Effects of body condition on measures of intramuscular and rump fat, endocrine factors, and calving rate of beef cows grazing common bermudagrass or endophyte-infected tall fescue1,2

M. L. Looper,*3 S. T. Reiter,† B. C. Williamson,† M. A. Sales,† D. M. Hallford,‡ and C. F. Rosenkrans Jr.†

*USDA-ARS, Dale Bumpers Small Farms Research Center, Booneville, AR 72927; †Department of Animal Science, University of Arkansas, Fayetteville 72701; and ‡Department of Animal and Range Sciences, New Mexico State University, Las Cruces 88003

ABSTRACT: Multiparous beef cows were managed to achieve marginal (BCS = 4.7 ± 0.07; n = 106) or good (BCS = 6.6 ± 0.06; n = 121) body condition (BC) to determine the influence of forage environment on BW and BC changes, intramuscular fat percentage (IMF), rump fat (RF), and serum hormones during 2 yr. Cows within each BC were randomly assigned to graze either common bermudagrass (CB; n = 3 pastures/yr) or toxic endophyte-infected tall fescue (EI; n = 3 pastures/yr) during a 60-d breeding season. Blood samples were collected at d 0, 30, and 60 of the breeding season, and serum concentrations of prolactin (PRL), IGF-I, and cortisol (CORT) were quantified; PRL and progesterone (P4) also were quantified 10 d before the breeding season (d −10). Body weight and BCS were recorded during the breeding season (d 0, 30, and 60). Cow IMF and RF were measured via ultrasonography at the start and end of the breeding season. Cows with increased (>1 ng/mL) P4 at the beginning of the breeding season (cyclic) had greater (P < 0.02) concentrations of PRL on d 30 and 60 compared with anestrous cows. A forage environment × BC interaction tended (P = 0.07) to influence PRL. Cows grazing CB independent of BC had increased PRL compared with cows grazing EI. Prolactin was decreased in good-BC cows grazing EI compared with cows grazing CB, and cows in marginal BC grazing EI had the least concentrations of PRL. Concentrations of IGF-I were similar (P > 0.10) among good- and marginal-BC cows grazing CB, as well as good-BC cows grazing EI; however, marginal-BC cows grazing EI had reduced (P < 0.04) concentrations of IGF-I compared with all other groups. Cows in marginal-BC grazing CB gained (P = 0.06) the most BW during the breeding season, whereas good-BC cows grazing EI gained the least amount of BW. Marginal-BC cows grazing CB tended (P = 0.06) to increase BC during the breeding season, whereas good-BC cows grazing either CB or EI lost BC. Rump fat tended (P = 0.07) to increase during the breeding season in marginal-BC cows compared with cows in good BC. Calving rates were similar (P > 0.10) among good- (82%) and marginal- (84%) BC cows grazing CB, and good-BC cows grazing EI (79%); however, marginal-BC cows grazing EI had a reduced (P = 0.04) calving rate (61%). Cattle grazing EI during the breeding season lost BC.

Key words: beef cow, body condition, calving rate, fescue toxicosis, insulin-like growth factor-I

INTRODUCTION

Annual production of healthy, productive calves is necessary to maintain profitability of the cow-calf enterprise. Of the numerous environmental factors that influence reproduction, nutritional input is an aspect that can be controlled by the beef cattle producer (Dunn and Moss, 1992). Further, identification of nu-
tritional factors that may compromise cattle fertility is important to the economic viability of the farm or ranch (Hess et al., 2005).

Approximately 14 million ha of endophyte-infected tall fescue (EI) are grown in the humid areas of the southeastern United States (Bouton, 2001). Furthermore, it is estimated that over 8.5 million beef cows are maintained on these EI pastures (Ball et al., 2002). Cattle grazing EI often have reduced reproductive performance compared with cattle grazing nontoxic forages, such as common bermudagrass (CB; Cynodon dactylon (L.) Pers.; n = 3 pastures/yr) or toxic endophyte-infected tall fescue [IE; Lolium arundinaceum (Schreb.) Darbysh. = Schedono- rus arundinaceus (Schreb.) Dumort.; n = 3 pastures/yr] during a 60-d breeding season. All pastures of both forage environments were established >20 yr, and EI pastures were >85% endophyte-infected. Cows were exposed to bulls (1 bull/20 cows) from May 14 to July 13 (yr 1) and May 12 to July 11 (yr 2). Body weight and BC were recorded during the breeding season (d 0, 30, and 60) each year. Intra-abdominal fat percentage and RF were measured via ultrasonography (Aloka SSD-500V with a 3.5-MHz linear array transducer; Aloka Co. Ltd., Wallingford, CT) by a trained technician using Biosoft Toolbox software (Biotronics Inc., Ames, IA) on d 0 and 60 of the breeding season each year.

Pastures were characterized 3 times (d 0, 30, and 60) during the breeding season to determine forage mass, nutritive value, and concentration of ergovaline. Forage mass was evaluated using a disk meter (Bransby et al., 1977). Forage height was recorded at 100 random locations (approximately 6 measurements/ha) in each pasture on each measurement day. To calibrate disk meter measurements, forage was clipped to ground level beneath the disk meter at each of 3 locations per pasture. Samples were dried (60°C) in a forced-air oven for 72 h and weighed for calculation of regression equations of kilograms of DM per hectare and disk meter height. Random samples (20 samples/16 ha of pasture) were utilized for evaluating nutritive value of forage at each of the 3 measurement dates. Nutritive subsamples were ground to pass through a 0.85-mm screen and analyzed for CP by rapid combustion (AOAC, 1990; Elementar Technology Corp. (Macedon, NY) procedures by the Agricultural Diagnostic Service Laboratory, University of Arkansas. Random samples of EI pastures (8 to 10 samples/ha) were pooled, cut into 5.1-cm pieces, and stored at −4°C until determination of ergovaline at the 3 measurement days. Concentrations of ergovaline were determined using HPLC as described by Hill et al. (1993).

**MATERIALS AND METHODS**

The committee for animal welfare at the USDA-ARS, Dale Bumpers Small Farms Research Center, Booneville, Arkansas, approved animal procedures used in this study.

Spring-calving, multiparous beef (1/4 to 3/8 Brahman) cows were managed to achieve marginal (BW = 480 ± 7.7 kg; BCS = 4.7 ± 0.07, where 1 = emaciated to 9 = obese; Wagner et al., 1988; n = 106) or good (BW = 591 ± 7.3 kg; BCS = 6.6 ± 0.06; n = 121) BC. Cows grazed stockpiled and spring-growth, EI pastures at a stocking rate of either 1 cow/0.3 ha (marginal BC) or 1 cow/0.8 ha (good BC) for 153 (yr 1) and 162 (yr 2) d before initiation of the breeding season. Calving dates for marginal-and good-BC cows ranged from February 14 to May 7 (mean date = March 13) and February 9 to May 7 (mean date = March 14), respectively. Calves were allowed to suckle their dams throughout the experiment. Cows within each BC were randomly assigned to graze (1 cow/0.7 ha) common bermudagrass [CB; Cynodon dactylon (L.) Pers.; n = 3 pastures/yr] or toxic endophyte-infected tall fescue [IE; Lolium arundinaceum (Schreb.) Darbysh. = Schedonorus arundinaceus (Schreb.) Dumort.; n = 3 pastures/yr] during a 60-d breeding season. All pastures of both forage environments were established >20 yr, and EI pastures were >85% endophyte-infected. Cows were exposed to bulls (1 bull/20 cows) from May 14 to July 13 (yr 1) and May 12 to July 11 (yr 2). Body weight and BC were recorded during the breeding season (d 0, 30, and 60) each year. Intramuscular fat percentage and RF were measured via ultrasonography (Aloka SSD-500V with a 3.5-MHz linear array transducer; Aloka Co. Ltd., Wallingford, CT) by a trained technician using Biosoft Toolbox software (Biotronics Inc., Ames, IA) on d 0 and 60 of the breeding season each year.

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**Blood Collection and Hormone Determination**

Blood samples (7 mL) were obtained from cows at −10 [PRL and progesterone (P₄) only], 0, 30, and 60 d of the breeding season. Serum was harvested from blood samples collected by venipuncture of the median caudal vein into Vacutainers (Becton Dickinson, Franklin Lakes, N.J.), allowed to clot for 24 h at 4°C, and centrifuged (1,500 × g for 25 min at 4°C). Serum was stored at −20°C until analyses.
Serum concentrations of P_4 and CORT were determined in duplicate with a solid-phase RIA using components of commercial kits (Siemens Diagnostic, Los Angeles, CA). These kits utilize antibody-coated tube technology, and assays were performed without prior extraction of individual hormones from serum. Validation of the P_4 RIA was reported by Schneider and Hallford (1996). In this experiment, intra- and interassay CV for P_4 determinations averaged 5.4 and 11.5%, respectively. Cortisol assays were validated in ruminant serum as described by Kiyma et al. (2004); intra- and interassay CV were less than 6% for CORT. Serum IGF-I (Berrie et al., 1995) and PRL (Spoon and Hallford, 1989) concentrations were determined in duplicate by double-antibody RIA using primary antisera and purified standard and iodination preparations supplied by the National Hormone and Peptide Program (Torrance, CA). Assay of total serum IGF-I was conducted after acid-ethanol inactivation of IGFBP and had intra- and interassay CV of 9.3 and 9.9%, respectively. Serum PRL was quantified in a single assay each year and had an average CV of 6.2%.

Serum samples collected on d −10 and 0 were analyzed for concentrations of P_4 to determine luteal status at the initiation of the breeding season. Cows were classified as anestrus if concentrations of P_4 were <1 ng/mL in at least 1 blood sample (Steven-son et al., 1996). These kits utilize antibody-coated tube technology, and assays were performed without prior extraction of individual hormones from serum. Validation of the P_4 RIA was reported by Schneider and Hallford (1996). In this experiment, intra- and interassay CV were less than 6% for CORT. Serum IGF-I (Berrie et al., 1995) and PRL (Spoon and Hallford, 1989) concentrations were determined in duplicate by double-antibody RIA using primary antisera and purified standard and iodination preparations supplied by the National Hormone and Peptide Program (Torrance, CA). Assay of total serum IGF-I was conducted after acid-ethanol inactivation of IGFBP and had intra- and interassay CV of 9.3 and 9.9%, respectively. Serum PRL was quantified in a single assay each year and had an average CV of 6.2%.

Serum samples collected on d −10 and 0 were analyzed for concentrations of P_4 to determine luteal status at the initiation of the breeding season. Cows were classified as anestrus if concentrations of P_4 were <1 ng/mL in both blood samples or cyclic if concentrations of P_4 were ≥1 ng/mL in at least 1 blood sample (Steven-son et al., 1996).

**Statistical Analyses**

Pasture was the experimental unit in all statistical analyses. Forage CP, NDF, and mass were analyzed by ANOVA utilizing the MIXED procedure (SAS Inst. Inc., Cary, NC). The model included forage environment, measurement date, and the interaction. Body weight, BCS, changes in BW and BCS, IMF, and RF during the experiment were analyzed by ANOVA with a 2 × 2 factorial arrangement of treatments (EI or CB forage and marginal or good BC) within a completely randomized design. Data were analyzed by ANOVA utilizing the MIXED procedure of SAS. The model included forage treatment, BC, and corresponding interactions; year was used as a random effect.

Concentrations of hormones were analyzed by ANOVA with a 2 × 2 × 2 factorial arrangement of treatments (EI or CB forage, marginal or good BC, cyclic or anestrus). Comparisons of concentrations of PRL, IGF-I, and CORT were analyzed using the MIXED procedure of SAS for repeated measures. The model included forage treatment, BC, luteal status, day, and all interactions; year was used as a random effect. The most appropriate covariance structure for each analysis was chosen from unstructured, compound symmetric, autoregressive, and ante-dependence structures utilizing Akaike’s information criterion and Schwarz’ Bayesian criterion (Littell et al., 2000). Kenward-Rogers’ approximation was used for calculation of the degrees of freedom of the pooled error term.

Correlation analyses were used to evaluate the associative relationships among BW and BC with IMF and RF measurements, and BW, BC with concentrations of serum hormones. Correlation coefficients were generated with the CORR procedure of SAS. Calving rate was analyzed by chi-squared analysis of SAS.

**RESULTS**

**Characteristics of Forages**

Forage DM mass was influenced (P < 0.01) by a forage environment × collection day interaction (Table 1). Across collection days, EI pastures (mean mass = 6,166 ± 219.3 kg/ha) had greater DM mass than CB (mean mass = 3,130 ± 219.3 kg/ha) pastures. Overall CP did not differ (P > 0.60) between forage environments (mean CP = 12.2 ± 1.16%); however, CP percentage was greater at d 0 compared with d 30 and 60 of the experiment (day effect; P < 0.01; Table 1). Percentage of NDF was greater (P < 0.01) in CB than EI pastures throughout the experiment (Table 1); NDF was greatest (P < 0.01) at d 60 of the experiment compared with other collection days (Table 1). Concentrations of ergovaline ranged from 0.28 to 0.83 mg/kg of DM (pooled SE = 0.058) for EI pastures from May to July throughout the 2-yr experiment; overall mean concentration of ergovaline was 0.51 ± 0.034 mg/kg of DM (Table 1).

**BW and BC, IMF and RF**

Initial BW (d 0), and BW at d 30 and 60 were not influenced (P ≥ 0.46) by a forage environment × BC interaction (Table 2). As intended with the current experimental design, good-BC cows were heavier (P < 0.0001) at all measurement days than cows in marginal BC. Cow BW did not differ on d 0 (P = 0.21); however, cows grazing EI weighed 37 kg less at d 30 (P = 0.02) and 49 kg at d 60 (P = 0.01) of the breeding season than cows grazing CB (Table 2). Overall BW change was influenced by a forage environment × BC interaction (P = 0.02). Cows in marginal BC grazing CB gained the most BW during the breeding season, whereas good-BC cows grazing EI gained the least amount of BW; good-BC cows grazing CB and marginal-BC cows grazing EI were intermediate in overall BW gain during the breeding season (Table 2).

Cows in good BC had greater (P < 0.0001) actual BCS on d 0 and 30 of the breeding season than marginal-BC cows as expected in the current experiment (Table 2). A forage environment × BC interaction (P = 0.04) influenced BCS at d 60. Cows in good BC and grazing either forage environment had greater BCS; cows in marginal BC and grazing EI had the least BCS (Table 2). Change in BCS tended (P = 0.06) to be affected
by a forage environment × BC interaction. Marginal-BC cows grazing CB gained BCS during the breeding season, whereas all other cows lost BCS; good-BC cows grazing either forage environment lost the most BCS during the breeding season (Table 2).

Intramuscular fat percentage was affected \( (P < 0.0001) \) by BC with good-BC cows having greater IMF at d 0 and 60 of the breeding season than marginal-BC cows (Table 3). Change in IMF was not influenced \( (P \geq 0.46) \) by forage environment, BC, or their interaction. Similar to IMF, RF was greater \( (P < 0.0001) \) in good-BC cows at d 0 and 60 of the breeding season compared with cows in marginal BC (Table 3). Marginal-BC cows tended \( (P = 0.07) \) to have greater RF change during the breeding season than cows in good BC (Table 3).

### Concentrations of PRL, IGF-I, and CORT

Serum concentrations of PRL were affected by a forage × day \( (P < 0.0001) \) interaction. Prolactin was similar at d −10 and 0 between CB and EI cows; however, concentrations of PRL were greater \( (P < 0.05) \) in CB cows than EI cows on d 30 and 60 of the breeding season (Figure 1a). Cyclic cows had greater (luteal status × day interaction; \( P < 0.02 \)) concentrations of PRL on d 30 and 60 of the breeding season compared with anestrous cows (Figure 1b). A forage environment × BC interaction tended \( (P = 0.07) \) to influence PRL (Figure 2). Cows grazing CB independent of BC had increased PRL compared with cows grazing EI forage (Figure 2). Prolactin was decreased in good-BC grazing EI compared with cows grazing CB, and cows in marginal BC grazing EI had the least concentrations of PRL (95 ± 5.6 ng/mL), whereas anestrous cows grazing CB had intermediate concentrations of PRL (61 ± 7.1 ng/mL) and anestrous (29 ± 7.7 ng/mL) cows grazing EI had reduced PRL.

Similar to PRL, concentrations of IGF-I were influenced \( (P < 0.02) \) by a forage × day interaction (Figure 3). Concentrations of IGF-I were greater at d 30 of the breeding season for cows grazing CB when compared with cows grazing EI pastures. However, by d 60 of the breeding season, IGF-I was greater in EI cows than CB cows.
cows (Figure 3). Cyclic cows had greater ($P < 0.0001$) concentrations of IGF-I ($56.8 \pm 1.28$ ng/mL) than anestrous cows ($46.0 \pm 2.17$ ng/mL). Further, a forage environment × BC interaction affected ($P < 0.04$) IGF-I (Figure 4). Concentrations of IGF-I were similar ($P > 0.10$) among good- and marginal-BC cows grazing CB, as well as good-BC cows grazing EI; however, marginal-BC cows grazing EI had reduced ($P < 0.04$) concentrations of IGF-I compared with all other groups.

Concentrations of CORT were influenced by forage environment × day and forage environment × BC interactions ($P < 0.03$). Concentrations of CORT were similar on d 0 and 60 of the breeding season between forage environments; however, CORT was greater on d 30 of the breeding season for cows grazing CB than EI cows (Figure 5). Cows in marginal BC and grazing EI pastures had decreased ($P < 0.03$) CORT compared with all other cow groups (Figure 6). Cyclic cows ($39.2 \pm 1.21$ ng/mL) had greater ($P < 0.0001$) CORT compared with anestrous cows ($29.0 \pm 1.54$ ng/mL).

**Calving Rates**

Calving rates were influenced ($P < 0.02$) by a forage environment × BC interaction. Calving rates were similar ($P > 0.10$) among good- (82%) and marginal-BC (84%) cows grazing CB, and good-BC cows grazing EI (79%); however, marginal-BC cows grazing EI had a reduced ($P = 0.04$) calving rate (61%).

**Correlations Among Variables**

Intramuscular fat percentage ($r = 0.34$) and RF ($r = 0.75$) on d 0 were correlated ($P < 0.0001$) with BCS on d 0. Similarly, IMF ($r = 0.46$) and RF ($r = 0.68$) on d 60 were correlated ($P < 0.0001$) with BCS on d 60. Body condition score on d 0 was inversely correlated ($r = -0.57$; $P < 0.0001$) to BC change during the 60-d breeding season. Body condition change during the breeding season was correlated ($P < 0.001$) with IGF-I on d 0 ($r = 0.25$) and 30 ($r = 0.22$). Intramuscular fat and RF at d 0 were correlated ($P < 0.004$) with PRL at d 30 ($r = 0.23$ and 0.21, for IMF and RF, respectively) and PRL at d 60 ($r = 0.20$ and 0.23, for IMF and RF, respectively).
respectively). Similar relationships were found between IMF and RF at d 60 with concentrations of PRL at d 30 (r = 0.23 and 0.20 for IMF and RF, respectively) and 60 (r = 0.20 and 0.22 for IMF and RF, respectively; P < 0.004). Concentrations of IGF-I on d 0 were correlated (P < 0.0001) with IMF and RF at d 0 (r = 0.36 and 0.27 for IMF and RF, respectively) and d 60 (r = 0.39 and 0.32 for IMF and RF, respectively). Further, IGF-I at d 60 were correlated (P < 0.0001) with IMF and RF at d 0 (r = 0.25 and 0.26 for IMF and RF, respectively) and d 60 (r = 0.28 and 0.23 for IMF and RF, respectively).

**DISCUSSION**

Reproduction is generally compromised in ruminants consuming EI; however, the mode of action and hormones involved are not fully understood. Cows in marginal BC grazing CB during the 60-d breeding season gained the most BW and BCS in the current experiment. However, marginal-BC cows grazing EI pastures lost BC during the breeding season. It is well established that adequate BC is necessary to optimize reproductive efficiency of cattle (Selk et al., 1988). Dry matter intake is generally decreased in ruminants consuming EI diets (Goetsch et al., 1987; Looper et al., 2007); thus, BW (Nihsen et al., 2004; Looper et al., 2006) and BCS (Burke et al., 2001) is reduced. Flores et al. (2007) reported cows in thin BC (BCS = 4.3) grazing CB gained BC during the postpartum and breeding season, whereas good-BC (BCS = 6.1) cows also grazing CB pastures lost BC. Reduced visceral organ mass in thin cows, possibly decreasing maintenance requirements, may be responsible for the increased efficiency of thin BC cows (Molle et al., 2004; Hess et al., 2005). In the current experiment, consumption of EI inhibited marginal-BC cows from increased BCS observed in marginal-BC cows grazing CB. Morrison et al. (1999) reported optimal reproductive performance of beef cows could be achieved at a BCS of 5. Marginal-BC cows grazing CB had a mean BCS of 5.1, whereas marginal-BC cows grazing EI had a lesser BCS averaging 4.6 at the end of the breeding season. It appears that cows in marginal BC at the beginning of the breeding season and grazing EI did not gain adequate BC during the 60-d breeding season, and this resulted in a reduced calving rate.

Intramuscular fat percentage as well as RF was greater in good-BC cows than marginal-BC cows; both IMF
and RF measurements (d 0 and 60) were correlated to their respective BCS measurements (d 0 and 60). Current findings support our recent study (Looper et al., 2008) that found ultrasound measurement of LM area and rib fat of cows was correlated with BCS. Intramuscular fat percentage remained relatively constant during the 60-d breeding season. Cows in marginal BC tended to have a greater increase in RF during the breeding season than good-BC cows. Forage environment did not alter IMF or RF or their changes throughout the current experiment. Thin cows may be more efficient in use of available nutrients (Houghton et al., 1990; Hess et al., 2005), which might explain why marginal-BC cows in the current experiment tended to have increased RF after 60 d.

Prolactin was decreased in cows consuming EI compared with cows grazing CB. Concentrations of PRL are usually reduced in cattle consuming toxic endophyte-infected tall fescue (Hurley et al., 1980; Schillo et al., 1988) with PRL frequently used as a physiological indicator of fescue toxicosis. In the current experiment, cyclic cows had greater concentrations of PRL than anestrous cows. These findings substantiate our previous findings of luteal status effects on serum PRL (Flores et al., 2008). Prolactin was least in cows in marginal BC and grazing EI in the current experiment. Wright et al. (1987) and Flores et al. (2008) found similar relationships between low BCS in cows and reduced circulating PRL. It is increasingly evident that either peripheral or ovarian PRL, or both, may play a role in cattle fertility (Borromeo et al., 1998; Lebedeva et al., 2001, 2004). In the current experiment, marginal-BC cows grazing EI had reduced serum PRL as well as decreased calving rate. Circulating concentrations of PRL may help communicate the nutritional as well as the luteal status of the cow to the reproductive axis.

Cyclic cows had greater concentrations of IGF-I than anestrous cows in this experiment. Increased concentrations of IGF-I were associated with reduced postpartum intervals in beef cows (Rutter et al., 1989) and increased luteal P4 in dairy cows (Spicer et al., 1993). Flores et al. (2008) reported a positive correlation between serum IGF-I and the diameter of the largest follicle 1 d after administration of PGF2α at CIDR removal. Anestrous cows in thin BC (BCS = 4.3) had reduced serum IGF-I compared with cyclic cows in thin BC (Flores et al., 2008). Interestingly, IGF-I was greater on d 30 but decreased on d 60 of the breeding season in cows grazing CB than EI. Changes in BW and BC of cows could be responsible for the current findings. Change in BC during the breeding season was related to concentrations of IGF-I on d 0 and 30. Forage mass was not limiting for either forage throughout the experiment; however, decreases in forage CP and increases in NDF throughout the 60-d experiment may have influenced DMI altering serum IGF-I. Marginal-BC cows grazing EI had the least serum concentrations of IGF-I of all cows in the current experiment. Dry matter intake is typically reduced in ruminants consuming EI (Paterson et al., 1995; Looper et al., 2007). Nutrient restriction uncouples the positive relationship of the GH-IGF axis with increased concentrations of GH and reduced IGF-I (Armstrong et al., 1993). Similar to concentrations of PRL, IGF-I was diminished in marginal-BC cows grazing EI, and this group of cows had the least calving rate of all cow groups in this experiment. Serum IGF-I, along with PRL, may serve as communication signals to convey nutritional and luteal status to the reproductive axis.

Concentrations of CORT were decreased at d 30 of the breeding season in cows grazing EI compared with cows grazing CB pastures. Studies investigating CORT response to EI have not been consistent and may depend on the duration of exposure. Cortisol was increased in steers and cows 3 to 4 h after infusion of the ergot alkaloid ergotamine (Browning et al., 1998); however, CORT in heifers fed EI diets for 20 d was similar to CORT in heifers consuming endophyte-free tall fescue seed diets (Aldrich et al., 1993). Concentrations of CORT were similar between ewes fed increased ergovaline (0.75 mg/kg) tall fescue seed diets for 7 d and ewes fed decreased ergovaline (0.11 mg/kg) tall fescue seed diets (Looper et al., 2007). It is possible that cattle exposed to ergot alkaloids found in EI may become acclimated to the toxic effects of EI (Al-Hairdary et al., 2001) at least in regard to CORT release (Looper et al., 2007). Previous results along with the current findings imply CORT may not mediate the detrimental effects of EI in the animal. As with concentrations of PRL and IGF-I, CORT was least in marginal-BC cows grazing EI in the current experiment, suggesting a possible asynchrony of the hypothalamic-pituitary axis in cattle consuming EI. Altered hypothalamic or pituitary and pineal gland function or all 3 in ruminants exposed to EI has been suggested (Sibley and Creese, 1983; Schillo et al., 1988; Porter et al., 1990). Luteinizing hormone release was reduced in steer hours after exogenous ergot alkaloid challenge (Browning et al., 1997). Jones et al. (2003) speculated that ergot alkaloids commonly found in EI might bind to dopamine or norepinephrine.
neurons or both that stimulate FSH receptors on the follicle in cattle as is the case in rodents (Mayerhofer et al., 1997). Ergot alkaloids found in EI can bind to dopamine receptors in the anterior pituitary, possibly disrupting endocrine function (Sibley and Creese, 1983).

Cows in marginal BC at the beginning of the breeding season lost BC and IMF when grazing EI, whereas marginal-BC cows grazing CB pastures gained the most BW and BC. Circulating concentrations of PRL, IGF-I, and CORT were reduced in marginal-BC cows grazing EI, suggesting a disruption of endocrine function in cattle consuming EI. Calving rates were least from cattle in marginal BC grazing EI. Losses in adipose stores in cattle consuming EI may be communicated to the hypothalamic-pituitary axis via metabolic hormones including IGF-I or PRL or both, resulting in decreased calving rates.

**LITERATURE CITED**


