Efficiency of Alternative Mating Systems for Cow-Calf Beef Production.

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Introduction

Use of Crossbred mating systems to utilize breed effects and heterosis or formation of composite breeds to retaining heterosis (recover inbreeding depression) both lead to the question: What is the optimal combination of breeds to maximize cow productivity (Gregory and Cundiff, 1980)? While there is a plethora of information on purebred and crossbred performance for performance measures related to growth and reproductive performance of a beef cattle herd and efficiency in the feedlot, there is little information on the nutrient efficiency of the cow herd. It is the purpose of this paper to estimate the annual net energy consumption (NeM) of a cow-calf pair and to compare efficiency of alternative mating systems for cow herd efficiency.

Method and materials

Data are from six independent mating systems of purebred Angus, Hereford or Simmental cattle, a 2 breed rotation of Angus and Hereford, a 3 breed rotation of Angus, Hereford and Simmental and a roto-terminal system with Angus and Hereford rotational cows bred to a Simmental terminal sire. The herd was maintained at 2 locations and managed as a typical temperate region herd in the Midwestern US. Cows grazed pasture from early spring though November. Cows were fed either hay or haylage in drylot during the winter months. Cows calved from February through April. All cows failing to have a calf at side when entering the breeding season in May were culled from the herd. Steer and heifers were placed in a feedlot at weaning and received a silage based ration through yearling age. Replacement heifers were bred to first calve at two years of age and were assigned to the mating system in which they were born. Weights of cow and calf were recorded at time of calf birth, at breeding and at weaning. Additionally cows were weighted mid winter prior to calving and yearling weights were taken on heifers and steers. Calf weaning weights were adjusted to 205 days of age and yearling weights were adjusted to 365 days of age.

A sample of 3 year old pregnant females from each mating system was moved to individual feeding facilities and provided an ad libitum diet of haylage for one year to estimate annual feed intake. Feed and weight data from the cows and calves were used to develop prediction equations for annual Mcal NeM (Pfennig, 1992). Those equations were used to predict the NeM for the 5091 annual records of cows in this study. Mixed model analysis was conducted to determine mating system least squares means for Cow weight (Cwt), calf weaning weight (Wwt), weaning weight per cow exposed(Wwt/Cow), yearling weight (Ywt), NeM, and

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annual efficiencies of Wwt/NeM, Wwt/Cow/NeM and Ywt/NeM. Fixed effects of location, year, parity and when appropriate calf sex were included in the model. A second analysis was run by regressing the same dependent variables on percent Angus and percent Simmental of the cow to develop response surfaces for each performance trait.

Result and discussion

Mating system least squares means for the weigh traits are presented in table 1. The three purebred breeds were averaged together into an overall purebred mean. Mating systems were significantly different for all weigh traits with the exception that weaning weights did not differ between the average of the three purebred systems and the Angus-Hereford 2 breed rotation. In all instances, crossbred systems had higher offspring weights than the purebred systems. Cow weights while variable among crossbred systems averaged 5 kg lower than the purebred systems. These results are in agreement with the consensus of literature reports on heterosis for calf and cow weights (Gregory and Cundiff, 1980)

Table 1: Mating system least squares means for weight traits

Mating System	Cwt, kg	Wwt, kg	Wwt/Cow, kg	Ywt, kg
Purebred	$493^{a} \pm 2.4$	$219^{a} \pm 1.8$	$213^{a} \pm 1.8$	$382^{a} \pm 2.7$
Angus-Hereford Rotation	$488^{b} \pm 2.4$	$221^{a} \pm 1.8$	$217^{b} \pm 2.0$	$386^{b} \pm 2.9$
Angus-Simmental-Hereford Rotation	$504^{c} \pm 2.3$	$243^{b} \pm 1.7$	$236^{c} \pm 1.9$	$404^{c} \pm 3.0$
Roto-terminal	$473^{d} \pm 3.3$	$228^{c} \pm 2.2$	$221^{d} \pm 2.5$	$415^{d} \pm 5.2$

[abcd] Means with differing superscripts differ ($p<.05$)

Table 2 shows the mating system performance for dietary energy consumption and measures of efficiency. Purebred and the 3 breed rotation mean Ne_M did not differ from each other and were significantly higher than the other two mating systems. Simmental was one of the purebreds and was only represented in the 3 breed rotation as a maternal breed. The increase size and milk production of the Simmental breed is reflected in the higher Ne_M and average cow weight, and are similar to the results reported by Montano-Bermudez and Neilsen (1990). Wwt/Ne_M, Wwt/Cow/Ne_M and Ywt/Ne_M were similar for the purebreds and the 2 breed rotation and were smaller than the 3-breed and roto-terminal crossbred systems which both would have included Simmental sired calves.

Table 2: Mating system least squares means for energy intake and efficiencies

Mating System	Ne_M, Mcal/year	Wwt/Ne_M, gm/Mcal	Wwt/Cow/Ne_M, gm/Mcal	Ywt/Ne_M, gm/Mcal
Purebred	$4781^{a} \pm 23$	$46^{a} \pm 0.4$	$44^{a} \pm 0.4$	$55^{a} \pm 3$
Angus-Hereford Rotation	$4703^{b} \pm 23$	$47^{a} \pm 0.3$	$45^{b} \pm 0.4$	$56^{a} \pm 4$
Angus-Simmental-Hereford Rotation	$4805^{a} \pm 22$	$50^{b} \pm 0.3$	$48^{c} \pm 0.3$	$60^{b} \pm 4$
Roto-terminal	$4588^{c} \pm 32$	$49^{b} \pm 0.5$	$47^{c} \pm 0.6$	$68^{b} \pm 4$

[abcd] Means with differing superscripts differ ($p<.05$)

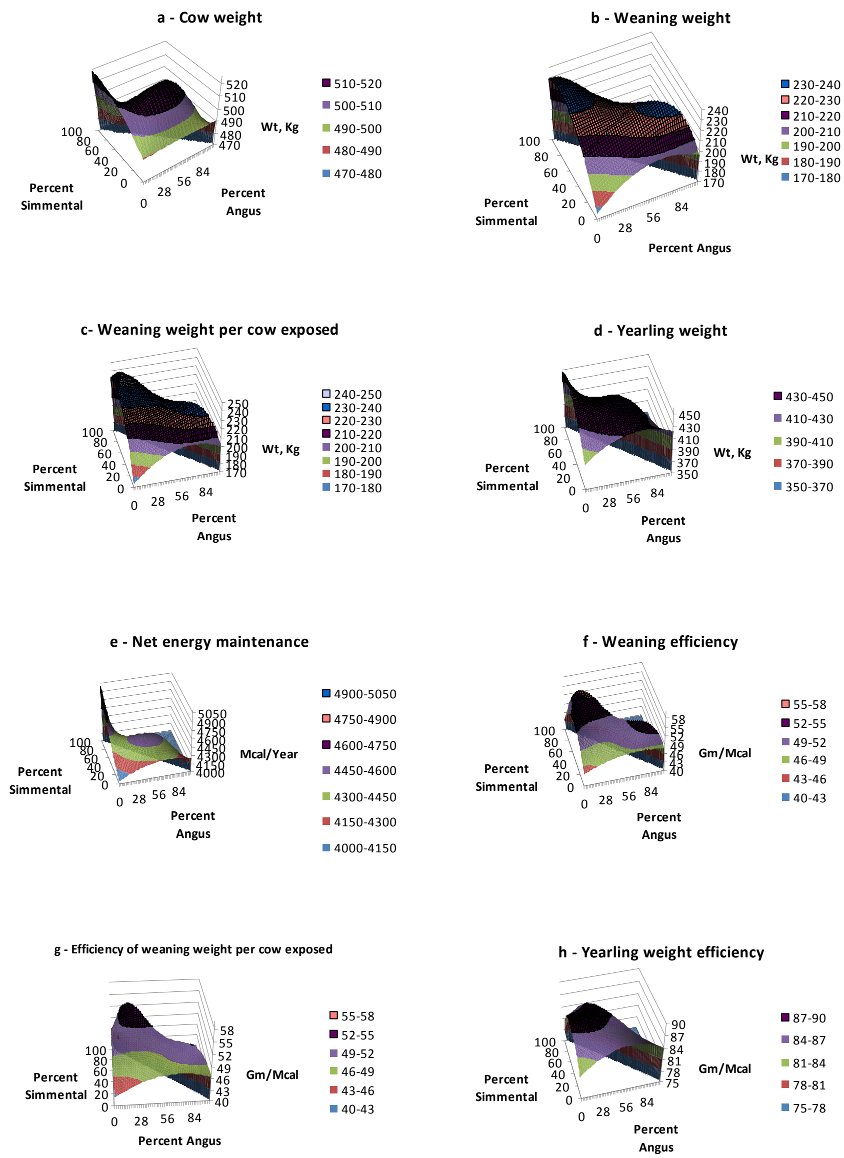

Figure 1: Response surfaces for performance and efficiency traits as a function of percentages Angus and Simmental of dam.

Surfaces in figure 1 show a consistent trend to increasing weights and efficiency as the portion of Angus and Simmental breeds increase. This is reflective of the lower milk production associated with Hereford compared to Angus and Simmental. The one exception to this trend is the surface for yearling weight where the maximum calf weight is associated with dams that are near equal composition of all three breeds. The back edges of the response surfaces show the performance of Angus-Simmental cattle. The effect of heterosis is apparent on all surfaces. Table 3 shows the optimal combination of breeds in the dam for maximum performance and efficiency. The optimum breed proportions differ considerably when comparing maximum Wwt versus Wwt/Cow, Wwt.NeM or Wwt/Cow/NeM. Using Ywt as an endpoint again shifts the optimal breed combinations (Table 3). However, it should be noted that the slopes of the response surface near the maxima tended to be quite flat meaning that there is some tolerance in the optimum composition.

Table 3: Optimal breed combinations for maximum performance.

Trait	Maximum performance	Percent Angus	Percent Simmental	Percent Hereford
Wwt, kg	237	76	24	0
Wwt/Cow, kg	243	12	88	0
Ywt, kg	450	34	34	32
Wwt/Ne_M	56	22	78	0
$Wwt/Cow/Ne_M$	55	22	78	0
Ywt/Ne_M	88	36	64	0

Conclusions

Comparison of mating systems confirms that crossbred systems are more productive and efficient than purebred systems in terms of output and efficiency of output per cow in the breeding herd. The three breed rotation was most efficient through weaning while the roto-terminal system was more efficient through yearling production. These results are consistent with the concept of moderate sized breeding females being combined with a larger sized sire breeds to increase growth performance of the calf. Optimal breed composition of beef cows for maximum output per unit of dietary energy consumed by the breeding herd is shown to depend on whether weaning or yearling weight is used as the endpoint. At weaning, optimum cow composition tended to be near 12-22% Angus and 78-88% Simmental depending on which measure of production or efficiency was used. At Yearling endpoints, the proportion of Angus and Hereford increased to near 33% of each breed.

References

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