Comparison of crossbred cows containing various proportions of Brahman in spring or fall calving systems: II. Milk production

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COMPARISON OF CROSSBRED COWS CONTAINING VARIOUS PROPORTIONS OF BRAHMAN IN SPRING OR FALL CALVING SYSTEMS: II. MILK PRODUCTION[1,2]

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ABSTRACT

Monthly estimates of 24-h milk yield were obtained on 160 spring-calving and 153 fall-calving crossbred cows containing various proportions (0, 1/4 or 1/2) of Brahman breeding, all bred to Limousin sires. Milk production was measured using weigh-suckle-weigh procedures. Interactions between crossbred group and season of calving were not significant. Across seasons, milk production rarely was affected by proportion of Brahman breeding; however, milk yield, averaged over six monthly measurements, was greater ($P < .10$) for cows out of Hereford dams than for cows out of Angus dams. Averaged over six monthly measurements, estimated 24-h milk yield ranged from 5.3 kg for Hereford × Angus to 6.2 kg for Brahman × Hereford cows. Season of calving affected milk yield during the first and fourth measurement periods. Fall-calving cows produced more ($P < .01$) milk during the first period whereas spring-calving cows produced more milk during the fourth period. Lactation patterns for the two seasons differed. Spring-calving cows had a more typical lactation curve, whereas the curve for fall-calving cows showed more variability in milk yield throughout lactation. Phenotypic correlations between monthly measurements of 24-h milk yield and calf performance tended to be moderate and positive within the spring group. Correlations for the fall group, although positive, tended to be weaker than those found in the spring group.

Key Words: Crossbreeding, Milk Yield, Angus, Brahman, Hereford

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Introduction

Milk production of the beef cow has a major impact on efficiency of beef production. Neville (1962) found that 66% of the variation in calf weight at weaning was due to milk consumption. Dinkel and Brown (1978) found calf weaning weight to be the best single indicator of cow efficiency. Therefore, milk production and consumption affects production efficiency. Totusek et al. (1973) reported a relationship similar to that found by Neville (1962) and found the weigh-suckle-weigh method was the most accurate estimator of milk yield; he attributed this to greater release of oxytocin caused by the nursing calf. Breed variation in milking ability has been demonstrated by various researchres (Notter et al., 1978; Chenette and Frahm, 1981; Daley et al., 1987); however, only limited data are available concerning milk production of cows either with various proportions of Brahman breeding or of similar breed groups in spring versus fall calving systems. The objectives of this study were to evaluate the effects of crossbred cow group, season of calving and the interaction of

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TABLE 1. DISTRIBUTION OF RECORDS BY CROSSBRED GROUP, SEASON OF CALVING AND YEAR

Crossbred cow group[a]	No.[b] of sires	Year and season 1984 Spring	1984 Fall	1985 Spring	1985 Fall	Total
H·A	9	7	11	14	9	41
A·H	5	1	2	5	9	17
BH·A	10	21	14	24	18	77
BA·H	11	13	8	20	20	61
B·A	11	8	15	19	21	63
B·H	8	10	10	18	16	54
Total	54	60	60	100	93	313

[a]H·A Hereford × Angus, A·H = Angus × Hereford, BH·A = Brahman-Hereford × Angus, BA·H = Brahman-Angus × Hereford, B·A = Brahman × Angus and B·H = Brahman × Hereford. Breed of sire × breed of dam.

[b]Sires of dams.

crossbred cow group and season of calving on milk yield measured using weigh-suckle-weigh procedures and to examine differences in lactation patterns between spring- and fall-calving cows.

Materials and Methods

Angus (A) and Hereford (H) dams were assigned at random to spring- and fall-calving groups and mated to either A, H, Brahman (B), 1/2B-1/2A or 1/2B-1/2H bulls to produce crossbred calves that were 0 B (H·A and A·H), 1/4 B ($B_1H_1A_2$ and $B_1A_1H_2$) and 1/2 B (B·A and B·H) over a 3-yr period (1981 to 1983). The mating system, origin of foundation breeding stock and growth performance of crossbred calves were reported by Bolton et al. (1987a). Postweaning growth, sexual development and pregnancy rate of heifers were reported by Bolton et al. (1987b). Management and productivity of these heifers as 2-yr-olds were reported by McCarter et al. (1990).

This research was conducted at the Southwestern Livestock and Forage Research Laboratory (El Reno, OK). Cows were maintained on pastures consisting predominantly of big bluestem (*Andropogon gerardii*), little bluestem (*Schizacharium scoparius*), buffalograss (*Buchloe dactyloides*), sideoats grama (*Bouteloua curtipendula*), silver bluestem (*Bothriochloa saccharoides*) and bermudagrass (*Cynodon dactylon*). Spring-calving cows were supplemented from mid-December through mid-April with .8 kg·head^{-1}·d^{-1} of cottonseed meal cubes (41% CP) and were provided hay (wheat, oat or Old World bluestem) as deemed necessary by the herdsman based on range and weather conditions. Cows calving in the fall were supplemented with 1 kg·head^{-1}·d^{-1} of cottonseed meal cubes from December through mid-April as well as hay based on range and weather conditions. All cows were bred to Limousin sires. Sires were randomized across cow groups, with a total of 17 sires being used.

Monthly estimates of 24-h milk production were obtained using weigh-suckle-weigh procedures on 160 spring-calving and 153 fall-calving cows selected randomly from the six crossbred breed groups over a 2-yr period (1984 and 1985 calf crops). Cows used in this study were either 2, 3 or 4 yr old at calving. The average age of calves at the first weigh period were 38 (range 14 to 79 d) and 47 d (9 to 79 d), respectively, for spring- and fall-calving groups. Distribution of records by crossbred cow group, season of calving and year are presented in Table 1. Only those cows successfully weaning a calf were included. Cow-calf pairs were assigned randomly to one of four milk production groups. The order in which the groups were processed each month was determined randomly. Cows and calves were gathered from pastures and placed by groups into holding pens the afternoon prior to measurement. Calves were separated from cows around 1800. Cows were provided hay and water at all times. Calves were placed with dams and allowed to nurse at 0545. Groups were staggered so that all groups could be properly observed. Calves were separated from dams as soon as most of the calves had finished nursing (20 to 30 min). This procedure was repeated at 1145 with the exception that calves were weighed prior to and after nursing. The difference between these two weights was considered to be the amount of

TABLE 2. SIGNIFICANCE LEVELS FOR MAIN EFFECTS INCLUDED IN PRELIMINARY MODEL AND CROSSBRED COW GROUP BY SEASON OF CALVING INTERACTION ON MONTHLY MEASUREMENTS OF 24-HOUR MILK PRODUCTION AND AVERAGE 24-HOUR MILK PRODUCTION[a]

		Month[b]							
Source	df	1	2	3	4	5	6	7	AMP[c]
Crossbred cow group (CG)	5	NS	NS	NS	NS	NS	NS	NS	NS
Sire of dam/CG	50	NS	NS	NS	NS	NS	NS	NS	*
Season of calving (S)	1	**	†	NS	**	NS	NS	NA	NS
CG	5	NS	NS	NS	NS	NS	NS	NS	NS
Year	1	NS	NS	NS	NS	**	NS	NS	**
Age of dam	2	NS	NS	NS	NS	NS	NS	NS	NS
Sex of calf	1	NS	NS	NS	†	NS	NS	NS	NS
Calf age	1	NS	NS	NS	NS	NS	NS	*	NS
Sire of calf	16	NS	NS	NS	NS	NS	NS	NS	NS
Error MS		12.9	12.2	6.9	6.4	6.0	9.8	5.5	1.8
Error df		228	228	228	228	228	228	87	228

[a]** = $P < .01$, * = $.01 < P < .05$, † = $.05 < P < .10$, NS = $P > .10$ and NA = not applicable.

[b]For spring-calving group, month 1 = April and month 6 = September, for fall-calving group, month 1 = November and month 7 = May.

[c]AMP = Average 24-h milk production for first 6 mo of lactation.

milk produced by the dam in 6 h. Less than 2% of the differences were negative. These negative differences were set to zero for the analysis. The 1145 procedure was repeated at 1745. Estimates obtained at 1145 and 1745 milkings were summed and doubled to estimate 24-h milk production.

Spring-calving cows were evaluated for 6 mo (April through September), and fall-calving cows were evaluated for 7 mo (November through May). Milk production of a cow was not measured more than 1 yr. The discrepancy in the number of measurements taken was due to the fact that spring-born calves were weaned at an average age of 205 d, whereas fall-born calves were weaned at an average age of 240 d. The average of six monthly estimates of 24-h milk production was computed for spring and fall groups using estimates for the first 6 mo of lactation. Data were analyzed using least squares procedures to determine the effects of crossbred cow group (CG), season of calving (S), year, age of dam, sex of calf, sire of calf and all two-factor interactions on 24-h milk production. Sire of dam nested within CG was included in all models and was used to test CG. Calf age also was included as a covariate. Comparisons among means were made using appropriate orthogonal contrasts. The five contrasts used to evaluate differences among crossbred cow groups were the linear and quadratic effect of increasing proportion Brahman, the effect of Angus vs Hereford as base breed and the interactions between proportion Brahman and base breed. A secondary analysis was performed to test differences between lactation curves between the spring- and fall-calving groups. The model used for this analysis included CG, cow (CG), month of lactation (M), S and S × M interaction.

Results and Discussion

Table 2 contains significance levels for main effects included in the primary model and cow group by season of calving interaction for monthly measurements of 24-h milk production and the average of six monthly estimates of 24-h milk production (AMP). Effect of CG was nonsignificant for all measurements. Season of calving was a significant source of variation for three of the six monthly measurements and AMP. The interaction of CG × S was not significant for any of the milk production measurements. Year of calving significantly affected milk production during mo 5 of lactation and AMP. Age of dam was not significant for any trait examined. One reason for this lack of significant differences may be the narrow range of ages (2 to 4 yr) of the cows used in this study. However, these findings agree with those of Bartle et al. (1984), who reported that age of cow had no effect on milk yield. Sex of calf was never significant ($P < .05$). Milk yield during the seventh measurement period was significantly affected by calf age. Otherwise, calf age was not a significant factor.

TABLE 3. LEAST SQUARES MEANS FOR 24-HOUR MILK YIELD BY MONTH AND AVERAGED OVER FIRST 6 MONTHS (AMP)[a]

	Crossbred cow group[b]					
Month[c]	HA	AH	BHA	BAH	BA	BH
1	6.31	5.90	6.04	6.41	5.81	6.20
2	5.58	6.84	6.79	7.74	6.75	7.22
3	6.04	6.77	6.76	6.33	6.66	7.53
4	4.29	5.27	5.33	5.60	5.82	5.29
5	4.98	5.07	5.30	4.94	5.18	5.53
6	4.78	5.56	5.08	5.19	4.72	5.54
7	2.20	2.22	2.73	3.42	3.51	3.41
AMP	5.33	5.90	5.88	6.04	5.82	6.22

[a]In kilograms.

[b]HA = Hereford × Angus, AH = Angus × Hereford, BHA = Brahman-Hereford × Angus, BAH = Brahman-Angus × Hereford, BA = Brahman × Angus and BH = Brahman × Hereford.

[c]Month 1 = April for spring-calving group and November for fall-calving group.

Least squares means for estimated 24-h milk yield are presented by month and averaged over the first 6 mo (Table 3). Least squares means for estimated 24-h milk yield averaged over the first six monthly measurements ranged from 5.3 kg for HA to 6.2 kg for BH. Means tended to be lower than reported by Daley et al. (1987) in *Bos taurus* and *Bos indicus* × *Bos taurus* dams, similar to those reported by Chenette and Frahm (1981) in Hereford, Angus, Simmental, Brown Swiss and Jersey crossbred cows, but higher than reported by Notter et al. (1978) in Hereford and Angus reciprocal crosses.

Linear contrasts of least squares means for monthly measurements of 24-h milk production and AMP are presented in Table 4. Monthly estimates of 24-h milk production, with the exception of the seventh month, were not affected by the linear effect of increasing proportion B. During the seventh month of lactation, milk yield increased as proportion B increased. Daley et al. (1987) found B × H and B × A cows to yield less milk than did A × H at 60 and 105 d after the onset of lactation. However, at 150 d B × A had higher 24-h milk yield than did A × H, which was similar to B × H. Cundiff et al. (1981) using

TABLE 4. SELECTED LINEAR CONTRASTS OF LEAST SQUARES MEANS FOR 24-HOUR MILK PRODUCTION BY MONTHS AND AVERAGED OVER MONTHS[a]

	Month of lactation[b]							
Contrast[c]	1	2	3	4	5	6	7	AMP[d]
Linear (L)	–.2	1.5	1.4	1.5	.7	–.1	2.5**	.8
Quadratic (Q)	–.7	–2.7	.8	–1.2	.3	.1	–1.0	–.6
Base (B)	–.3	–2.7*	–1.2	–.7	–.1	–1.7	–.6	–1.1†
L × B	–.8	.8	–.1	1.5	–.3	.0	.1	.2
Q × B	–1.5	–1.1	.7	1.0	.4	–.3	–1.3	–.1
Season[e]	–3.2**	.5	.1	1.6**	–.1	–.6	NA	–.3
Sex[f]	–.2	–.9	.5	–.8†	–.1	–.8	.0	–.4
Linear dam age	–.7	.7	–1.0	.1	–.3	.4	.2	–.2

** = $P < .01$, * = $.01 < P < .05$, † = $.05 < P < .10$ and NA = not applicable.

[a]In kg.

[b]Month 1 = April for spring-calving group and November for fall-calving group.

[c]Linear = linear effect of increasing proportion Brahman, Quadratic - quadratic effect of increasing proportion Brahman and Base = effect of base breed (Angus vs Hereford)

[d]Average 24-h milk production of mo 1 through 6.

[e]Spring = positive and fall = negative.

[f]Heifers = positive and steers = negative.

12-h milk yields, found that Brahman crosses produced more milk than did H × A. Their 3-yr-old Brahman crosses and H × A averaged 3.8 and 2.5 kg, respectively. The quadratic effect of increasing proportion of B did not significantly affect milk yield. Base cow breed affected ($P < .01$) milk yield during the second month of lactation as well as AMP. Cows from H dams produced more milk than those from A dams. The possibility exists that a negative maternal influence on milk yield created these differences in milk production between cows out of H and A dams because 1/2 A cows were raised by A cows and 1/2 H cows were raised by H cows. Similar findings were reported by Cundiff et al. (1974), who found that H × A produced less milk than did A × H. Interactions between proportion B and base cow breed were not significant.

Seasonal effects on 24-h milk production are presented graphically in Figure 1, and orthogonal contrast results are presented in Table 4. Season of calving significantly affected 24-h milk production during the first and fourth months of lactation. Fall-calving cows (FC) produced more milk during the first month of lactation than did spring-calving cows (SC). The opposite was found for the fourth month, with SC producing more milk than FC. Averaged over six monthly measurements, 24-h milk production was similar for SC and FC. If the seventh-month 24-h milk production estimates were used in calculation of AMP for FC, SC would have had higher AMP than FC due to the relatively low amount of milk given during the seventh month by FC. In the secondary analysis, the month of lactation × season of calving interaction was significant, indicating that lactation curves for the two seasons differed. The lactation pattern for SC was the more typical of the curves expected, because it was at its lowest point the first month, increased sharply the second month, declined slightly during the third and fourth months and decreased substantially the fifth and sixth months. This curve is similar to that reported for spring-calving cows by Clutter and Nielsen (1987) and Chenette and Frahm (1981) for crossbred cows and to that reported by Neidhardt et al. (1979) for Brahman beef cows. In contrast, milk production for FC was at its highest point the first month, steadily declined during the second, third and fourth months, remained steady during the fifth and sixth months and then declined sharply in the seventh month. Differences in lactation curves may be attributable to climatic changes; low milk production in FC corresponds with periods of low temperature (McCarter et al., 1990) or to seasonal forage availability.

Sex of calf was a significant source of variation for 24-h milk production in the fourth month of lactation. Cows raising steer calves produced .8 kg more ($P < .10$) milk in the fourth month than did cows raising heifer

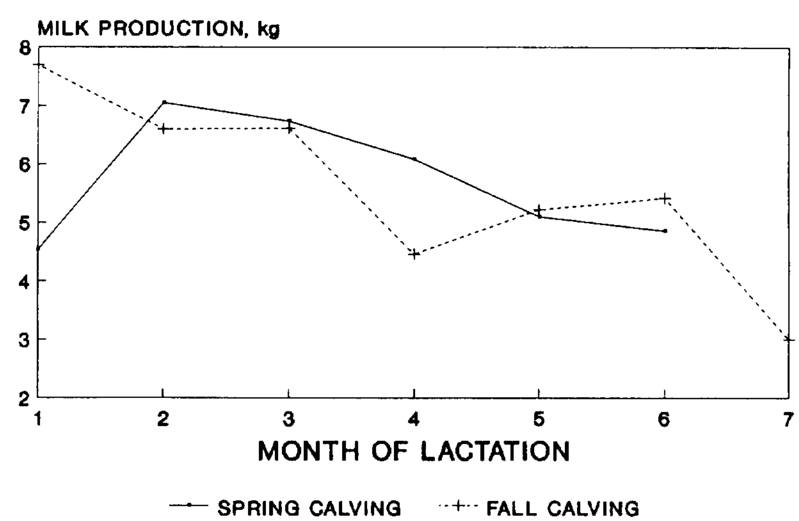

Figure 1. Lactation patterns for spring- and fall-calving groups generated using average 24-h milk production.

TABLE 5. PHENOTYPIC CORRELATIONS[a] BETWEEN MONTHLY MEASUREMENTS OF 24-HOUR MILK PRODUCTION AND CALF PERFORMANCE FOR SPRING-CALVING AND FALL-CALVING GROUPS[b]

	Month												
Trait[c]	1	2	3	4	5	6	7	AMP	PWADG	AWWT	WG	WC	AWHT
Mo 1		.40**●	.37**	.31**	.37**	−.05		.62**	.23**	.21**	.15†	.18*	.14†
Mo 2	.02		.48**	.45**	.29**	.02		.72**	.48**	.45**	.23**	.37**	.25**
Mo 3	.07	.19*		.47**	.41**	.03		.75**	.32**	.25**	.17*	.25**	.12
Mo 4	.03	.06	.25**		.34**	.09		.73**	.36**	.30**	.21**	.21**	.15†
Mo 5	.07	−.14†	.10	.12		.06		.63**	.13†	.11	.10	.19*	.04
Mo 6	.21**	−.01	.19*	.03	−.05			.29**	.11	.13†	.07	.05	.08
Mo 7	.01	.18†	.13	.09	.00	.07							
AMP	.60**	.50**	.54**	.37**	.27**	.51**	.17**		.45**	.40**	.25**	.34**	.21**
PWADG	.06	.10	.25**	.37**	.22**	.24**	.23**	.37**		.98**	.53**	.57**	.62**
AWWT	.03	.11	.24**	.35**	.22**	.22**	.22**	.35**	.98**		.52**	.57**	.69**
WG	.13	.26**	.28**	.22**	−.06	.38**	.20*	.42**	.57**	.57**		.68**	.19*
WC	.13†	.13	.23**	.16*	.03	.31**	.10	.34**	.48**	.48**	.70**		.22**
AWHT	−.14†	−.16*	−.09	.02	.13	−.22**	.00	−21**	.27**	.30**	−.14†	−.08	

[a]Product moment correlations.

[b]Spring-calving are above diagonal and fall-calving are below.

[c]Month 1 = April and month 6 = September for spring group and month 1 = November and month 6 = April for fall group; AMP = milk yield, averaged over six monthly measurements; PWADG = preweaning ADG; AWWT = age adjusted weaning weight; WG = weaning conformation grade; WC = weaning condition score and AWHT = adjusted weaning hip height.

† = $P < .10$.

* = $P < .05$.

** = $P < .01$.

calves. Averaged over six monthly measurements, 24-h milk production did not differ for the two sexes. Daley et al. (1987) reported similar findings for 24-h milk yield at 60 and 105 d postpartum.

Phenotypic correlations, calculated across crossbred groups, between monthly measurements of 24-h milk production and calf performance for SC and FC groups are presented in Table 5. Correlations were calculated by season of calving because previous results indicated that lactation curves for the two groups differed. Within the SC group, correlations between estimates of 24-h milk production in first through fifth months of lactation were moderate and positive, ranging from .29 to 48. Correlations between month 6 milk yield and milk yield during months 1 through 5 were not significant ($P > .10$), indicating a very weak to nonexistent relationship. Correlations between AMP and monthly estimates of 24-h milk yield ranged from .29 to .75. Correlations between monthly estimates of 24-h milk production and calf weaning traits were positive and generally significant. Milk production during the earlier months of lactation was correlated more highly with weaning traits than was milk production in later months. During later months of lactation, calves apparently began utilizing nutritional sources other than dam's milk. Chenette and Frahm (1981) reported correlations of .29 and .20, respectively, for calf ADG and calf weaning weight with milk yield. Daley et al. (1987) reported correlations of .45, .36 and .41 for preweaning ADG and 24-h milk yield at 60, 105 and 105 d postpartum, respectively. Clutter and Nielsen (1987) reported that correlations between ADG at various times during the preweaning period and 205-d milk intake ranged from .11 to .60. Correlations between 24-h milk production in the second month of lactation and calf weaning traits were stronger than those found for other months with calf weaning traits. This could be related to the second month of lactation being the month in which 24-h milk production peaked for the SC. Milk production was correlated more highly with weight traits than with weaning conformation (a measure of muscling), weaning condition and weaning hip height. Weaning traits generally were highly correlated with each other.

Phenotypic correlations for FC cows are presented below the diagonal in Table 4. Monthly measurements of 24-h milk production were weakly correlated (range −.14 to .25). In general, correlations between milk production and calf weaning traits were weaker than those found for SC cows. Milk production estimates during the third, fourth and sixth months were more highly correlated with calf traits than during other months. The FC lactation curve was at a low point at the fourth month, so the trend found with SC is reversed, with stronger correlations occurring between calf traits and months of lower milk production. Correlations between calf traits and first month of lactation were not significant except for a weak, positive correlation with weaning condition, a weak, negative correlation with weaning condition and a weak, negative correlation with weaning hip height. The stronger correlations between milk yield in the sixth month and calf weaning traits also are opposite the trends present with SC. All correlations with seventh month milk production were weak. For four of the seven months, milk production and weaning hip height were negatively correlated.

Implications

Only subtle differences existed between crossbred cows containing 0, 1/4 or 1/2 of Brahman breeding for milk yield. Genotype × environment interactions did not significantly affect milk yield, and season of calving rarely affected milk yield. Based on the results of this study, differences in calf performance prior to weaning, if any, cannot be attributed to milk production differences between cows containing either 0, 1/4 of 1/2 Brahman breeding. Thus, use of Brahman breeding in a crossbreeding program will not improve calf performance through improved milk yield and consumption.

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