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Cow Efficiency Update

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Introduction

In 1968, weaning heifer calves were purchased that led to the production of the experimental cows in phase 1 of our cow efficiency work. That phase lasted from 1972 through 1979 and involved straight Angus and straight Charolais and the reciprocal crosses of the two breeds. Our goal was to evaluate sources of differences in cow efficiency with particular emphasis on cow size. In addition, we wanted to study the extent to which the cow's first record indicates her lifetime efficiency (repeatability). In 1978, we started the second phase which involved the straight Hereford, Simmental-Hereford and Angus-Hereford breed groups from the Antelope Range Livestock Station. The objectives in this phase are to estimate the degree to which cow efficiency is transmitted from parent to offspring (heritability) and to study possible predictors of cow efficiency.

Procedures

Measuring cow efficiency requires drylot management where energy intake of the cow and calf can be measured for the cow year. Calves are allowed to nurse morning and evening when the cows are individually penned and fed. Calves remain in the pens overnight with access to creep feed. Energy intake of the cow and calf are thus measured and cross nursing by the calves is prevented. Cow efficiency is expressed as TDN required by the cow and calf divided by calf weaning weight, thus smaller numbers indicate higher efficiency.

Summary of Results

No important differences have been found between breed groups and no effect of cow size on cow efficiency has been detected. These results appear to be in agreement with other published reports dealing with cow size and breed differences where (1) the annual energy intake for the cow and calf has been measured, (2) the output resulting from net energy input has been measured, and (3) the cow has been fed sufficient energy to maintain reproduction. These experiments have been conducted in environments from Texas to Canada and with a variety of methods used to determine intake level of the cows. The cow has indicated a marvelous ability to adjust her output to the energy input provided, even in one experiment where the plane of nutrition varied sufficiently to affect reproduction.

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A study by Brent Buckley in 1981 indicated the repeatability of cow efficiency was equal to that of weaning weight in the first phase. Thus, the estimate of efficiency based on the first calf produced should be as good an indicator of her future efficiency as is the first calf's weaning weight an indication of the weight of her future calves. Since as well, there does not seem to be any evidence for heterosis in cow efficiency, we might expect cow efficiency to be somewhat higher in heritability. The actual measure of heritability will require several additional years of data collection before we can expect a dependable estimate.

Recent analyses have provided equations for predicting cow efficiency utilizing calf weight, cow weight and calf age (table 1). Evaluation of these equations has indicated that calf weaning weight and cow weight at weaning are essentially as accurate as the equation including calf age at weaning. These equations, calculated from the first phase cows, when used to predict cow efficiency as measured in the second phase cows indicated an accuracy of 79% (R^2). We feel this accuracy is high enough to recommend their use. This would require forming contemporary groups of cows considering not only the usual season, sex and creep differences but also breeding value of sire, breeding value of the breed of sire and heterosis level of the calf. If the equation is to be used to compare cows with calves of different sex, our data show heifer calves to be 8½% less efficient than bull calves. This program would be primarily for breeders of registered cattle, allowing commercial producers to select their replacement bulls on the basis of their expected transmitting ability for cow efficiency as they now do for growth and maternal traits.

Table 1. Cow Efficiency[a] Prediction Equations

Equation no.	
	<u>Phase 1</u> (<u>Ang</u>, <u>Char</u>, <u>AC</u>, <u>CA</u>)
1[b]	Cow efficiency = 16.458 + .006 x calf age (days) - .0181 x actual weaning weight (lb) + .0025 x cow weight at weaning (lb)
2[b]	Cow efficiency = 17.37 - .0175 x actual weaning weight (lb) + .00246 x cow weight at weaning (lb)
	<u>Phase 2</u> (<u>Her</u>, <u>Sim-Her</u>, <u>Ang-Her</u>)
3[c]	Cow efficiency = 17.03 + .006 x calf age (days) - .0244 x actual weaning weight (lb) + .0055 x cow weight (lb)

[a] Cow efficiency defined as pounds TDN cow and calf for a year divided by weaning weight. Lower values indicate lower energy required per pound of weaned calf.
[b] Essentially equal in accuracy (79%). Recommended for lower milking beef types.
[c] Accuracy not validated. Recommended for higher milking beef types.

A common recommendation for crossbreeding systems in recent years has been to breed a high growth potential bull to small cows. More specifically, breeds with high maternal potential are crossed, producing cows to be bred to bulls high in growth potential and carcass merit. Data collected in the first phase offer opportunity to evaluate this recommendation for cows of varying size but with equal maternal ability. Because there were heifers calving for the first time in each of the first three years, the Polled Hereford bulls were chosen for smaller size and lower growth potential. The four years in which Polled Hereford bulls were used formed the low growth potential sire group. In the remaining four years, a Limousin and Simmental bull were each used one year and two Salers bulls were each used one year. This group formed the high growth potential sire group. Small and large cow size groups were formed by dividing the cows in all four breed groups on the basis of the average weight of the Angus cows. All cows below 963 pounds were designated small and all above that weight large. Results indicate that cow size did not affect cow efficiency nor did the cows of different size react differently to the two sire groups (table 2). Sire group effect was significant and further analysis indicated that, when bred to a high growth potential bull, cows of both size groups increased their milk production by 1.3 pounds per day. These results are based on the same cows bred to the two different groups of bulls with all cows in one year bred to the same bull.

Table 2. Cow Efficiency[a] for Large and Small Cows Bred to Bulls with High and Low Growth Potential

	Low growth sire	High growth sire	Cow size averages
Small cows	11.62	10.86	11.24
Large cows	11.35	10.74	11.05
Sire averages	11.48	10.80	

[a] Lower values indicate lower energy required per pound of weaned calf.

Another study has provided energy partition for the breed groups in phase 2 (table 3). The Angus-Hereford and Hereford breed groups were combined to increase the numbers since they are of similar body size. The cow year was divided into three periods, mid-gestation (weaning to start of last trimester), last trimester (90 days prior to calving) and lactation (calving to weaning). The tabled values indicate how each biological type separates its energy requirements for maintaining body function, changing weight and producing milk. The ratio of the Simmental-Hereford to the combined Angus-Hereford and straightbred Hereford groups emphasizes how the two biological types differ in this regard. An energy partition of this type developed by Vern Anderson in our first phase data predicted within 6% the energy consumption of a group of Hereford cows on experiment in Wisconsin.

Table 3. Prediction Equations for TDN Requirements for Three Periods of the Cow Year for Angus x Hereford and Hereford Combined and Simmental x Hereford Groups

Breed group					
			Mid-gestation		
AxH&H	Period TDN =	273.00 +	.637 (MWT)[a] +	.581 (WTC)[b]	
SxH	Period TDN =	282.31 +	.527 (MWT) +	.633 (WTC)	
SxH/AxH&H			.82	1.09	
			Last trimester		
AxH&H	Period TDN =	412.65 +	.649 (MWT) +	.367 (WTC)	
SxH	Period TDN =	532.33 +	.540 (MWT) +	.298 (WTC)	
SxH/AxH&H			.83	.81	
			Lactation		
AxH&H	Period TDN =	1504.85 +	1.537 (MWT) +	.299 (WTC) +	3.4325 (MILK)[c]
SxH	Period TDN =	1551.47 +	1.725 (MWT) +	.282 (WTC) +	2.8398 (MILK)
SxH/AxH			1.12	.94	.83

[a] Maintenance weight - average cow weight for period.
[b] Weight change - desired change in cow weight for period.
[c] Milk production - average daily milk production.

Discussion

Recently a good deal of attention has been given to maintenance requirements. In some cases the implication whether intended or not seems to be that, since smaller cows have lower maintenance and thus lower input, they automatically have an advantage either in efficiency or economics. However, lower input means lower output as evidenced by the lack of difference in cow efficiency due to cow size. It may be useful to think of cow efficiency in terms of interest rate. If you put a small amount of principle in the bank to draw interest, the amount of interest received will certainly be smaller than if you made a larger deposit. Large cows will eat more, but they will also produce more. The concept needed is that there is a given energy supply associated with any particular ranch. If we move to larger size cows, then we must reduce the number of cows in relation to the carrying capacity of the unit with smaller cows. With no other variables involved other than cow size, the available evidence on efficiency would indicate no difference in output due to change in cow size. The limitation is that size cannot be increased beyond the ability of the range to provide energy to maintain reproduction. Changing the milk producing ability of the cow herd can affect carrying capacity in a similar way. Available evidence indicates that weaning weights increase sufficiently due to the increased milk to offset the increased energy required.

The results obtained from the study involving cow size and growth potential of the sire have practical application. One does not need to be concerned about utilizing small cows and the possible calving difficulty that might result when they are bred to high growth potential sires. The cow herd can be tailored according to the maternal traits needed and also according to the size of the cow needed to perform well with the sires to be used.

Suggestions to the effect that using large breeds with small breeds in rotation crossbreeding systems will not work because of the disparity in mature size have been made. Our Simmental-Hereford two breed rotation has worked well for the past nine years. We have commercial producers all across South Dakota that have been successful with two and three breed rotations that involve large breeds. Part of the explanation is that the crossbred cows do not attain the large mature size of purebred cows of the large breed. Perhaps part of the explanation is due to some of the misconceptions regarding the effect of large cow size in relation to bull size just discussed. I would caution that selection of bulls on growth potential should be on their early growth potential such as weaning weight or yearling weight breeding values and not on frame size or height measurement. The latter is primarily an indication of mature size, secondarily an indication of birth weight but not necessarily an indication of the early growth potential that is important to the industry.