PRODUCTION BY CROSSBRED BEEF FEMALES IN A RANGE ENVIRONMENT

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SUMMARY

Pregnancy rate, maternal performance, cow weight and body condition of Angus (A), Pinzgauer (P), Red Poll (R), and Simmental (S) sired females were evaluated. Pregnancy rates of A, R and P were similar, averaging 92 ± 2%, and exceeded the 74 ± 4% pregnancy rate of S. Dystocia occurred less frequently in A (13 ± 4%) and R (13 ± 5%) than in P (24 ± 4%) and S (23 ± 4%). Calves from A were lighter at birth (38.1 ± .7 kg) than calves from P (42.6 ± .7 kg) and S (41.6 ± .7 kg). Calves from R were lighter at birth (39.8 ± .9 kg) than calves from P but not different from calves with A or S. Calves from A grew less rapidly from birth to weaning (ADG = 932 ± 14 g/d) and were lighter at 200 d (WWT = 225 ± 3 kg) than calves from P and S (ADG = 968 ± 14 and 994 ± 14 g/d, and WWT = 236 ± 3 and 240 ± 3, kg respectively). Calves from R grew less rapidly from birth to weaning (938 ± 17 g/d) and were lighter at weaning (228 ± 4 kg) than calves from S and were not different from calves with A or P. Red Poll females weighed less (470 ± 2 kg) and S weighed more (534 ± 2 kg) than A (502 ± 2 kg) and, P (502 ± 2 kg). Red Poll carried less condition than A, S, or P, with S intermediate to A and P. Of the original A-sired females 66±6% were pregnant to calve when 7-yr-old compared with 47 ± 6%, 54 ± 6% and 38 ± 6% of P, R, and S, respectively.

INTRODUCTION

If expression of breed direct and maternal additive effects is not constant across environments, then documentation of those effects in several environments is required to make practical recommendations concerning breed use. There is a need to evaluate diverse breeds under conditions typical of the Northern Great Plains. Previously, Reynolds et al. (1990) evaluated calving traits and preweaning growth of Angus- (A), Pinzgauer- (P), Red Poll- (R), and Simmental- (S) sired calves out of Hereford dams raised on rangeland at Miles City, Montana. Urick et al. (1991) reported postweaning growth and carcass characteristics of the steer calves and Reynolds et al. (1991) reported postweaning growth, fitness, and productivity to 2 yr of age of female half-sibs. Breed effects on components of productivity of the F_1 females to 6 yr of age, their weight and body condition, and genotype by environment (GxE) interaction effects are presented herein.

MATERIALS AND METHODS

Crossbred females (n = 275) were produced by mating of A, P, R and S sires to Hereford dams. On average, the 14 A, 13 P, 20 R, and 27 S sires, respectively produced 4.6, 5.2, 4.6, and 2.8 daughters that subsequently produced progeny themselves.

Yearling heifers were exposed to Shorthorn bulls for 45 d in multiple-sire breeding herds with 15 to 20 females per bull. Two-year-old and older cows were exposed for 45 d to Charolais bulls in multiple-sire breeding herds with 15 to 20 females per bull. Numbers of calves sired by Shorthorn and Charolais bulls were 235 and 700, respectively. Shorthorn and Charolais bulls were obtained from breeders in Montana and were 2 yr of age when first used for breeding. New samples of Shorthorn and Charolais bulls were purchased each year. However, individual bulls were occasionally used for two successive years.

All cow-calf pairs grazed native range during the breeding season. Calves remained with their dams on native range until mid-October when they were weaned and weighed. Native ranges typical of the Northern Great Plains region are mixtures of warm- and cool-season grasses, forbs, and shrubs. Annual brome grasses, Sandberg bluegrass, western wheatgrass, blue grama, buffalo grass, needle-and-thread, green needle grass, thread leaf sedge, greasewood, silver sagebrush, and Wyoming big sagebrush are predominant. Median annual precipitation is 33.2 cm.

In March 2-yr-old heifers were placed in a small pasture, observed continuously until calving, and fed approximately 10 kg of alfalfa hay daily. At the same time, three-year-old and older cows were placed on native range pasture and observed during daylight hours until they calved. Cows were fed alfalfa or native grass hay daily until after calving. Calves were born between March 1 and May 8 and were weighed within 24 h of birth. Within 3 d after calving cow-calf pairs were moved to separate pastures of crested wheatgrass or Russian wild rye and fed a protein-barley supplement until green forage was available, usually in early May. Calves were branded and dehorned and male calves were castrated in May.

Cows were weighed before calving (d 52 to 63, FEB), before (d 150 to 159, JUN) and after breeding (d 220 to 232, AUG) and at weaning (d 286 to 293, OCT). Body condition scores (1 = very emaciated to 10 = very obese) were assigned to cows at the FEB and OCT workings. All females were palpated for pregnancy in OCT. Six-year-old cows were removed from the study after being palpated. Physically sound heifers born in or before 1977 were retained for breeding at 2 yr of age. Initially, females failing to become pregnant in two successive years were culled. All nonpregnant females were removed from the herd in the fall of 1979 and each fall thereafter.

Calving day, frequencies of dystocia and neonatal survival, calf birth weight, preweaning daily gain and 200-d weight were dependent variables measured on offspring and analyzed as traits of the dam. Pregnancy rate, cow weight, and body condition were measured and analyzed as traits of the females themselves. Three separate linear models were used to analyze these data using least-squares procedures. For those traits measured on progeny, the model was,

$y_{ijklmn} = \mu + r_i + a_j + x_k + b_l +$ interactions $+ s_{lm} + e_{ijklmn}$, wherein: y_{ijklmn} is an observation on the nth random offspring of the kth sex (x_k), born in the ith year (r_i), to a dam of jth age (a_j), sired by the mth random sire (s_{lm}) of the lth breed (b_l), and μ is a constant applicable to all observations.

For cow weight and condition score, the model was,

$y_{ijklmn} = \mu + a_i + m_j + b_k +$ interactions $+ s_{kl} + f_{klm} + e_{ijklmn}$, wherein: y_{ijklmn} is an observation on the nth random female (f_{klm}), sired by the lth random sire (s_{kl}) of the kth breed $b(_k)$ made in the jth month (m_j) when she was a_i years of age and μ is a constant applicable to all observations.

Finally, for pregnancy rate the model was,

$y_{ijklm} = \mu + r_i + b_j +$ interactions $+ s_{jk} + f_{jkl} + e_{ijklm}$, wherein the effects are as defined previously.

Throughout, effects of year, age, sex, breed of sire and month were considered fixed and sire within breed of sire, female within sire within breed, and residual $e_{ijk...}$ were considered random. Interactions among fixed effects were tested with residual variance and deleted from the models if they did not approach significance ($P > .10$). Significance tests for breed of sire of female used the mean square for sire within breed as error variance.

Pregnancy rate, dystocia, and neonatal calf survival were assessed as binomial variables. Females that calved without assistance were assigned score of 0. Females that required assistance at parturition, regardless of the level of assistance, were assigned a score of 1. Similar assignments of 0 and 1 were made for females either not pregnant or pregnant, and for calves dead or alive at 72 h postpartum (neonatal survival).

Age at culling was summarized for each breed group of females. Non-parametric estimates of the respective survival distributions were calculated considering those females pregnant in October when they were 6 yr old as right-censored. A log-rank chi-square was used to test homogeneity of the survival distributions among breed groups.

RESULTS AND DISCUSSION

Interactions of maternal breed of sire with other fixed effects complicate evaluation of maternal genotypes because simultaneous consideration of the other fixed effect is warranted. However, there were relatively few significant first-order interactions involving maternal breed of sire in these data. Only interaction effects of age with maternal breed of sire affecting rates of pregnancy and dystocia might impinge on comparisons among breed groups. Recall that yearling heifers were bred to Shorthorn bulls and older cows were bred to Charolais bulls, thus further clouding interpretation of the age effects and any interactions with them. In addition, age specific decisions concerning which breeds of cows to use for producing beef are impractical.

Results pertaining to the average level of annual performance attained by the F_1 females at Miles City, Montana are presented in Table 1.

TABLE 1. LEAST SQUARES MEANS AND PROBABILITY OF SIGNIFICANT DIFFERENCES FOR MATERNAL TRAITS EXPRESSED BY CROSSBRED FEMALES FROM DIFFERENT SIRE BREEDS

	Breed of sire of dam				
Trait	Angus	Red Poll	Pinzgauer	Simmental	Probability
Pregnancy rate, %	85.0 ± 3.2	85.7 ± 3.8	81.1 ± 3.6	74.5 ± 3.8	<.01
Calving day	98.4 ± 1.0	99.1 ± 1.3	99.8 ± .9	100.9 ± 1.1	.35
Dystocia					
None vs assisted, %	13.0 ± 4.2	13.0 ± 5.2	24.3 ± 3.9	22.8 ± 4.4	.04
Calf survival rate					
Birth to 72 hr, %	95.5 ± 2.3	96.3 ± 2.8	90.8 ± 2.1	93.3 ± 2.4	.27
Birth wt, kg	38.1 ± 0.7	39.8 ± 0.9	42.6 ± 0.7	41.6 ± 0.7	<.01
Daily gain, g	932. ± 14.	938. ± 17.	968. ± 14.	994. ± 14.	<.01
200 d wt, kg	225. ± 3.	228. ± 4.	236. ± 3.	240. ± 3.	<.01

Because cycling females with lower than average genetic potential for fertility would be expected to calve later than cohorts with higher levels of innate fertility, it might be inferred that a greater proportion of S sired females were acyclic or had a greater proportion of other fertility problems during the breeding season than A, P, and R sired females. This result is the primary source of genotype by environment interaction in comparisons among these breed groups at Clay Center, Nebraska and Miles City, Montana. Genotype by environment interactions for other traits among these breed groups at Clay Center, Nebraska and Miles City, Montana were consistently small and not significant.

Breed of sire of dam estimates from this study for frequencies of dystocia and neonatal calf survival, and birth weight, preweaning daily gain, and weaning weight were consistent with other reports (e.g. Cundiff et al., 1986; Kress et al., 1990a,b). The g^I and g^M for A, P, R and S on birth weight were: -3.4 kg and -1.4 kg, 4.2 kg and 2.1 kg, -1.8 kg and -.6 kg, and 2.2 kg and -.1 kg, respectively. Greater incidence of dystocia was observed in those breed groups where g^I for birth weight was greater than g^M. Differences in birth weight and calving difficulty were not reflected in neonatal survival rate. The g^I and g^M for A, P, R and S on preweaning daily gain were: 36 g/d and -70 g/d, -30 g/d and 35 g/d, -56 g/d and -12 g/d, and 50 g/d and 47 g/d, respectively.

Red Poll sired cows were lighter, and S sired cows heavier, than the other breed groups at all ages and months (Table 2). Weights of A and P sired cows were consistently intermediate and similar to each other. Females of all breed groups lost weight between FEB and JUN, gained weight from JUN to AUG, lost weight from AUG to OCT and gained weight from OCT to FEB. Concentrations of crude protein and metabolizable energy in the range forages at Fort Keogh Livestock and Range Research Laboratory are greatest from May through July and cows may be in a state of negative energy and/or protein balance during late lactation from August to October (Adams and Short, 1988). The net effect of these seasonal variations in weight was for cows of all genotypes studied to gain weight from year-to-year through 6 years of age.

Breed of sire, age, month and the interaction of age and month significantly affected body condition score of cows (Table 2). Angus sired cows were in significantly greater condition at all ages than the other sire breed groups. Pinzgauer sired cows were intermediate in body condition between S and R sired cows and not different from either one. Red Poll sired cows, on average, had significantly less body condition than S sired cows. Cows either lost or maintained, but did not gain body condition from FEB to OCT at two years of age. However, at older ages cows tended to either maintain or gain body condition during the same time period. Cows of all ages lost body condition during the OCT to FEB time period. The net effect was that these cows lost body condition as they aged.

In the conditions of this study which may typify commercial cow-calf production systems in the Northern Great Plains, Angus-Hereford cows were the longest lived breed group. There were 66±6% of the original A-sired females pregnant to calve at seven years of age when the study ended, compared with 47±6%, 54±6% and 38±6% of the P-, R- and S-sired females respectively.

Table 2. Seasonal weights and condition scores of F_1 crossbred beef females out of Hereford dams

Breed of sire	Weight, kg				Score	
and age.	FEB	JUN	AUG	OCT	OCT	FEB
Angus						
2	391	395	429	435	7.0	6.7
3	454	441	478	482	6.4	6.9
4	506	492	529	531	6.5	6.9
5	547	517	590	547	6.1	6.4
6	571	544	597	564	6.0	6.0
Pinzgauer						
2	405	405	432	441	6.1	5.8
3	460	442	473	480	5.4	6.2
4	507	488	526	524	5.7	6.3
5	550	518	572	544	5.6	5.7
6	570	546	598	566	5.1	5.1
Red Poll						
2	378	374	402	400	6.1	5.6
3	422	411	442	447	5.0	5.7
4	478	459	493	488	5.4	5.7
5	518	491	548	513	5.4	5.6
6	538	503	562	525	4.8	4.7
Simmental						
2	418	422	459	464	6.3	6.3
3	480	476	515	515	6.1	6.1
4	531	515	565	556	5.9	6.6
5	580	548	625	580	5.4	5.6
6	609	564	652	601	5.5	5.7

Jenkins et al. (1991) concluded that F_1 cows producing the heaviest calves at weaning required more metabolizable energy to maintain body weight during a lactation test period. Thus, it seems probable that S sired females would have the greatest total maintenance requirement and requirement per unit of body weight. They would also be expected to have the greatest requirements for growth and lactation, because they performed these function at the highest levels among the breeds examined. Bellows (1988) and Short and Adams (1988) postulated a general strategy by which beef cows partition nutrients which puts generation of estrous cycles and initiation of pregnancy at lower priority than basal metabolism, growth and lactation. We theorize that S sired females were unable to meet physiological threshold requirements for energy from the combination of Northern Great Plains rangeland and supplemental feeds provided. This energy deficit was manifested in the reduced pregnancy rates of S sired females. Thus, because culling was based in part on reproductive performance, S sired females had a lowered probability of remaining in the herd. The breed of sire effects on individual traits affecting maternal performance have important implications for breed selection by cow-calf producers in some environmental circumstances. Considering reproduction, growth, and attrition jointly it appears differences in maternal genotype may result in differences in lifetime productivity approaching the equivalent of producing an extra calf.

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