Crossbreeding of Beef Cattle: Why??

The economic climate of today's beef business is challenging. Commercial cow-calf producers are faced with optimizing a number of economically important traits, while simultaneously reducing costs of production in order to remain competitive. Traits such as reproduction, growth, maternal ability, and end product merit all influence productivity and profitability of the beef enterprise. Implementation of technologies and systems that both reduce costs and enhance productivity is essential. One of the oldest and most fundamental principles that has a positive influence on accomplishing these goals is crossbreeding.

Why Crossbreed?

Crossbreeding beef cattle offers two primary advantages relative to the use of only one breed: 1) crossbred animals exhibit *heterosis* (hybrid vigor), and 2) crossbred animals combine the strengths of the various breeds used to form the cross. The goal of a well-designed, systematic crossbreeding program is to simultaneously optimize these advantages of heterosis and breed complementarity.

Heterosis or hybrid vigor refers to the superiority in performance of the crossbred animal compared to the average of the straightbred parents. Heterosis may be calculated using the formula:

% Heterosis = [(crossbred average - straightbred average) ÷ straightbred average] x 100

For example, if the average weaning weight of the straightbred calves was 470 pounds for Breed A and 530 pounds for Breed B, the average of the straightbred parents would be 500 pounds. If Breed A and Breed B were crossed and the resulting calves had an average weaning weight of 520 pounds, heterosis would be calculated as:

[(520 - 500) ÷ 500] x 100 = 4 %

This 4% increase, or 20 pounds in this example, is defined as heterosis or hybrid vigor.

The amount of heterosis expressed for a given trait is inversely related to the heritability of the trait. Heritability is the proportion of the measurable difference observed between animals for a given trait

that is due to genetics (and can be passed to the next generation). Reproductive traits are generally low in heritability (less than 10%), and therefore respond very slowly to selection pressure since a very small percentage of the differences observed among animals is due to genetic differences (a large proportion is due to environmental factors). The amount of heterosis is largest for traits that have low heritabilities. This has significance for commercial breeding systems, as crossbreeding can be used to enhance reproductive efficiency. To date, the ability to select for reproduction is limited (ie. there are no EPDs for reproduction). Traits that are moderate in their heritabilities (20 to 30%) such as growth rate are also moderate in the degree of heterosis expressed (around 5%). Highly heritable traits (30 to 50%) such as carcass traits exhibit the lowest levels of heterosis. Improvements in production from heterosis may be captured by having both a crossbred calf and a crossbred cow. The following two tables summarize the effects of individual heterosis (crossbred calf) and maternal heterosis (crossbred cow). These tables include results from numerous crossbreeding studies conducted in the Southeast and Midwest involving several breeds. The advantage of the crossbred calf is two-fold: an increase in calf livability coupled with an increase in growth rate. Perhaps the most important advantage for crossbreeding is realized in the crossbred cow. Maternal heterosis results in improvements in cow fertility, calf livability, calf weaning weight, and cow longevity. Collectively, these improvements result in a significant advantage in pounds of calf weaned per cow exposed, and superior lifetime production for crossbred females.

Individual Heterosis: Advantage of the Crossbred Calf[1]

Trait	Observed Improvement	% Heterosis
Calving rate, %	3.2	4.4
Survival to weaning, %	1.4	1.9
Birth weight, lb.	1.7	2.4
Weaning weight, lb.	16.3	3.9
ADG, lb./d	.08	2.6
Yearling weight, lb.	29.1	3.8
[1]Adapted from Cundiff and Gregory, 1999.		

Maternal Heterosis: Advantage of the Crossbred Cow[1]

Trait	Observed Improvement	% Heterosis
Calving rate, %	3.5	3.7
Survival to weaning, %	.8	1.5
Birth weight, lb.	1.6	1.8
Weaning weight, lb.	18.0	3.9
Longevity, yr.	1.36	16.2
Cow Lifetime Production:		
No. Calves	.97	17.0
Cumulative Wean. Wt., lb.	600	25.3
[1]Adapted from Cundiff and Gregory, 1999.		

The other important advantage to crossbreeding is the ability to take advantage of the strengths of two or more breeds to produce offspring that have optimum levels of performance in several traits. As an example, British breeds generally excel in marbling potential whereas Continental breeds typically are superior for red meat yield (cutability). Combining the breed types results in offspring that have desirable levels of both quality grade (marbling) and retail yield (yield grade). Similarly, milk production and growth rate may be most effectively optimized by crossing two or more breeds.

It is important to realize that the crossbred offspring will not excel both of the parent breeds for all traits. In the example given previously, straightbred calves of Breed B would have had heavier weaning weights (530 pounds) than the Breed A x Breed B crossbreds (520 pounds). However, Breed B females may be larger in mature size and have higher milk production potential resulting in increased nutitional requirements and higher production costs. Limited feed resources coupled with very high milk production may result in lower reproductive performance. Therefore, the cumulative effect of crossbreeding when several traits are considered is more important than the effect on any one particular trait. Effective crossbreeding programs must be designed to optimize performance, not necessarily maximize it.