, with final BW and BCS measurements taken at time of breeding (d 220). Reproductive-tract scores (**RTS**; scale of 1 to 5; Anderson et al., 1991) of heifers were determined via ultrasonography (Aloka 500 V; Corometrics, Wallingford, CT, equipped with a 5.0-MHz transducer) on d 106 and 195. Heifers with BW <227 kg were not subjected to ultrasound to avoid possible injury to the heifers and categorized as an RTS 2 (Patterson and Bullock, 1995). Reproductive-tract scores of 1, 2, and 3 were categorized as noncyclic, and scores of 4 and 5 were categorized as cyclic (Rosenkrans and Hardin, 2003).

Estrous synchronization was initiated on d 195 when heifers received an intravaginal, controlled internal drug-releasing device (EAZI-BREED CIDR, Zoetis, Kalamazoo, MI) for 16 d, followed by gonadotropin-releasing hormone (Factrel, 100 µg i.m.; Zoetis) 2 d later (d 213 of the experiment); prostaglandin $F_{2\alpha}$ (Lutalyse, 25 mg i.m.; Zoetis) was administered 1 wk after gonadotropin-releasing hormone (d 220 of the experiment). Estrous behavior was monitored by radiotelemetry (HeatWatch, CowChips LLC, Manalapan, NJ) for 96 h after prostaglandin $F_{2\alpha}$. Duration of estrus, number of standing events, and quiescence periods between standing events were calculated. Onset of estrus was defined as the first of 2 mounts received within a 4-h period, and the end of estrus was considered to be the last mount, with a mount 4 h before, and no mounts during the next 12 h (White et al., 2002). Quiescence period, as defined by Flores et al. (2006), was the interval between each successive mount and calculated as mean quiescence period = duration of estrus, h/(number of mounts received − 1). Based on the AM-PM rule (Barratt and Casida, 1946), heifers were AI with frozen–thawed semen from the same sire 10 to 19 h after onset of estrus (d 222 to 223 of the experiment). All heifers were exposed for 28 d starting 12 d after AI (d 235 of the experiment) to Angus bulls (1 bull/22 heifers) that had passed a breeding-soundness exam. Pregnancy was diagnosed via ultrasonography (Aloka 500 V; Corometrics, equipped with a 5.0-MHz transducer) on d 280 and 301.

Statistical Analyses

Growth-performance parameters and estrous-behavior data were analyzed using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC) with heifer as the experimental unit. Variables analyzed were BW, BCS, HH and their change, ADG, duration of estrus, number of standing events, and quiescence periods between standing events. Treatment means were reported as least squares means and compared using the PDIFF statement of SAS when protected by a significant ($P < 0.05$) treatment effect. Influence of implant treatment group on RTS (proportion of heifers categorized as cyclic and noncyclic at d 106 and 195) and pregnancy rates as determined by ultrasonography (proportion of all heifers that became pregnant during the experimental period) were analyzed by Chi-squared using the FREQ procedure of SAS.

RESULTS AND DISCUSSION

Growth-promoting implants have been used extensively in beef production for many years to increase rate of BW gain and feed efficiency. In the current experiment, there were no differences ($P > 0.10$) in BW among treatment groups at d 106 (280.3 ± 8.74 kg) and 195 (320.7 ± 8.11 kg). However, heifer ADG from d 0 to 106 and 220 and BW change from d 0 to 220 was greater ($P < 0.03$) for TBA+E2-treated heifers compared with all other treatment groups (Table 1). Kreikemeier and Mader (2004) reported feedlot heifers receiving TBA+E2 implants had greater ADG (1.43 kg/d) than heifers receiving TBA (1.31 kg/d), estrogenic (1.33 kg/d), or no growth promotants (1.25 kg/d). Similarly, ADG in steers implanted with TBA+E2 was greater (1.58 kg/d) than in steers receiving