Heterosis can boost performance in commercial herds

by BRAD PARKER

Heterosis, or "hybrid vigor," is the performance of a crossbred animal above the average of the breeds in its pedigree. Many commercial cattlemen have found this "boost" in certain genetic traits to be economically advantageous.

To illustrate the concept, imagine Breed A has an average weaning weight of 650 pounds (lb.). Breed B's average weaning weight is 750 lb. If a female of Breed A is bred to a bull of Breed B, the resulting calf is expected to wean heavier than 700 lb. (the average of the parent breed averages). Say the calf actually weans at 725 lb. That "extra" 25 lb. is attributable to heterosis.

There are two types of heterosis, explains Dan Moser, assistant professor of beef cattle genetics in the department of animal sciences and industry at Kansas State University in Manhattan. "Direct heterosis is the increase in performance due to crossbreeding in the calf, while maternal heterosis is the increased productivity, primarily increased fertility and milk production, due to crossbreeding in the dam."

Tables 1 and 2 show the percent change in selected production traits due to direct and maternal heterosis, respectively.

According to Moser, the greatest benefit of heterosis in a commercial cow-calf operation is in fertility. The greatest increases (on a percentage basis) are observed in the reproductive traits, such as age at puberty and calves weaned per cow exposed.

"This is a benefit to producers since those traits are lowest in heritability, and thus are more difficult to improve through selection," he says, explaining there are few reliable indicators of fertility. Heterosis can help ensure improvement in that area, although proper management is a big factor in reproductive efficiency, too.

"A lot of the efficiency we can have by crossbreeding systems comes through a crossbred cow," Moser emphasizes.

Of course, the faster gains of crossbred feeder calves also are important to the industry.

Carcass traits seem to benefit less from heterosis, however. "The way you improve carcass traits is through selection," Moser explains. "They're the easiest ones to select for if you have the data. If you have the information — the accurate EPDs (expected progeny differences) — you can move faster and improve carcass traits more quickly than any other type of traits."

It also should be noted that not all heterosis is beneficial. While crossbred calves may wean heavier and grow faster in the feedlot, they also can grow heavier in the womb. Those higher birth weights could mean an increased rate of dystocia (difficult births).

In addition, crossbred cows will be larger, possibly requiring more feed. Moser says their improved fertility may offset the increased maintenance costs.

Maximum heterosis, or "total hybrid vigor," results from crossing two different pure breeds. According to data from the Meat Animal Research Center (MARC) in Clay Center, Neb., maximum heterosis can increase by 23% the pounds of calf weaned per cow exposed. That increase is attributable to increased fertility, milking ability and calf growth.

This maximum is difficult to achieve in a rotational breeding system because the crossbred cows generally have some genetics in common with the last breed of sire used.

"The more they have in common [the more of a single breed they both have], that reduces the amount of heterosis," Moser explains.

For example, if a cow that's one-quarter Breed A and three-quarters Breed B is bred to a bull that's pure Breed A, the calf can only achieve 75% of the maximum heterosis. Hybrid vigor is forfeited on the common ancestry.

As Moser explains, maximum heterosis is rarely necessary. "There are very few things in our business that we have to maximize," he says, "and heterosis isn't necessarily one of them." He believes at least 50% maximum heterosis is enough, so females should be at least half of a different breed than the sire to which they're bred to increase the fertility of their progeny.

Including more breeds in a rotational crossbreeding system maintains a higher percentage of the maximum heterosis, but it also increases variation within the calf crop. "It's kind of a balancing act in terms of how much heterosis we get vs. how much variation we create," Moser admits.

Research has indicated that three-breed rotations may be more efficient than those using two breeds, but that's about as good as it gets.

"Like anything, there is a factor of diminishing returns," he explains. "Rarely is a four-breed rotation recommended over a three-breed rotation because the amount of additional heterosis observed is small, but the additional management required and variation produced is significant."

Table 1: Maximum direct heterosis for selected beef production traits (resulting from the mating of two pure breeds)

Trait	Percent change
Birth weight	3.8%
Weaning weight	8.3%
Yearling weight	7.0%
Weight at harvest	4.1%
Feedlot avg. daily gain	2.2%
Carcass wt.	4.4%
Dressing percent	0.3%
12th-rib fat thickness	7.7%
Ribeye area	4.0%
Marbling score	1.0%
Percent retail product	-1.5%
Pounds of retail product	3.0%
Shear force	0.8%

Source: Gregory, K.E., L.V. Cundiff, and R.M. Koch. 1999. Composite breeds to use heterosis and breed differences to improve efficiency of beef production. USDA Technical Bulletin No. 1875.

Table 2: Maximum maternal heterosis for selected beef production traits (resulting from the mating of two pure breeds)

Trait	Percent change
% reaching puberty at 410 days of age	29.8%
Age at puberty	-5.7%
Maternal birth weight	5.8%
Calving difficulty	-2.6%
Calving date	-6.1%
Calf survival	2.3%
Pregnancy rate	6.5%
Calving rate	6.6%
Calves weaned/cow exposed	8.5%
Lb. calf weaned/cow exposed	14.8%
Weaning wt.	6.6%
Mature cow wt.	2.5%
Cow body condition score	5.5%

Source: Gregory, K.E., L.V. Cundiff, and R.M. Koch. 1999. Composite breeds to use heterosis and breed differences to improve efficiency of beef production. USDA Technical Bulletin No. 1875.