2000

Effects of Breed-Type and Breeding System on Efficiency of Weaned Calf Production

D. M. Marshall
South Dakota State University

Effects of Breed-Type and Breeding System on Efficiency of Weaned Calf Production

D.M. Marshall[1]
Department of Animal & Range Sciences

CATTLE 00-12

Summary

The objective of this study was to evaluate effects of cow breed-type (two-breed rotations of Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford) and breeding system (rotational vs terminal sires) on production efficiency to weaning. Cows were limit fed in drylot for one year to simulate weight change of range cows. Both cow breed-type and sire type significantly affected efficiency of weaned calf production (weaning weight divided by cow and calf creep feed ME intake). However, there was an interaction of cow breed-type with breeding system for efficiency of weaned calf production. In particular, Hereford-sired Simmental-Hereford cows had higher weaning efficiency when mated to Simmental (i.e., rotational) bulls than when mated to Charolais (i.e., terminal) bulls. In contrast, cows of other breed-types were more efficient when mated to terminal bulls than when mated to rotational bulls. Because cow breed-type rankings for production efficiency can vary depending on the type of sire to which cows are mated, it is important to consider genetic complementarity in the design of breeding systems.

Introduction

In choosing germ plasm for commercial cow-calf production, a common suggestion is to match cow genetic type to existing resources such as climate, feedstuffs, and management preferences. Sire selection should complement dam type by accounting for calf performance and market demands. Rotational mating systems provide maternal and direct heterosis and generate replacement heifers within the system. Terminal matings of crossbred females to sires of different breeding provide maternal and direct heterosis and allow increased opportunities for genetic complementarity by emphasizing maternal traits in the dam and growth/carcass traits in the sire. Terminal matings have arguably been under-utilized by the beef industry because of issues related to replacement of breeding females. In herds large enough to support the use of two or more bulls, it is possible to simultaneously utilize terminal matings and matings in which potential replacement females are born.

A series of studies have been conducted at SDSU to evaluate factors, including genetic type of dam, affecting efficiency of production. The effects of sire genetic type or complementarity between dam and sire type were usually not addressed in the previous studies. The objective of this study was to determine if dam breed-type rankings were consistent in rotational versus terminal matings for traits related to efficiency of weaned calf production.

Materials and Methods

Three conventional two-breed rotations (Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford) were developed at the Antelope Range Livestock Station. A small number of foundation Tarentaise-Hereford cows were purchased. Otherwise, the rotations were initiated by mating Hereford cows to Simmental, Angus, or Tarentaise bulls. F_1 cows were bred to Hereford bulls, and cows in subsequent generations were bred to a bull of the breed other than that of her own sire. Cows evaluated in the present study were born after the F_1 generation. The Simmental x Hereford and Angus x Hereford rotations were begun several years earlier than the Tarentaise x Hereford rotation. Consequently, there were no Tarentaise-sired cows available for this study. For the present study, some of the cows were mated within their respective rotations, while others were mated to Charolais bulls in a terminal cross (Table 1). Samples of cows from each of the mating types were transported to a drylot at the Beef Cattle Breeding Research Unit

[1]Professor

near Brookings. Only cows that had been diagnosed as pregnant were used. Prior to being transported to the drylot, the cows had spent the previous year under conventional management at the Antelope Range Livestock Station. In drylot, cows were limit-fed in individual stalls for a one-year period, from soon after weaning a previous calf through weaning of the subsequent calf.

Cows were placed in stalls once daily precalving and twice daily postcalving for approximately one hour per feeding. Initial feed levels offered to cows were based on NRC (1984), and so differences between cows varied with cow weight. The pre-trial weight used to calculate the amount of feed offered was measured at weaning at the Antelope Range Station just prior to transport to drylot. At subsequent 4-week intervals, cow weights and body condition scores were monitored and feed levels were adjusted to simulate weight and body condition changes of contemporary cows under conventional management. The base cow diet in drylot consisted of chopped prairie hay and pelleted alfalfa hay, although corn grain was added during lactation. Most cows consumed all feed offered at each feeding.

Calves were born in March and April and were weaned at an average age of about 7 months. Calves were allowed to nurse only when the cows were in the individual feeding stalls. Calves were also provided ad libitum amounts of high roughage creep feed from early summer until weaning to simulate replacement of forage they would have had access to under conventional pasture management. Milk production was estimated by the calf nursing method on six separate dates, and cumulative milk yield was estimated by within-cow non-linear regression.

Data were analyzed by least-squares procedures. Initial statistical models included cow breed-type, breeding system (i.e., rotational versus terminal sire), year, calf sex, and significant two-way interactions. Calf age at weaning (equivalent to length of lactation) was included as a linear covariate for all traits except cow weight and body condition score.

Results and Discussion

The full array of matings used in the study is shown in Table 1. The Simmental x Hereford and Angus x Hereford rotations were each divided into two groups for purposes of analyses depending on whether the cows were Hereford-sired or non-Hereford-sired. Cow breed-type abbreviations are defined in Table 1.

The interaction between cow breed-type and breeding system was not significant for cow-calf productivity traits (Table 2). Thus, least-squares means are presented for the main effects only. Cow breed-types tended to have relatively similar means with the exception of Angus x Hereford cows of high percentage Hereford (HAH). Cows in the HAH group, on average, were fatter, produced less milk, and weaned lighter-weight calves compared to the other cow breed-types. Terminal-sire matings produced heavier (P=.04) calf weights than rotational matings. Interestingly, the increased preweaning growth of terminal-sired calves apparently stimulated their dams to produce more (P=.08) milk than cows nursing rotational calves.

Breeding system and the interaction between cow breed-type and breeding system were nonsignificant for intake traits (Table 3). Creep feed intake varied modestly (P=.10) among calves of different cow breed-types. Cow intake of metabolizable energy (ME) varied significantly among cow breed-types on an absolute basis and as a proportion of cow weight. It should be emphasized that these values for cow ME intake were based on limit feeding and might not accurately reflect differences under ad libitum conditions. Cow ME intakes were greatest for SHS, intermediate for HSH, HTH, and AHA, and lowest for HAH. Relative to body weight, cow ME intakes were greatest for HTH and SHS, intermediate for HSH and AHA, and lowest for HAH. The fact that HAH cows maintained the most body condition while consuming the least feed energy can be at least partly explained by their lower milk production.

Efficiency of milk production was calculated as cumulative milk yield (lb) divided by cumulative cow feed ME intake (kcal). Least-squares means (Table 4) are presented for each cow breed-type by breeding system combination because of a significant interaction. In rotational matings, differences between cow breed-types were relatively small with a slight advantage for HSH and HTH cows. However, cow breed-type rankings changed considerably in matings to terminal sires. The AHA and SHS cow breed-types benefited the most in milk production efficiency from being mated to terminal sires.

Efficiency of weaned calf production was calculated as calf weaning weight (lb) divided by cumulative cow feed and calf creep feed ME intake (kcal). Again, cow breed-type rankings varied depending on breeding system (Table 5). In rotational matings, weaning efficiency was greatest for the HSH cow group, intermediate for AHA, HTH, and SHS, and lowest for HAH. In terminal matings, weaning efficiency was greatest for the AHA and HTH cow breed-types, intermediate for SHS, and lowest for HSH and HAH. All cow breed-type groups benefited from terminal matings except for HSH cows. This is perhaps not too surprising considering that HSH cows were mated to bulls of high-growth breeds in both rotational and terminal matings (i.e., Simmental and Charolais, respectively).

The previous discussion has been based on efficiency of feed utilization. Reproductive performance is also an important component of overall production efficiency. All cows were pregnant at the beginning of the study. There were no significant differences between cow breed-types in rebreeding percentage, although numbers of observations were too small for adequate comparison.

Implications

Output traits (e.g., milk yield, weaning weight) by themselves are not always good indicators of production efficiency when evaluating breed-types. Extra costs associated with increased production must also be considered. Both cow breed-type and sire type significantly affected efficiency of weaned calf production. Cow breed-type rankings varied depending on whether cows were bred to rotational or terminal sire breeds, indicating the importance of genetic complementarity in the design of breeding systems for commercial beef production.

Table 1. Matings, Breed Composition, and Expected Heterosis Levels.

			Average % Hereford		Average % Heterosis	
Cow breed-type[a]	Calf sire breed	N	Cow	Calf	Cow	Calf
	Simmental x Hereford Rotation					
SHS	P. Hereford	6	37.0	68.5	74.0	63.0
	Charolais	10	37.2	18.6	74.4	100.0
HSH	Simmental	7	71.0	35.5	58.0	71.0
	Charolais	10	69.4	34.7	61.3	100.0
	Angus x Hereford Rotation					
AHA	P. Hereford	11	36.1	68.0	72.2	63.9
	Charolais	15	35.8	17.9	71.7	100.0
HAH	Angus	10	67.5	33.8	65.0	67.5
	Charolais	11	69.6	34.8	60.8	100.0
	Tarentaise x Hereford					
HTH	Tarentaise	8	74.2	37.1	51.6	74.2
	Charolais	8	73.4	36.7	53.1	100.0

[a] H=Hereford, S=Simmental, A=Angus, T=Tarentaise. First letter denotes breed of cow's sire. Second letter denotes breed of cow's maternal grandsire.

Table 2. Cow-Calf Production Traits.

Cow breed-type [a]	Calf weaning wt, lb wt wt, kg		Avg cow wt, lb		Avg cow Condition score		Cumulative Milk yield, lb	
	mean ±	se	mean ±	se	mean ±	se	mean ±	se
HSH	603 ±	12	1246 ±	22	5.0 ±	.1	3294 ±	121
HAH	506 ±	11	1222 ±	20	5.7 ±	.1	2786 ±	107
HTH	568 ±	12	1186 ±	23	4.9 ±	.1	3259 ±	135
SHS	595 ±	13	1243 ±	23	4.7 ±	.1	3387 ±	127
AHA	594 ±	10	1220 ±	18	5.2 ±	.1	3270 ±	97
P-value of F-test	<.01		.38		<.01		<.01	
Breeding system								
Rotational	562 ±	8	-		-		3105 ±	77
Terminal	584 ±	7	-		-		3294 ±	71
P value of F-Test	.04		-		-		.08	

[a]H=Hereford, S=Simmental, A=Angus, T=Tarentaise

Table 3. Metabolizable Energy (ME, Mcal) Intake in Drylot[a].

Cow breed-type [b]	Cumulative calf creep ME, Mcal		Cumulative cow feed ME, Mcal		Cumulative cow feed ME (Mcal) / body weight (lb)	
	mean ±	se	mean ±	se	mean ±	se
HSH	408 ±	17	8898 ±	109	7.20	.14
HAH	379 ±	15	8299 ±	104	6.77	.13
HTH	364 ±	17	8802 ±	125	7.42	.15
SHS	368 ±	18	9173 ±	114	7.39	.15
AHA	412 ±	13	8611 ±	89	7.09	.11
P-value of F-test	.10		<.01		.01	
Breeding System						
Rotational	392 ±	11	8776 ±	73	7.16	.09
Terminal	380 ±	9	8737 ±	62	7.19	.08
P value of F-Test	.40		.69		.79	

[a]Intake values shown were for approximately one year
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise

Table 4. Efficiency of Milk Production (lb cumulative milk / Mcal cumulative cow feed ME) for Main Effects and Interaction of Cow Breed-Type and Breeding System[a]

	Breeding system				
	Rotational		Terminal		Cow breed-type
Cow breed-type[b]	mean ±	se	mean ±	se	average
HSH	.357 ±	.018	.351 ±	.015	.354
HAH	.331 ±	.016	.312 ±	.014	.322
HTH	.353 ±	.017	.367 ±	.020	.360
SHS	.329 ±	.019	.382 ±	.016	.356
AHA	.332 ±	.015	.391 ±	.012	.362
Breeding system average	.341		.361		

[a] P-values for AOV F-tests were.06 for cow breed-type, .05 for breeding system, and .06 for the cow breed-type x breeding system interaction.
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise.

Table 5. Efficiency of weaned calf production (lb weaning wt/Mcal cow and calf creep ME) for main effects and interaction of cow breed-type and breeding system[a]

	Breeding system				
	Rotational		Terminal		Cow breed-type
Cow breed-type[b]	Mean ±	se	mean ±	se	average
HSH	.0674 ±	.0019	.0619 ±	.0016	.0647
HAH	.0558 ±	.0016	.0618 ±	.0015	.0588
HTH	.0611 ±	.0018	.0664 ±	.0021	.0637
SHS	.0603 ±	.0020	.0649 ±	.0017	.0626
AHA	.0628 ±	.0015	.0678 ±	.0013	.0653
Breeding system average	.0615		.0646		

[a]P-values for AOV F-tests were<.01 for cow breed-type, <.01 for sire type, and .01 for the cow breed-Type x breeding system interaction.
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise