



Guarding Heterosis

Is the “free ride” provided by heterosis being trampled under the stampede to black cattle?

By Clint Peck

Senior

In the cow business, Aristotle’s expression “the whole is more than the sum of its parts” comes to fruition in the form of heterosis.

Heterosis, or hybrid vigor, is the boost in performance a producer gains in crossbreeding, over and above the performance of the individual parental breeds. And few factors of the cattle business are better documented than the benefits of heterosis.

Today though, even the genius Aristotle would be tested by all the pressures cow-calf producers face in developing a breeding program. Productivity and profitability are no longer simply influenced by reproductive, growth and maternal traits. End-product traits including tenderness, retail product yield and optimum carcass weight are driving many selection decisions.

No question, genetic improvement can be achieved by selection. But, genetic change via selection within a breed is slow

compared to what’s achievable in a single generation by crossbreeding (Table 1).

“I’ve always said hybrid vigor is the only free ride a cowman gets,” says Dave Nichols, Nichols Farms, Bridgewater, IA. “Corn and soybean farmers, and hog and poultry producers, have used heterosis for decades to increase yield and efficiency and build a higher quality, higher-value end-product.”

But to obtain the greatest benefits of hybrid vigor, breed complementarity must be considered, Nichols adds.

“Complementarity results when desirable characteristics from different breeds are combined into a crossbred,” he says.

Taking on the color

But, over the past 15 years, many cow-calf operations across large regions of the country have evolved to maintaining

straightbred cattle. They’ve eschewed crossbreeding mainly for the good reason that truckload lots of black-hided cattle bring more money.

The popularity of black cattle is linked in large part to the unprecedented success of Certified Angus Beef® – coupled with the large and powerful database of the American Angus Association.

“The long-term goal may be to breed superior carcass cattle for a ‘color-blind’ market,” says Jim Gosey,

University of Nebraska beef specialist. “But, the short-term reality in many markets is that black cattle generally sell for a higher price.”

The dominance of the black gene solves color inconsistency, and ranchers concerned about practical conditions like cancer eye and sunburned udders prefer the



Dave Nichols

Table 1. Levels of expected heterosis for various mating systems

Mating system ^a	% of maximum possible heterosis ^a	Estimate increase in calf weight weaned per cow exposed %
Pure breeds	0	0
Two-breed rotation at equilibrium	67	16
Three-breed rotation at equilibrium	86	20
Static terminal sire system	86	20
Two-breed rotation & terminal sire (rota-terminal)	90	21
Terminal sire x purchased F ₁ females	100	23-28
Rotate sire breed every 4 years (two breeds)	50	12
Rotate sire breed every 4 years (three breeds)	67	16
Two-breed composite (½ A, ½ B)	50	12
Three-breed composite (½ A, ¼ B, ¼ C)	63	15
Four-breed composite (¼ A, ¼ B, ¼ C, ¼ D)	75	17
Rotating F ₁ bulls		
AB↔AB	50	12
AB↔AD	67	16
AB↔CD	83	19

^aRelative to F₁ @100%

^bSee "Crossbreeding Systems for Beef Cattle," Michigan State University, Ext. Bull. E-2701

Source: Harlan Ritchie's Beef Review

pigmentation of black cows. Plus, Angus genetics have become the calving-ease choice for breeding commercial heifers.

The logic of breeding cattle for a market that rewards black cattle has led many producers to make their cattle black, then to work on making them genetically superior for production and carcass traits.

"Producers shouldn't be criticized for this decision," Gosey says. "They're simply responding to market reality."

In making those breeding decisions, Gosey warns many commercial herds have been drained of nearly all their heterosis. He points to research conducted at the U.S. Meat Animal Research Center, Clay Center, NE, that indicates lifetime productivity of crossbred cows exceeds that of purebred cows by at least 20%.

"Three generations of Angus bulls on F1 Angus-Hereford cows results in 15/16 Angus cows and 87% lost hybrid vigor," Gosey explains. Hardest hit are conception, survival, and fitness traits – lowly heritable traits that don't respond well to selection for the more highly heritable carcass and growth traits (see Table 2).

Gosey says much of the industry's attraction to high percentage or purebred commercial cattle was prompted by a desire for increased consistency. The so-called "mongrelization" and "rainbow herds" of the 1970s and '80s led many in the industry to conclude there were too many breeds. One solution was to return to two or three breeds – and purebred commercial cattle.

"Lack of consistency wasn't caused by too many breeds or multi-colored crossbred cattle," Gosey says. "It was caused by

Table 2. Heritability estimates of beef cattle traits.

Trait	Percentage heritable
Low Heritability	
Conception Rate	0-10
Calving interval	0-10
Moderate Heritability	
Milking ability	15-25
Calving ease	10-40
Gestation length	30-40
Cancer eye susceptibility	25-30
Birth weight	35-40
Weaning weight	25-30
Weaning conformation score	20-25
Postweaning daily gain-pasture	30-35
Postweaning feed conversion	35-40
Slaughter conformation score	35-40
Dressing percentage	35-40
Percentage retail product	25-30
Moderate to High Heritability	
Scrotal circumference	40-55
Postweaning daily gain	40-45
Postweaning daily feed consumption	50-55
Final feedlot weight	50-55
Yearling weight	50-55
Ribeye area	60-65
Fat thickness	40-55
Marbling score	40-45
Tenderness score	50-60

Source: USDA/ARS U.S. Animal Research Center

producing extreme biological types that weren't adapted to their environment as cows, nor targeted to a specific beef market as finished steers."

Simply put, many crossbreeding programs were mismanaged.

"The continual swing in breed composition became too difficult to manage," Gosey adds. "This is multiplied when breeds used are not similar in biological type."

Proof is in the pudding'

Some crossbreeding systems offer more

heterosis than others, and some traits respond more to crossbreeding. But, can a rancher maintain high levels of production efficiency through by straightbreeding, even if heterosis may not be maximized, and still optimize market factors?

Bill Davis, Sidney, MT, owner of Rollin' Rock Angus, says the Angus breed offers enough genetic diversity that commercial producers can maintain a straightbred Angus-based herd and optimum levels of maternal and end-product traits.

"There is opportunity for heterosis within the Angus breed," he says. "If a commercial producer pays attention to his selection program and uses the data base we have, he can absolutely put heterosis to work."

Should a rancher bent on straightbreeding worry about inbreeding? Davis says today's inbreeding coefficient in the breed's top 200 bulls (according to number of calves registered) is less than 2%.

"This gives an incredible amount of genetic choices for ranchers without inbreeding," Davis says. "Within the breed there are very adaptable lines that can do well in just about any environment."

The proof is in the pudding' – so to speak.

Bill Donald, Melville, MT, lives in an area where it's almost understated to say Angus genetics dominate. Donald readily admits he doesn't spend a lot of time thinking about heterosis.

"I don't care so much about heterosis – uniformity is the big issue for me," Donald says. "With the genetic base and EPDs the Angus breed offers, we can select for and produce steers that look the same, feed the same, dress the same and grade the same."

These straightbred Angus calves – steers or heifers – are in the highest demand for a lot of reasons, he emphasizes.

But, Gosey maintains that, long-term, a purebred commercial industry based on only a handful of breeds might come at a cost. It's unlikely, he claims, that a single beef breed can produce cows adapted to a wide range of environments and also produce high-quality carcasses without the coping mechanism of hybrid vigor.

Getting back to heterosis

Gosey isn't alone in his concern over a narrowing genetic base of the nation's cattle herd. In South Carolina, a producer-led project is underway to evaluate the integration of new genetic beef production systems for the state's coastal plains. There are four beef breeds in the state from which significant numbers of perfor-

mance-tested bulls are available to cow-calf producers – Angus, Gelbvieh, Simmental and Charolais.

The goal of the project is to develop Angus-based genetics that use a 25% Continental cross to optimize heterosis while maintaining color uniformity.

“Variation is a wonderful thing,” says Larry Olson, Blackville, SC, a Clemson University animal scientist and a population geneticist. “But in the real world of the cattle business, genetic and phenotypic

uniformity and predictability is the name of the game.”

While Olson knows breeding Angus bulls back to 50/50 Angus/Continental females will mean some loss of heterosis, the maternal and end-product traits provided by the Angus will make up the difference.

“Our producers bought a lot of Angus bulls and got into straightbreeding to demongrelize their herds,” he says. “Now, they’re looking at getting back some of the

heterosis they lost in doing so.”

Unlike 25 years ago, Olson says using today’s genetic evaluation tools allow crossbreeding that results in uniform and predictable cattle. Stressing he’s not trying to build a composite, Olson says this crossbreeding model is a way to utilize readily available genetics and do a better job in matching the genetics and environment.

“Our guys are not going to artificially inseminate, and they’re not ranching out in Montana where they have a sea of black bulls to choose from,” he says. “We’re just trying to find the best of both worlds – gaining the benefits of heterosis and producing for market reality.”

Gosey agrees potentially diverse pure breeds can be crossed to produce F1s of similar biological type. Then those bulls can be used in a rotation and help solve management problems.

“Thus, more diverse breeds can be used which allows large breed complementarity effects and avoids big swings in breed composition,” he explains. “Two-breed cattle and three-breed crosses with no backcrossing yields maximum hybrid vigor.”

Cows of the future

Most commercial cows of the future will have at least 50% of maximum F1 hybrid vigor as a result of crossing only two or three mostly British breeds, Gosey says.

“This cow will likely be at least ½ Angus or Red Angus and have no more than ¼ Continental breeding, if in a program that produces yearlings for grazing,” he says. “But, she may have up to ½ Continental breeding if her progeny are placed directly on feed post-weaning.”

Gosey says feeder cattle will be the product of at least two generations of known genetics (including carcass merit) and sired by bulls with linkage to comprehensive databases.

“The stone-age practice of allowing the price of cattle to be influenced by coat color will continue only until such generic cattle are replaced by genetically sourced cattle that will be priced on factors that relate to their true profit potential,” Gosey concludes. ■



Jim Gosey