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Effects of acclimation to human interaction on performance, temperament, physiological responses, and pregnancy rates of Brahman-crossbred cows[1]

R. F. Cooke,* J. D. Arthington,†[2] D. B. Araujo,† and G. C. Lamb‡

*Oregon State University, Eastern Oregon Agricultural Research Center, Burns 97720; †University of Florida, Animal Sciences, Gainesville 32611; and ‡University of Florida, Institute of Food and Agricultural Sciences (IFAS), North Florida Research and Education Center, Marianna 32446

ABSTRACT: The objective of this study was to evaluate, over 2 consecutive years, the effects of acclimation to human interaction on performance, temperament, plasma concentrations of hormones and metabolites, and pregnancy rates of Brahman-crossbred cows. A total of 160 Braford and 235 Brahman × British cows were assigned to the 2-yr study. Approximately 45 d after weaning (August 2006) in yr 1, cows were evaluated for BW, BCS, and temperament (chute score, pen score, and exit velocity), stratified by these measurements in addition to breed and age, and randomly allocated to 14 groups (Braford = 8; Brahman × British = 6). Groups were randomly assigned to the control or acclimation treatment. In yr 2, cows were reevaluated within 45 d after weaning (August 2007) for BW, BCS, and temperament, stratified, and divided into 14 groups similarly as in yr 1, but in such a way that cows received the same treatment assigned in yr 1. Cows were acclimated to human interaction from August to January, and the acclimation process consisted of the same person visiting groups twice weekly and offering approximately 0.05 kg of range cubes per cow (as-fed basis). In January of both years, cow temperament, BW, and BCS were reassessed and cows were exposed to a 90-d breeding season. Blood samples were collected at the beginning of the acclimation period (August) and breeding season (January) for determination of plasma cortisol, IGF-I, and acute phase proteins. A treatment × breed interaction was detected during yr 1 ($P < 0.01$) for pregnancy analysis because acclimated Braford cows conceived earlier and at a greater percentage ($P < 0.01$) compared with control cows. According to values obtained at the beginning of breeding and pooled across treatments and breeds, IGF-I concentrations and BCS affected quadratically ($P < 0.05$), and concentrations of ceruloplasmin and haptoglobin decreased linearly ($P < 0.05$), the probability of pregnancy during both years. Temperament and cortisol concentrations decreased the probability of pregnancy linearly ($P < 0.05$) during yr 1 (only Braford cows for cortisol analysis) and affected the probability of pregnancy quadratically ($P < 0.05$) during yr 2. Results from this study indicate that acclimation did not affect cow temperament and physiological responses but did increase pregnancy rates of Braford cows during yr 1. Further, measurements and physiological responses associated with temperament influenced the probability of cows becoming pregnant during the breeding season.

Key words: acclimation, Brahman, cow, reproduction, temperament

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INTRODUCTION

The major objective of cow-calf systems is to produce 1 calf per cow annually. Therefore, reproductive performance of the cow herd contributes to the profitability of cow-calf operations. Ovulation of a competent oocyte establishes the length of the postpartum interval and also the fertility of beef cows during the breeding season (Short et al., 1990). Follicle size and LH pulsatility are major factors responsible for a successful ovulation (Roche, 2006); consequently, alternatives to stimulate GnRH delivery to the pituitary and to anticipate or enhance the ovulatory LH surge are options to maximize the reproductive performance of beef cows (Day, 2004).

Brahman-crossbred cows, however, may experience impaired pituitary gland sensitivity to GnRH (Griffin and Randel, 1978), which may compromise their

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[2]Corresponding author: jarth@ufl.edu
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ability to resume estrous cycles and conceive. In addition, Brahman-crossbred cattle are often described as temperamental (Voisinet et al., 1997), and this trait is expected to negatively influence their reproductive function further (Plasse et al., 1970). As an example, cattle with excitable temperament often have heightened secretion and circulating concentrations of ACTH and cortisol (Curley et al., 2008). These hormones may directly impair the synthesis and release of GnRH and gonadotropins (Dobson et al., 2000). Nevertheless, acclimation of cattle to human interaction and handling has been reported to improve temperament (Krohn et al., 2001) and alleviate the negative physiological effects of excitable temperament on reproduction (Echternkamp, 1984).

Therefore, we hypothesized that acclimation to human interaction would improve the temperament and increase the reproductive performance of Brahman-crossbred cows. The objectives of the present study were to compare BW and BCS, measurements of temperament, concentrations of plasma hormones and metabolites, and pregnancy rates in Brahman × British and Braford cows exposed or not to an acclimation procedure consisting of frequent human interaction.

MATERIALS AND METHODS

Animals were cared for in accordance with acceptable practices as outlined in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 1999).

This study was conducted over 2 yr (2006 and 2007) at the University of Florida, IFAS, Range Cattle Research and Education Center, Ona. Each experimental period was divided into an acclimation phase (August to January) and a breeding season (January to April).

Animals and Diets

A total of 160 Braford (37.5% Brahman + 62.5% Hereford) and 235 Brahman × British (mostly Angus, and containing approximately 25% of Brahman breeding) cows were assigned to the study. Initial mean BW and age (±SD) across breeds and years were 545 ± 71 kg and 6 ± 3 yr, respectively. Approximately 45 d after weaning in yr 1 (August 2006), cows were evaluated for BW, BCS (Wagner et al., 1988), and temperament, stratified by these measurements in addition to breed and age, and randomly allocated to 14 groups. Braford cows were divided into 8 groups of approximately 20 cows each, whereas Brahman × British cows were divided into 6 groups of approximately 40 cows each. Groups were assigned randomly to receive or not (control) the acclimation treatment (7 groups/treatment). In yr 2, cows were reevaluated within 45 d after weaning (August 2007) for BW, BCS, and temperament, and were stratified and divided into 14 groups similarly as in yr 1. However, cows were reallocated into groups so that they received the same treatment assigned in yr 1. Group was considered the experimental unit (7 groups/treatment per year). Within acclimated cows, 3 Braford and 19 Brahman × British cows were culled before the beginning of yr 2 and were replaced by cohorts not previously assigned to the study.

During both years, groups were maintained on separate bahiagrass (*Paspalum notatum*) pastures and were rotated among pastures weekly. Stargrass (*Cynodon nlemfuensis*) hay was offered in amounts to ensure ad libitum intake when pasture availability was limited. From early December to the end of the breeding season, cows from both treatments received a blend of sugarcane molasses and urea (97:3 as fed-basis) 3 times weekly, at a rate to provide a daily amount of 1.8 kg of DM per cow. This feeding procedure provided no substantial interaction between cows and the technician because it was performed using a tractor attached to a mixer tank. Nutrient composition of sugarcane molasses was estimated to be (DM basis) 79.2% of TDN and 12.3% of CP (SDK Laboratories, Hutchinson, KS). A complete commercial mineral-vitamin mix (14% Ca, 9% P, 24% NaCl, 0.20% K, 0.30% Mg, 0.20% S, 0.005% Co, 0.15% Cu, 0.02% I, 0.05% Mn, 0.004% Se, 0.3% Zn, 0.08% F, and 82 IU/g of vitamin A) and water were offered for ad libitum consumption throughout the study.

Acclimation Procedure

The acclimation process was applied from August to January, and cows for both treatment groups calved during this period (from October to December of each year). During the acclimation period, acclimated groups were visited twice weekly. During each visit, the same person walked among cows for 15 min and hand-offered approximately (as-fed basis) 0.05 kg of range cubes per cow. Control cows remained undisturbed on pasture. Range cubes consisted of (as-fed basis) 66.7% of wheat middlings, 27.0% of soybean hulls, 3.7% of blackstrap molasses, and 2.6% of cottonseed meal. Nutrient composition of range cubes was estimated to be (DM basis) 62.5% of TDN and 22.2% of CP (Dairy One Forage Laboratory, Ithaca, NY). The amount of range cubes offered during each acclimation visit was designed to provide no meaningful nutritional contribution to cows (approximately 0.5 and 1.0% of TDN and CP daily requirements, respectively), according to the NRC (1996) model.

Sampling

At the beginning of the acclimation phase (August) and breeding season (January), one blood sample was collected from each cow in addition to BW, BCS, and temperament evaluation. Blood samples were analyzed for plasma concentrations of cortisol, ceruloplasmin, haptoglobin, and IGF-I (prebreeding samples only). Plasma concentrations of ceruloplasmin and haptoglobin were determined to evaluate a potential association between temperament, cortisol concentrations, and the acute-phase response. Plasma IGF-I concentrations were determined to evaluate cow nutritional status before the initiation of breeding. Cow temperament was assessed by pen score, chute score, and exit velocity, as described by Arthington et al. (2008). Further, within each assessment day, cows were divided in quintiles according to their chute exit velocity and were assigned a score from 1 to 5 (exit score; 1 = cows within the slowest quintile; 5 = cows within the fastest quintile). Individual temperament scores were calculated by averaging cow chute score, pen score, and exit score.

Breeding Season

During yr 1 and 2, each cow in the Braford group was randomly assigned and exposed to 1 mature Angus bull (1:20 bull to cow ratio) for 90 d. Bulls were not rotated among groups, but were submitted to and approved by a breeding soundness evaluation before the breeding season. During yr 1, Brahman × British cows were assigned to estrous synchronization and fixed-time AI at the beginning of the breeding season (d 0). Cows received a 100-μg injection of GnRH (Cystorelin; Merial Ltd., Duluth, GA) and a controlled internal drug-releasing intravaginal device containing 1.38 g of progesterone (Pfizer Animal Health, New York, NY) on d 0, and received a 25-mg $PGF_{2\alpha}$ injection (Lutalyse; Pfizer Animal Health), a controlled internal drug-releasing device, and calf removal on d 6, followed by calf return and fixed-time AI on d 8. All cows were inseminated by the same technician and with semen from the same bull. Fifteen days after AI, cows in the Brahman × British groups were randomly assigned and exposed to 2 mature Angus or Brangus bulls (1:20 bull-to-cow ratio) for 90 d. Bulls were not rotated among groups but were submitted to and approved by a breeding soundness evaluation before the breeding season. During yr 2, Brahman × British cows were exposed only to natural breeding by mature Angus or Brangus bulls (1:20 bull-to-cow ratio) for 90 d, similarly as in yr 1. The Braford groups were not assigned to AI because these cows were part of a multiyear crossbreeding study and had to be naturally bred by specific bulls from the research station. During yr 2, Brahman × British cows were not assigned to AI because of management planning of the research station. Mean days postpartum (±SD) at the beginning of the breeding season were 72 ± 23.8 and 98 ± 22.6 d for Braford and Brahman × British cows during yr 1, and 48 ± 24.2 and 22 ± 21.0 d for Braford and Brahman × British cows during yr 2, respectively. This difference in mean days postpartum between years was observed because the breeding season during yr 2 was anticipated as a management decision of the research station.

Pregnancy rates to AI in Brahman × British cows were evaluated by detecting a conceptus with transrectal ultrasonography (5.0-MHz transducer, Aloka 500V, Wallingford, CT) 50 d after AI. Overall pregnancy status was verified by detecting a fetus via rectal palpation 90 d after the end of both breeding seasons. Further, date of conception was estimated retrospectively by subtracting gestation length (286 d; Reynolds et al., 1980) from the calving date.

Blood Analysis

Blood samples were collected via jugular venipuncture into commercial blood collection tubes (Vacutainer, 10 mL; Becton Dickinson, Franklin Lakes, NJ) containing sodium heparin (143 USP units), placed on ice immediately, and centrifuged at 2,400 × g for 30 min at room temperature for plasma collection. Plasma was frozen at −20°C on the same day of collection.

Concentrations of cortisol were determined using a Coat-A-Count solid-phase ^{125}I RIA kit (DPC Diagnostic Products Inc., Los Angeles, CA). A double-antibody RIA was used to determine concentrations of IGF-I (Badinga et al., 1991; Cooke et al., 2007). Concentrations of ceruloplasmin were determined according to procedures described by Demetriou et al. (1974). Concentrations of haptoglobin were determined by measuring haptoglobin-hemoglobin complex by estimating differences in peroxidase activity (Makimura and Suzuki, 1982), and results are expressed as arbitrary units from the absorption reading at 450 nm × 100. Across years, the intra- and interassay CV were 9.5 and 7.2% for cortisol, 5.6 and 6.3% for ceruloplasmin, 8.4 and 9.7% for haptoglobin, and 5.8 and 6.3% for IGF-I, respectively. Assay sensitivity was 5 ng/mL for cortisol and 10 ng/mL for IGF-I.

Statistical Analysis

Performance, temperament, and physiological data were analyzed using the MIXED procedure (SAS Inst. Inc., Cary, NC) and Satterthwaite approximation to determine the denominator df for the tests of fixed effects. The model statement used for analysis of hormones and metabolites, BW, BCS, and temperament contained the effects of treatment, breed, time variables, and appropriate interactions. Data were analyzed using group(breed × treatment × year) as a random variable. Results are reported as least squares means and were separated by LSD.

Pregnancy data were analyzed with the GLM and LOGISTIC procedures of SAS and were evaluated separately by year of study because of differences in breeding systems and mean days postpartum at the beginning of the breeding season between years. The model statement contained the effects of treatment, breed, group, estimated time of conception, and the appropriate interactions. Further, cow days postpartum at the beginning of the breeding season were included in the pregnancy analysis for yr 1 as a covariate; therefore, pregnancy results for yr 1 are reported as covariately adjusted means. Pregnancy data for yr 2 did not include days postpartum as a covariate so that potential carryover effects of treatments across years could be accounted for. Results are also reported as least squares means and were separated by LSD.

The probability of cows becoming pregnant during the breeding season was evaluated by rectal palpation results and according to BCS, temperament score, and concentrations of plasma metabolites and hormones obtained at the beginning of breeding. The GLM procedure of SAS was used to determine if each individual measurement influenced pregnancy rates linearly, quadratically, cubically, or all 3. The LOGISTIC procedure was used to determine the intercept and slope(s) values according to maximum likelihood estimates from each significant continuous order effect, and the probability of pregnancy was determined according to the following equation: Probability = $(e^{logistic\ equation})/(1 + e^{logistic\ equation})$. Logistic curves were constructed according to the minimum and maximum values detected for each individual measurement.

Pearson correlations were calculated among plasma and temperament measurements. These correlation coefficients were determined across years, collection day, breeds, and treatments with the CORR procedure of SAS.

For all analyses and contrasts, significance was set at $P \leq 0.05$ and tendencies were determined if $P > 0.05$ and $P \leq 0.10$. Results are reported according to treatment effects if no interactions were significant, or according to the highest order interaction detected.

RESULTS AND DISCUSSION

Treatment × breed × year interactions were detected for mean BW ($P = 0.05$), mean BCS ($P = 0.01$), and BCS change ($P = 0.02$) during the study, which may suggest that the acclimation process influenced nutritional status and, consequently, BCS change of Brahman × British cows during yr 2, BW of Braford cows during yr 2, and BCS of Braford cows during both years (Table 1). Nevertheless, the detection of significant effects was inconsistent between treatment groups, breeds, and years (Table 1). Further, mean BCS of cows from both breeds and treatments during yr 1 and 2 were always greater than 5 (Table 1), which is the critical BCS level for adequate cow productivity (Kunkle et al., 1994), whereas treatment effects detected for mean BCS and BCS changes, although statistically significant, can be considered marginal and insufficient to affect the performance of cows with BCS above 5 (Kunkle et al., 1994; Cooke and Arthington, 2008). Further supporting this rationale, no treatment effects were detected ($P = 0.21$) for plasma IGF-I (Table 2), whereas circulating concentrations of IGF-I are positively associated with body composition and nutritional status of cattle (Ellenberger et al., 1989; Bossis et al., 1999; Lapierre et al., 2000). No relevant treatment carryover effects from yr 1 to yr 2 were observed on cow BW and BCS measurements, given the inconsistent treatment responses detected across years. To ensure that acclimation effects were not confounded with nutritional effects, only 0.05 kg of range cubes was offered per cow during each of the acclimation events. This amount contributed to approximately 0.5 and 1.0% of the TDN and CP daily requirements of the cows used in the study, according to the NRC (1996) model.

No treatment effects were detected for measures of temperament and concentrations of cortisol and haptoglobin (Table 2). A treatment × day interaction was detected ($P = 0.04$) for ceruloplasmin (Table 3). Acclimated cows tended ($P = 0.08$) to have decreased ceruloplasmin concentrations compared with control cows at the beginning of the acclimation period (15.8 vs. 16.6, respectively; SEM = 0.30) but to have similar ($P = 0.82$) concentrations at the beginning of the breeding season (14.2 vs. 14.1; SEM = 0.30). Previous research has indicated that acclimation of cattle to human interaction is an alternative to improve temperament (Boivin et al., 1994; Jago et al., 1999; Krohn et al., 2001) and prevent elevated cortisol concentrations in response to excitable temperament and handling stress (Fordyce et al., 1988; Andrade et al., 2001; Curley et al., 2006). We hypothesized, based on these studies, that Brahman-crossbred cows would benefit from acclimation, particularly because of their usual excitable temperament during handling practices (Hearnshaw and Morris, 1984; Fordyce et al., 1988; Voisinet et al., 1997). This physiological rationale can be extrapolated to ceruloplasmin and haptoglobin concentrations because the acute phase response is stimulated by elevated concentrations of corticoids (Yoshino et al., 1993; Higuchi et al., 1994). However, cows from both treatments had similar temperaments and similar concentrations of cortisol and acute phase proteins after the acclimation period during yr 1 and 2 of the study. This lack of treatment effects across years may indicate that the acclimation process applied herein failed to improve cow temperament and the physiological responses associated with this trait, and no treatment effects were carried over from yr 1 to yr 2. Still, positive correlations were detected ($P < 0.01$) between concentrations of ceruloplasmin and haptoglobin (r = 0.48; data not shown), between concentrations of cortisol and temperament score (r = 0.49; data not shown), and between concentrations of cortisol and individual measurements of temperament (Table 4). Ceruloplasmin and haptoglobin are correlated because both proteins are components of the acute phase response in cattle (Carroll and Forsberg, 2007). Positive correlations among measurements of temperament and cortisol concentrations have also been described by others (Stahringer et al. 1990; Fell et al., 1999; Curley et al., 2006), indicating that cattle with excitable temperaments experience elevated concentrations of cortisol, whereas chute score, exit velocity, and pen score can be used as indicators of cattle temperament and also denote the amount of stress that the animal is experiencing during handling practices (Thun et al., 1998; Sapolsky et al., 2000).

Table 1. Mean BW, BCS, and BCS change of Brahman-crossbred cows acclimated or not (control) to human interaction from weaning to the beginning of the next breeding season, over 2 consecutive years[1]

	Yr 1		Yr 2	
Item	Brahman × British	Braford	Brahman × British	Braford
BW, kg				
Acclimated	517	519	514	556
Control	506	523	514	526
SEM	7.8	7.7	8.0	7.9
P-value[2]	0.32	0.72	0.97	0.01
BCS[3]				
Acclimated	5.7	5.7	5.8	6.0
Control	5.5	6.1	5.7	5.7
SEM	0.12	0.11	0.12	0.12
P-value	0.21	0.04	0.91	0.05
BCS change[4]				
Acclimated	−1.07	−0.66	−0.30	−0.59
Control	−1.09	−0.82	−0.86	−0.44
SEM	0.115	0.116	0.119	0.123
P-value	0.89	0.35	<0.01	0.39

[1]Acclimated cows were visited twice weekly from August (weaning) to January (beginning of breeding season) by the same person, who walked among cows for 15 min and hand-offered approximately (as-fed basis) 0.05 kg of range cubes per cow. This amount of range cubes was designed to provide no meaningful nutritional contribution to acclimated cows. Control cows remained undisturbed on pasture.

[2]Treatment comparisons within breed and years.

[3]Emaciated = 1, obese = 9 (Wagner et al., 1988).

[4]Calculated using BCS collected at the beginning of the acclimation period and breeding season.

A treatment × breed interaction was detected ($P < 0.01$) for pregnancy analysis during yr 1 of the study. Acclimated Braford cows became pregnant earlier and at a greater number ($P < 0.01$; Figure 1) during the breeding season compared with control cohorts. However, pregnancy rates were similar (data not shown) between acclimated and control Brahman × British cows, either to fixed-time AI (7.8 vs. 10.8% of pregnant cows/total cows, respectively; $P = 0.43$; SEM = 2.70), bull breeding (74.7 vs. 75.6% of pregnant cows/total cows not pregnant to AI, respectively; $P = 0.87$; SEM = 4.15), or accumulative (AI + bull breeding) pregnancy during the breeding season of yr 1 (74.1 vs. 75.4% of pregnant cows/total cows, respectively; $P = 0.81$; SEM = 3.93). No treatment effects ($P = 0.78$; data not shown) were detected for pregnancy analysis in both breed types during yr 2 (73.8 vs. 72.3% of pregnant cows/total cows for the acclimated and control treat-

Table 2. Mean BW change, temperament measurements, and plasma concentrations of cortisol, haptoglobin, and IGF-I of Brahman-crossbred cows acclimated or not (control) to human interaction from weaning to the beginning of the next breeding season, over 2 consecutive years[1,2]

Item	Acclimated	Control	SEM	*P*-value
BW change,[3] kg	−43	−50	5.4	0.38
Chute score	1.98	1.96	0.034	0.59
Pen score	2.48	2.58	0.043	0.12
Exit velocity, m/s	2.12	2.08	0.049	0.57
Temperament score[4]	2.50	2.49	0.042	0.94
Cortisol, μg/dL	3.33	3.36	0.122	0.88
Haptoglobin, 450 nm × 100	1.96	2.12	0.275	0.68
IGF-I, ng/mL	133	123	5.7	0.21

[1]Acclimated cows were visited twice weekly from August (weaning) to January (beginning of breeding season) by the same person, who walked among cows for 15 min and hand-offered approximately (as-fed basis) 0.05 kg of range cubes per cow. This amount of range cubes was designed to provide no meaningful nutritional contribution to acclimated cows. Control cows remained undisturbed on pasture.

[2]Chute score, pen score, and exit velocity were assessed according to the techniques described by Arthington et al. (2008).

[3]Calculated using BW collected at the beginning of the acclimation period and breeding season.

[4]Calculated by averaging cow chute score, exit score, and pen score. Exit score was calculated by dividing exit velocity results into quintiles and assigning cows with a score from 1 to 5 (exit score: 1 = cows within the slowest quintile; 5 = cows within the fastest quintile).

Table 3. Plasma ceruloplasmin concentrations of Brahman-crossbred cows acclimated or not (control) to human interaction from weaning to the beginning of the next breeding season, over 2 consecutive years[1]

Item	August	January	SEM
Acclimated	15.8	14.2	0.31
Control	16.6	14.2	0.30
P-value[2]	0.08	0.82	

[1]Acclimated cows were visited twice weekly from August (weaning) to January (beginning of breeding season) by the same person, who walked among cows for 15 min and hand-offered approximately (as-fed basis) 0.05 kg of range cubes per cow. This amount of range cubes was designed to provide no meaningful nutritional contribution to acclimated cows. Control cows remained undisturbed on pasture.

[2]Treatment comparison within month.

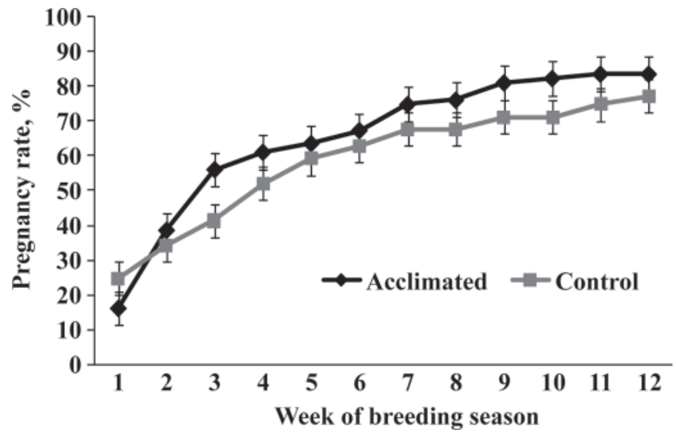

Figure 1. Pregnancy rates [(pregnant cows/total cows) × 100] during the breeding season from yr 1 of the study of Braford cows exposed or not (control) to acclimation procedures. Acclimated cows were visited twice weekly from August (weaning) to January (beginning of breeding season) by the same person, who walked among cows for 15 min and hand-offered approximately (as-fed basis) 0.05 kg of range cubes per cow. This amount of range cubes was designed to provide no meaningful nutritional contribution to acclimated cows. Control cows remained undisturbed on pasture. Date of conception was estimated retrospectively by subtracting gestation length (286 d; Reynolds et al., 1980) from the calving date. Values reported are least squares means adjusted covariately to cow days postpartum at the beginning of the breeding season. A treatment effect was detected ($P < 0.01$).

ments across breeds, respectively; SEM = 3.31). Acclimation increased reproductive performance of Braford cows during yr 1 of the study, but the reasons for this effect cannot be clarified because of the similar treatment responses observed among the physiological and temperament measurements evaluated. One can speculate that the lack of similar treatment effects for pregnancy of Brahman × British cows during yr 1 can be attributed to the estrus synchronization + fixed-time AI protocol, which unexpectedly resulted in decreased pregnancy rates and likely influenced the reproductive function of cows during the remainder of the breeding season. The estrus synchronization protocol used herein was based on a previous research effort with *Bos indicus*-influenced cows (Vasconcelos et al., 2008) and was selected because calf removal is an alternative to stimulate ovulation instead of exogenous GnRH administration (Williams et al., 1983; Pursley et al., 1995). Exogenous GnRH could bypass the detrimental effects of excitable temperament on the physiological mechanisms associated with fertility, such as gonadotropin secretory activity, and thus impair treatment evaluation of pregnancy rates. Still, no treatment effects were detected for pregnancy analysis during yr 2 of the study, when both treatment groups were exposed to natural breeding only. Therefore, positive effects of acclimation on pregnancy rates were detected only for Braford cows during yr 1, hence were inconsistent among breeds and years, and were not carried over from yr 1 to yr 2.

Table 4. Pearson correlation coefficients among measurements of temperament and plasma cortisol concentrations of cows (n = 395)[1]

Item	Cortisol	Chute score	Exit velocity
Chute score	0.34		
	<0.01		
Exit velocity	0.49	0.49	
	<0.01	<0.01	
Pen score	0.44	0.45	0.75
	<0.01	<0.01	<0.01

[1]Upper row = correlation coefficients; lower row = *P*-values.

The probability of cows becoming pregnant, according to rectal palpation results and measurements obtained at the beginning of the breeding season, was evaluated within each year because mean days postpartum across breeds at the onset of breeding differed ($P < 0.01$) from yr 1 to yr 2 (88 vs. 34 d, respectively; SEM = 1.5). Plasma IGF-I concentrations and cow BCS affected the probability of pregnancy quadratically ($P = 0.02$ and <0.01, respectively) during both years (Figure 2). These results indicate that under- and overconditioned cows have impaired reproductive performance compared with cows in moderate nutritional status, as reported by others (Armstrong et al., 2001; Bilby et al., 2006; Cooke and Arthington, 2008). Cow temperament score and plasma cortisol concentrations reduced the probability of pregnancy linearly ($P =$ 0.03 and 0.04, respectively) during yr 1 (only Braford cows for cortisol analysis), and affected the probability of pregnancy quadratically ($P < 0.01$ and = 0.02, respectively) during yr 2 (Figure 2). These results support our hypothesis and previous research indicating that excitable temperament (Plasse et al., 1970) and elevated cortisol concentrations (Li and Wagner, 1983; Dobson et al., 2000), partially explained by cow temperament (Table 4), are detrimental to the reproductive function of cows. In addition, as observed in yr 2, reduced cortisol concentrations and temperament scores during the early postpartum period may denote subclinical health disorders that negatively affect cattle reproduction, such as lethargy, lameness (Sprecher et al., 1997), and immunosuppresion (Goff, 2006), given that clinical diseases were not detected in any of the cows evaluated herein. Plasma concentrations of ceru-

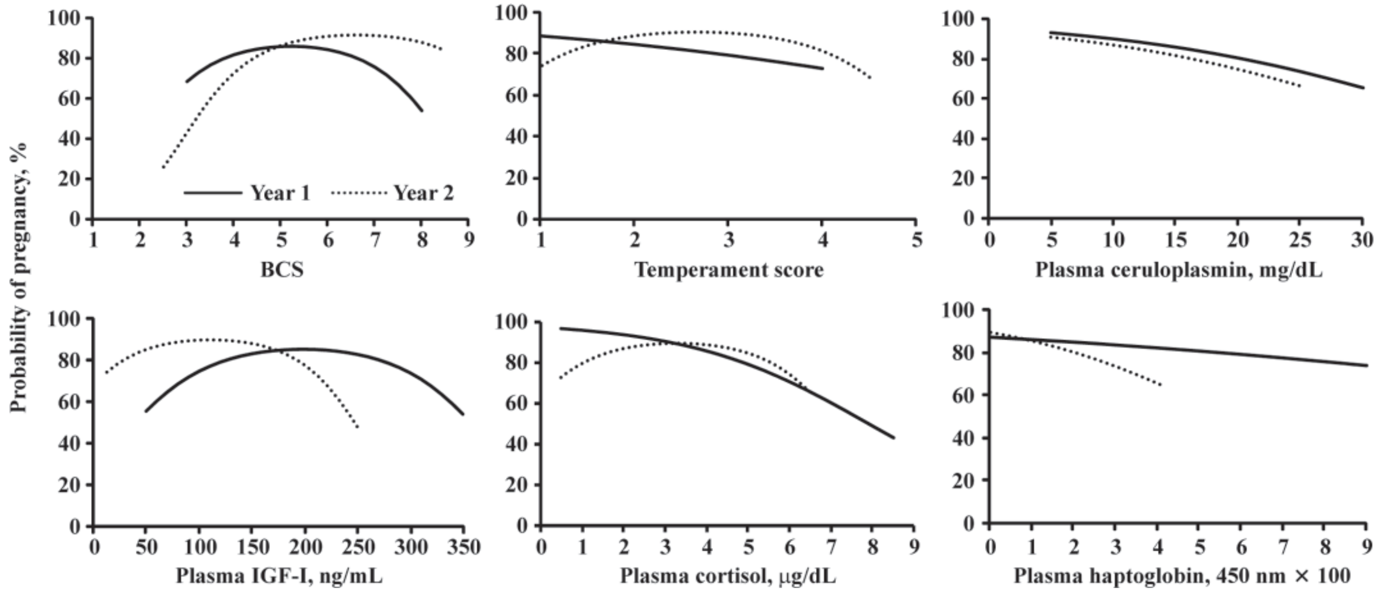

Figure 2. Effects of BCS (emaciated = 1, obese = 9; Wagner et al., 1988), temperament score (1 = calm, 5 = excitable temperament), and plasma substances, assessed at the beginning of the breeding season, on the probability of Brahman × British and Braford cows to become pregnant during a 90-d breeding season. During both years, linear effects were detected ($P < 0.05$) for ceruloplasmin and haptoglobin, whereas quadratic effects were detected ($P < 0.05$) for BCS and IGF-I. For temperament score, a linear ($P = 0.03$) and a quadratic effect ($P < 0.01$) were detected for both breeds during yr 1 and 2, respectively. For cortisol, a linear effect was detected ($P = 0.04$) for Braford cows during yr 1, whereas a quadratic effect was detected ($P = 0.02$) for both breeds during yr 2.

loplasmin and haptoglobin reduced the probability of pregnancy linearly during yr 1 ($P < 0.01$ and $= 0.04$, respectively) and yr 2 ($P = 0.01$; Figure 2), indicating and supporting previous data reporting that the acute phase response is detrimental to reproductive function of livestock (Peter et al., 1989; Battaglia et al., 2000; Williams et al., 2001).

In conclusion, results from this study indicate that acclimation of Brahman-crossbred cows to human interaction did not influence temperament or concentrations of plasma cortisol and acute phase proteins. Cow BW and BCS were affected by acclimation, although these outcomes were inconsistent among breeds, years, and treatment groups. Nevertheless, the reproductive performance of acclimated Braford cows was enhanced during yr 1, whereas measurements and physiological responses associated with temperament influenced the probability of cows becoming pregnant during the breeding season. Therefore, although positive effects of acclimation to human interaction were inconsistent among the responses measured during the study, this or other management strategies that improve cow temperament should be enhanced and developed to maximize the reproductive performance of Brahman-crossbred cows, and the consequent productivity of cow-calf operations containing these types of cattle.

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