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IMPACT OF BODY CONDITION SCORE ON REPRODUCTIVE PERFORMANCE IN YOUNG POSTPARTUM RANGE COWS GRAZING NATIVE RANGE

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ABSTRACT: Body condition score (**BCS**) is used as a management tool to predict reproduction of young beef cows. The objective was to determine the effects of BCS at calving on pregnancy rates, days to first estrus (**DTFE**), nutrient status (assessed by blood metabolites), and calf BW change in 315, 2- and 3-yr-old cows grazing native range over 5 yr at the Corona Range and Livestock Research Center, NM. Palpable BCS (1 to 9) were determined by experienced technicians prior to calving. Cows were assigned to 1 of 4 BCS groups: Thin (**T**; BCS = 3.5 to 4.25), Thin-Moderate (**TM**; BCS = 4.5), Moderate-Fat (**MF**; BCS = 4.75 to 5.25), or Fat (**F**; BCS = 5.5 to 7.0). Postpartum supplementation was terminated each year when cows reached BW nadir. Cows were weighed weekly and serum was collected 2×/wk for progesterone analysis to estimate DTFE. Year effects were also evaluated, with years identified as either above (**AA**) or below (**BA**) average rainfall. Data were analyzed as a 4 × 2 factorial. A calving BCS × rainfall interaction occurred for DTFE (P = 0.01). In AA years, all BCS groups achieved DTFE within 86 d postpartum with F cows cycling the earliest at d 68 postpartum. In contrast, during BA years, cows with a greater BCS (MF and F) took up to 61 d longer postpartum to reach DTFE compared to cows in a thinner BCS (T and TM). Pregnancy rates did not differ between BCS (P = 0.45; 90, 95, 90, 90 for T, TM, MF, and F, respectively). Calf weights at birth (P = 0.19), branding (P = 0.27), weaning (205-d weight; P = 0.51) were not affected by cow BCS at calving**.** Results suggest that BCS interacts with rainfall and may not be a consistent indicator of reproductive performance in young beef cows.

Key Words: beef cattle, body condition score, reproduction

INTRODUCTION

Postpartum interval can have a major economic impact on cow/calf producers in terms of cow productivity. Mature cows tend to be more resilient and have a shorter postpartum interval than young cows (Wiltbank, 1970). A prolonged postpartum interval is more frequent in young cows because of the additional demands for continued growth combined with the stress of lactation. Thus, prepartum body energy reserves can be very important for the resumption of luteal activity and be a useful indicator of nutritional status and reproductive efficiency (i.e., days to first estrus and pregnancy rates) in young cows (Spitzer et al., 1995). Cows with greater body condition before calving respond with improved reproductive performance (Selk et al., 1988; DeRouen et al., 1994; Looper et al., 2003). Guidelines suggest that young cows need to be in a BCS $\geq$ 6 for optimal reproductive performance (DeRouen et al., 1994). Therefore, one objective was to determine the effects of BCS at calving on pregnancy rates, days to first estrus, nutrient status (assessed by blood metabolites), and calf BW change in 315, 2- and 3-yr-old cows grazing native range. Another objective was to determine the interaction of rainfall on reproductive performance, nutrient status, and calf BW in young beef cows.

MATERIALS AND METHODS

Over 5 yr, 315 crossbred, spring-calving 2- and 3-yr-old cows were used to compare the influence of BCS on reproductive performance at the Corona Range and Livestock Research Center (**CRLRC**), Corona, NM. Average elevation at CRLRC is 2,000 m with an average annual precipitation of 380 mm, approximately 70% of which occurs from May to October. Predominant forages in the experimental pastures were blue grama (*Bouteloua gracilis*) and wolftail (*Lycurus phleoides*), as well as other less dominant grasses and forbs (Knox, 1998). The annual standing forage was at least 355 kg/ha in each year and availability was never limiting in all 5 yr (A. Cibils, personal communication).

All animal handling and experimental procedures were in accordance with guidelines set by the New Mexico State University Institutional Animal Care and Use Committee. Management before calving was similar in all 5 yr and between age groups. Prior to calving cows were assigned to 1 of 4 BCS groups: Thin (**T**; BCS = 3.5 to 4.25; palpatable backbone), Thin-Moderate (**TM**; BCS = 4.5; palpatable ribs), Moderate-Fat (**MF**; BCS = 4.75 to 5.25; rib and backbone not palpatable), or Fat (**F**; BCS = 5.5 to 7.0; palpatable fat covering over tailhead). Body condition scores (BCS; 1 = emaciated, 9 = obese) were assigned to each cow by visual observation and palpation at initiation of the study by a trained technician. Cow/calf pairs were moved to a common pasture within 10 d of calving and postpartum supplementation was initiated. Postpartum supplementation provided 36% CP that was fed at a rate of 908 g/cow/d in 4 out of 5 yr or 30% CP fed at 1,135 g/cow/d in 1 yr (cottonseed meal/wheat middlings-based supplement). Total days of supplementation were strategically determined by monitoring average cow BW change within each year. Cows also had ad libitum access

to water and a loose macro- and micro-mineral mix year long. Breeding season started mid-May and ended in less than 60 d. Cows were weighed 1×/wk after calving until the end of breeding and again at weaning. Days to BW nadir were calculated from the lowest BW after calving. Calves were weighed at birth, branding, and weaning in each year. Calf birth weights were recorded in the field with a portable scale within 3 d of birth. Branding weights and weaning weights were adjusted for a 55-d branding and 205-d weaning weight with no adjustments for sex of calf or age of dam.

Serum samples were collected once weekly (1 yr; Friday) or twice weekly (4 yr) on supplementation days (Monday and Friday) via coccygeal venipuncture beginning 35 to 55 d postpartum for progesterone analysis to estimate days to first estrus (2 or more consecutive progesterone concentrations $\geq$ 1.0 ng/mL). Blood was collected immediately after cows received supplement. Samples were analyzed for progesterone by solid-phase radioimmunoassay (Coat-A-Count, Siemens Medical Solutions Diagnostics, Los Angeles, CA) as described by Schneider and Hallford (1996). Serum samples were also analyzed for insulin, glucose, non-esterified fatty acid (**NEFA**), and serum urea nitrogen (**SUN**) to evaluate nutrient status of each cow. Samples were analyzed using commercial kits for NEFA (Wako Chemicals, Richmond, VA), SUN (Thermo Electron Corp., Waltham, MA), and glucose (enzymatic endpoint, Thermo Electron Corp., Waltham, MA). Insulin was analyzed by solid-phase RIA (Coat-A-Count; Siemens Medical Solutions Diagnostic, Los Angeles, CA). Inter- and intra-assay CV were less than 10% for all serum metabolites.

Statistical Analysis. Years were characterized as being either above (**AA**) or below (**BA**) an 18-yr average rainfall for CRLRC. Consequently, year served as the experimental unit for rainfall. Within each year, there were either 3 or 4 BCS groups. A mixed model ANOVA accounted for correlations within year and BCS group within year and allowed for appropriate comparison of BCS groups even though some BCS groups did not appear in every year. Data was analyzed as a 4 × 2 factorial. The SAS PROC MIXED (ver 9.1.3) was used to analyze the mixed model with cow as the experimental unit and with the fixed effects of BCS, rain, and BCS × rain. Year within rain and year within rain × BCS were used as the random effects. The Kenward-Roger degrees of freedom method was used to adjust standard errors and calculate denominator degrees of freedom. Two preplanned contrast statements were used to test for linear and quadratic effects of increasing BCS. The GENMOD procedure of SAS was used to analyze pregnancy rates. Significance was determined at $P \leq 0.10$.

RESULTS

A calving BCS × rainfall interaction occurred for days to first estrus (**DTFE**; $P = 0.01$). In AA years, all BCS groups achieved DTFE within 86 d postpartum with F cows cycling the earliest at d 68 postpartum. In contrast, during BA years, cows with a greater BCS (MF and F) took up to 61 days longer postpartum to reach DTFE compared to cows in a thinner BCS (T and TM). Cows in a thinner BCS at parturition tended to return to estrus earlier more consistently than cows in a greater BCS. Body condition score at parturition had no effect on pregnancy rates ($P = 0.45$) or days to BW nadir ($P = 0.74$). These data do not support the conclusion that BCS at parturition is the single most important factor affecting subsequent reproductive performance (Selk et al., 1988; Looper et al., 2003).

Cow BW were similar at the initiation of the study ($P = 0.31$) and at the end of breeding ($P = 0.15$). Body condition score did interact with rainfall for cow BW at the beginning of breeding, BW nadir, and at weaning ($P \leq 0.01$). During AA rainfall years, cow BW of T and TM cows were lighter or similar in BW to MF and F cows. However, in BA years, T and TM cows were heavier than MF and F cows, suggesting that MF and F cows tend to lose more BW after calving than T and TM cows. Cow BW change was not influenced by calving BCS score ($P \geq 0.25$). However, BW change interval from initial BW to beginning of breeding and initial BW to BW nadir tended to exhibit a quadratic ($P = 0.11$; 0.12; respectively) response to calving BCS. Cows in a greater BCS tended to lose more BW than cows in a thinner BCS. Calf weights at birth ($P = 0.19$), branding ($P = 0.27$), and weaning (205-d weight; $P = 0.51$) were not affected by cow BCS at calving, which is consistent with previous results with primiparous beef cows (DeRouen et al., 1994).

Serum glucose concentration was not influenced by calving BCS ($P = 0.90$), which is expected due to the tight regulation of blood glucose (Kaneko, 1997). In contrast, previous research has found an increase in BCS linearly increases concentration of glucose (Vizcarra et al., 1998). A calving BCS × rainfall interaction ($P \leq 0.02$) occurred for serum insulin, NEFA, and SUN. In AA years, insulin was similar for all BCS groups. However, during BA years, serum insulin concentrations were greater for MF and F cows than T and TM cows. In contrast to serum insulin concentrations, NEFA and SUN concentrations were greater in AA rainfall years than in BA years.

Rainfall did not influence pregnancy rates ($P = 0.21$) or days to BW nadir ($P = 0.57$). Cows regained a positive energy balance at similar times which might have influenced the pregnancy rates. Serum glucose concentrations were decreased in lower rainfall years ($P = 0.06$; 55.5 and 50.7 ± 1.6 mg/100 mL for AA and BA, respectively). Cow and calf BW were similar between AA and BA years ($P \geq 0.13$). In contrast, cows in AA years lost more weight from the initiation of the study until the beginning of breeding ($P < 0.01$).

IMPLICATIONS

In this study, body condition score at parturition was not a dominant factor influencing reproductive performance. However, BCS tended to interact with annual rainfall. In years with above average rainfall, all cows tended to perform similarly regardless of BCS. On the other hand, in below-average rainfall years, cows in lower BCS tended to be more resilient to the increase in environmental stress which allowed for a decrease in days from parturition to first estrus. With the variability in annual rainfall pattern of arid climates in the southwestern United States, managing cows to maintain BCS 4.0 to 4.5 at

calving may be more practical to producers on the basis of being more reproductively efficient and more resistant to environmental changes than cows with a greater body condition.

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Table 1. Calving body condition score × rainfall interactions for days to first estrus, serum metabolites, and cow body weight of young cows grazing native range.

		Calving BCS				
Measurement	Rainfall	Thin[a]	Thin-Moderate[b]	Moderate-Fat[c]	Fat[d]	SEM
Days to first estrus	Above Average	86[ex]	75[ex]	77[ex]	68[ex]	8
	Below Average	73[ex]	57[ex]	105[fy]	119[fy]	14
Serum Metabolite						
Insulin, ng/mL	Above Average	0.43[ex]	0.42[ex]	0.42[ex]	0.46[ex]	0.21
	Below Average	1.51[ey]	1.53[ey]	2.6[fy]	2.78[fy]	0.19
NEFA, µmol/L	Above Average	455[ex]	478[ex]	472[ex]	399[ex]	63
	Below Average	356[ey]	399[ex]	207[fy]	223[fy]	55
SUN, mg/100 mL	Above Average	8.5[ex]	8.4[ex]	8.5[ex]	7.8[ex]	1.5
	Below Average	7.7[efx]	9.5[ex]	6.2[fy]	6.7[fx]	1.3
Cow BW, kg						
Begin of Breeding	Above Average	371[ex]	383[efx]	392[fx]	384[efx]	10
	Below Average	407[ex]	417[ex]	352[fy]	378[efx]	25
Nadir	Above Average	349[ex]	356[efx]	364[fx]	360[ex]	8
	Below Average	375[efx]	397[fy]	320[gy]	342[egx]	20
Weaning	Above Average	437[ex]	444[ex]	451[ex]	447[ex]	9
	Below Average	438[ex]	466[ex]	398[fy]	439[ex]	24

[a]BCS 3.5 to 4.25
[b]BCS 4.5
[c]BCS 4.75 to 5.25
[d]BCS 5.5 to 7
[e,f,g] For each interaction, means in rows with different superscripts differ ($P < 0.10$).
[x,y] For each interaction, means in columns with different superscripts differ ($P < 0.10$

Table 2. Effects of calving body condition score on reproduction, cow weight and weight change, serum metabolites, and calf weight in young cows grazing native range.

	Calving BCS						Contrast	
Measurement	Thin[a]	Thin-Moderate[b]	Moderate-Fat[c]	Fat[d]	SEM	*P*-value	Linear	Quadratic
Days to BW nadir	59	51	54	53	20	0.74	0.89	0.64
Pregnancy, %	90	95	90	90	--	0.45	--	--
Ratio	26/29	125/132	87/97	51/57	--	--	--	--
Cow BW, kg								
Initial Wt	438	454	434	437	16	0.31	0.74	0.69
End of Breeding	390	411	395	416	15	0.15	0.37	0.97
Cow BW change, kg								
Initial to Begin of Breeding	-48	-54	-62	-55	7	0.25	0.48	0.11
Initial to Nadir Wt	-76	-78	-91	-84	9	0.39	0.46	0.12
Initial to End of Breeding	-47	-42	-39	-22	20	0.27	0.43	0.69
Nadir to End of Breeding	29	36	54	62	16	0.29	0.24	0.43
Nadir to Weaning Wt	76	79	83	93	10	0.50	0.3	0.78
Initial to Weaning Wt	0	1	-8	9	15	0.28	0.75	0.2
Serum Metabolite								
Glucose, mg/100 mL	51.7	53.5	53.4	53.7	3.3	0.9	0.67	0.66
Calf BW, kg								
Birth Wt	33	36	32	31	2	0.19	0.28	0.44
Branding Wt	72	73	64	66	7	0.27	0.35	0.59
Weaning Wt	209	222	195	196	23	0.51	0.59	0.92

[a]BCS 3.5 to 4.25
[b]BCS 4.5
[c]BCS 4.75 to 5.25
[d]BCS 5.5 to 7

Table 3. Effects of annual rainfall (above or below an 18 yr average at the Corona Range and Livestock Research Center) on reproduction, cow body weight and body weight change, serum metabolite and calf body weight in young cows grazing native range.

	Rainfall			
Measurement	Above Average	Below Average	SEM	*P*-value
Days to BW nadir	64	44	23	0.57
Pregnancy, %	93	88	--	0.21
Ratio	221/238	68/77	--	--
Cow BW, kg				
Initial Wt	451	430	11	0.29
End of Breeding	409	397	15	0.59
Cow BW change, kg				
Initial to Begin of Breeding	-69	-41	5	< 0.01
Initial to Nadir Wt	-93	-71	9	0.14
Initial to End of Breeding	-43	-32	23	0.75
Nadir to End of Breeding	51	39	19	0.67
Nadir to Weaning Wt	89	77	11	0.46
Initial to Weaning Wt	-5	5	18	0.70
Serum Metabolite				
Glucose, mg/100 mL	55.5	50.7	1.6	0.06
Calf BW, kg				
Birth Wt	33	33	2	0.98
Branding Wt	62	75	4	0.13
Weaning Wt	196	215	26	0.63