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PHOTO BY ANGIE STUMP DENTON

Building the Baldie

Commercial cattlemen can find value utilizing crossbreeding and heterosis.

by Angie Stump Denton

As bull sale and breeding season approaches, it's a good time to remember the benefits of crossbreeding and the value of heterosis. For commercial producers with black cow herds, Hereford bulls are a great option to add value to the resulting calf crop.

According to Matt Spangler, University of Nebraska-Lincoln Extension beef genetics specialist, "Crossbreeding takes advantage of heterosis (hybrid vigor) and breed complementarity. Commercial cattlemen must realize that no one breed excels in all areas that affect profitability. Breed combinations

can be engineered to accommodate environmental constraints and meet marketing objectives."

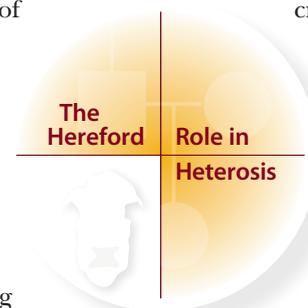
A crossbred animal is created by mating two straightbred animals of different breeds or a crossbred animal to an animal of a third breed or two crossbred animals of different mixes of breeds. Crossbreeding is the opposite of inbreeding.

Traditional crossbreeding systems have been shown to maximize heterosis but can be very cumbersome in practice. "Crossbreeding

is yet another tool in the tool box of genetic improvement and like anything else can be very profitable if understood and used correctly," Spangler explains.

Beginning in the 1960s, numerous studies documented crossbreeding effectiveness in improving lifetime productivity by more than 20%. Crossbreeding can be fairly easy to implement and has the potential for significant benefits.

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"The use of Hereford genetics in a traditionally straightbred commercial herd can help capture profit for the commercial cattleman that straightbred cattle leave on the table."

— Matt Spangler

“There is a clear economic advantage to crossbreeding,” Spangler says. “Crossbred cows can generate \$100 per year or more than their purebred contemporaries. Traits that are lowly heritable, like reproductive traits, benefit greatly from heterosis.”

Spangler says the advantages of crossbreeding can be thought of as 1) taking advantage of breed complementarity, 2) taking advantage of non-additive effects (dominance and epistatic) and 3) capturing heterosis (hybrid vigor).

Breed complementarity is the combination of strengths of the breeds in the cross. Spangler adds that the strengths of the Hereford breed can be utilized to complement strengths and weaknesses of other breeds in a strategic crossbreeding system. “Heterosis can only be

garnered by crossbreeding, and the use of Hereford genetics in a traditionally straightbred commercial herd can help capture profit for the commercial cattleman that straightbred cattle leave on the table,” he explains.

As explained by Jim Gosey, retired University of Nebraska Extension beef specialist, heterosis is actually the recovery of accumulated inbreeding depression. In just one generation, the offspring exhibit the maximum of what was lost through generations of “pure” breeding within a closed gene pool.

By definition, the gene pool in any given breed is limited. A certain amount of production potential is always sacrificed in order to gain the uniformity desired in a breed, since the most dependable way to gain

the uniformity was by using inbreeding and linebreeding in the early history of the breed. A breed is essentially a closed group of cattle, not allowing any infusion of other genetics. It thus accumulates some inbreeding over time, even if it’s not done deliberately.

Heterosis

Spangler says a phenomenon as old and as recognized as heterosis still seems to spark debate and, unfortunately, confusion. A quick search of the scientific literature will provide numerous studies quantifying heterosis for specific traits under specific crosses.

“We would expect that when mating two parental lines (breeds), the corresponding calf crop would represent the average of the two parents,” Spangler explains. “Heterosis is the

unexpected, and often beneficial, deviation from the parental average. This deviation arises due to dominance and epistatic effects that within breed selection tools do not allow us to capture.”

Heterosis beneficially influences many traits that are important for increased beef production, including fertility and reproduction, calf survival — due to hardier calves — maternal ability, growth rate of young animals, efficiency and longevity.

Percent heterosis can be calculated as:

$$\% \text{ heterosis} = \frac{[(\text{crossbred average} - \text{straightbred average}) \div \text{straightbred average}] \times 100}$$

A simple example would be the percent heterosis realized in the average weaning weight from breeding a herd of Breed A cows to a group of

Real experience



Commercial cattleman Jim Harrison, Bella Vista, Calif., has been realizing the benefits of crossbreeding for 25 years. He can testify to the benefits of utilizing Hereford bulls on an Angus-based cow herd and the value of heterosis.

Jim and his wife, Leddi, along with their son and daughter-in-law, Will and Jennifer, manage Elwood Ranch in northern California.

The ranch is home to more than 500 cows and has been in existence for more than 40 years.

Jim credits Herefords for adding more growth and bone to his calf crop. “Herefords are bigger-footed and add structural soundness,” Jim says.

The father and son wean their calves at 10 months of age when they average 800 lb. Then the calves are backgrounded for 45 days, sold in Reno in July as part of the video sale and shipped in September.

They keep about 100 replacement heifers each year. “I don’t think there is any better cow than the black baldie cow,” Jim says. He explains their selection process focuses on maternal traits and structural soundness with the goal of incorporating carcass characteristics with bull selection. **HW**



Jim says this is his ideal type of female.



Managing both Angus and Hereford bulls for their program, Jim admits the Hereford bulls are his choice in the bull pen. “Hereford bulls don’t fight compared to Angus bulls that will fight all day long to breed a cow,” he says. “I’ve had better luck with the Herefords staying sounder longer.”

The Harrison family has been managing the Elwood Ranch for 27 years. Pictured (l to r) are: Jim, Letti, holding granddaughter Hannah, Jennifer and Will.





Table 1: Individual heterosis: Advantage of the crossbred calf¹

Trait Observed	Improvement	% Heterosis
Calving rate	3.2	4.4
Survival to weaning	1.4	1.9
Birth weight	1.7	2.4
Weaning weight	16.3	3.9
ADG	0.08	2.6
Yearling weight	29.1	3.8

¹Adapted from Cundiff and Gregory, 1999

Table 2: Maternal heterosis: Advantage of the crossbred cow¹

Trait Observed	Improvement	% Heterosis
Calving rate	3.5	3.7
Survival to weaning	0.8	1.5
Birth weight	1.6	1.8
Weaning weight	18.0	3.9
Longevity	1.36	16.2
Cow lifetime production:		
No. calves	0.97	17.0
Cumulative wean wt., lb.	600	25.3

¹Adapted from Cundiff and Gregory 1999

Breed B bulls. Let 525 lb. be the average weaning weight of the F1 calves, 450 be the average weaning weight of the Breed A population and 550 be the average weaning weight of the sire's population.

The pounds of heterosis would be:
 $\text{pounds of heterosis} = 525 - [(450+550)/2] = 25 \text{ lb.}$

The percent of heterosis would be:
 $\% \text{ heterosis} = 25/[(450+550)/2] = .05 \text{ or } 5\%$

The amount of heterosis that is realized for a particular trait is inversely related to the heritability of the trait. This result is logical since traits that are lowly heritable have a small additive component (proportionally speaking) and crossbreeding takes advantage of dominance and epistatic effects.

With that in mind, traits of low heritability (reproductive traits) generally benefit from heterosis the most (Table 1). They generally have a heritability of less than 10% and can be improved through the adequate use of crossbreeding systems. End-product traits that benefit from heritability in the moderate to high range, on the other hand, benefit less from heterosis.

Spangler says there are three main types of heterosis: 1) individual, 2) maternal and 3) paternal. He says the offspring of a F1 female will benefit from maternal heterosis (Table 2). See "Crossbred cows provide the ultimate benefit," for more about the F1 female. **HW**

Editor's Note: This issue focuses on "The Hereford Role in Heterosis." See these articles for more real-life stories about producers utilizing Herefords in crossbreeding programs:

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Crossbred cows provide the ultimate benefit

Commercial cattlemen can experience the greatest amount of benefit gained by crossbreeding when using crossbred cows. Even though many stockmen use crossbreeding of straightbred parents to produce exceptional market calves — calves that gain faster than straightbreds and do well in the feedlot — the crossbred cow is the key to maximum beef production and profitability in a cow-calf operation since hybrid vigor in the cow produces phenomenal maternal advantages.

Research has shown that a crossbred cow is 8% more efficient than a purebred cow, lives 38% longer and has 25% more lifetime production in pounds of calf weaned. These advantages are partly due to crossbreeding having the biggest effect on traits that are not highly heritable (and hence more difficult to improve through selective breeding within a breed), such as fertility, age at puberty and longevity.

Crossbred cows live longer and are also less apt to be culled for being late or open due to increased fertility. Any cow that can calve at 2 years of age, never miss a year of calving and stay in the herd another year or two beyond average culling age makes her owner money. When a producer considers all the benefits of a crossbred cow, he can see why animal scientists call this the "only free lunch" in the cattle business.

As pointed out by Larry Cundiff, retired from the U.S. Meat Animal Research Center (USMARC), Clay Center, Neb., data from his heterosis studies showed that the breakeven costs of production were reduced about 10% by using crossbred cows.

Another study at Montana State University compared the effects of breed and heterosis on heifer pregnancy using purebred and crossbred females of several breeds. Results showed that a higher percent of crossbred heifers calved at 2 years of age, reaching puberty and becoming pregnant earlier than purebreds.

And if a cow is healthier, with a stronger immune system due to hybrid vigor, she develops better immunity when vaccinated and imparts better colostrum to her calf, which in turn keeps him healthier through the risky days of early calthood. Genetics plays a big role in an animal's immunity and immune response. The crossbred animal is hardier than a straightbred animal partly just because genes control the process of recognizing disease agents and inbreeding doubles up more of the undesirable immune-response genes. Crossbreeding ensures more genetic diversity and optimal immune response. Thus, a crossbred cow tends to have more optimum immune system function than a straightbred cow and, hence, not only stays healthier herself but may also produce more protective colostrum.

When all factors are weighed, the crossbred cow gives her owner the most benefit. By contrast, the stockman who is merely trying to take advantage of hybrid vigor in the calves using straightbred cows and bulls of another breed, gains less impact on profitability. Calf weaning weights for crossbred calves are 5% more (and yearling weights 4% more) than straightbred calves. The research study in the 1990s that came up with these figures



showed that a straightbred cow with a crossbred calf earned an average of \$23.37 more than if she had a straightbred calf. But a crossbred cow with a crossbred calf netted \$116.88 more than a straightbred cow with a straightbred calf. This potential increase in profit is one reason a number of producers went to crossbred cow herds.

During the past decade, however, with the increasing popularity of "black" cattle and the drive toward more uniformity and marbling, many of America's commercial cow herds have lost most of the heterosis they once had. Due to market pressures for beef calves, many stockmen have been using bulls of just one breed, and the replacement heifers then become more and more straightbred with each generation.

Jim Gosey, retired University of Nebraska beef Extension specialist, says the loss of heterosis in these herds shows up most quickly in the traits that are least heritable and most associated with inbreeding depression, namely reproduction (fertility), hardiness and longevity. The price paid for the loss of heterosis is cumulative — as a number of very small losses add up and amount to a substantial sacrifice in lifetime productivity.

As one cattle buyer observed a few years ago after a very cold and slow spring during which feed supplies were short, most of the cows in several herds he worked with were thin, and there was a high rate of open cows after the breeding season. Interesting to note, the cows that bred back the best and on time — in spite of the tough conditions — were the old crossbred cows that were still in the herds. The younger females that were a high percentage of straight breeding didn't do as well.

— Heather Smith Thomas