

Heterosis — Ignored or Forgotten?

by Dave Daley, California State University-Chico



So why are we still talking about heterosis? I remember attending a cattlemen's meeting in 1967, in Bangor, Calif., when I was 9 years old. Our farm advisor gave this very clear, simplistic report on crossbreeding — and the data was irrefutable.

Crossbreeding generates economic returns for commercial beef producers. The following spring, my dad purchased the first Angus bulls to be used on a herd that ran very heavy to Hereford, with a smattering of "Durham" (Shorthorn) influence. It was not necessarily a popular decision with all of the neighbors! Yet, 40 years later, I think that as an industry, we have ignored or forgotten the value of heterosis.

The classical work conducted at Fort Robinson in the early 1960s, provided the scientific documentation for heterosis. These elegant and truly remarkable germ plasm evaluation and germ plasm utilization studies at the U.S. Meat Animal Research Center (MARC) provide substantive and meaningful data on the value of crossbreeding. If we design breeding programs that capture direct and maternal heterosis, we can increase lifetime production by more than 20%. The literature is clear, overwhelming and consistent regarding the benefits of capturing heterosis in beef production systems.

I think back to my first animal breeding classes studying crossbreeding systems and discovering that nature was good to us — we were able to use both selection and crossbreeding to make genetic progress. Not only could we effectively utilize

selection within breed for highly heritable traits, we could also make significant improvement in lowly heritable traits with crossbreeding.

In graduate school in the early 1980s, I had the very fortunate experience to work with people like Bob Taylor and Jim Brinks — practical, skilled animal breeders — who had the ability to clearly elucidate the importance of designed breeding programs.

From that experience, I was one of a handful of people who met in Denver in 1990, to form a group that worked on the utilization of "composite" seedstock. What I particularly appreciated about those "out-of-the-box" thinkers is that it was not about protecting territory, but about making progress.

Heterosis (hybrid vigor) is the amount (percent) by which the crossbred average exceeds the average of the two (or more) parental purebreds for a measured trait.

From an economic perspective, the most important gains are made in lowly heritable traits that are often difficult to measure. Traits like calf livability, survival to weaning, conception rate, age at puberty and many others, all benefit from heterosis. The individual change in one trait is small, but the cumulative effect on total productivity and lifetime productivity is tremendous, ranging well over 20%.

I do not believe it is necessary to revisit the scientific evidence regarding hybrid vigor, but more importantly to address the failure of our industry to effectively utilize the powerful tool that nature has provided. For some

reason, poultry and pork have seemed to figure out how to take advantage of genetic diversity and produce a consistent product. The beef industry has not done so on a widespread basis.

After participating in this industry at many levels (educator, cow-calf and stocker producer, purebred breeder), I thought it appropriate to summarize 10 reasons that we have ignored or forgotten about heterosis in our quest to make genetic progress. If assigning blame is important there is plenty to go around, including much of it directed to the historical direction of our research and education at universities.

1 A cultural bias that clearly reflects "purebreds as better," if for no other reason than they have a registration paper. Society, at many levels, rewards purity. Is your dog registered? Does your quarter horse gelding have papers? How far can you trace your ancestry? Please don't misunderstand — there is certainly value associated with that record, particularly our ability to track performance and predict genetic potential of purebreds. But being purebred should not be a presumption of superiority.

2 Our predilection for single-trait selection focusing on "bigger is better." This industry seems to choose a trait of importance and then puts an inordinate amount of pressure on that trait, ignoring genetic antagonisms. If a 90-pound (lb.) yearling expected progeny difference (EPD) is good, 100 must be better! It is intuitive! We have already done that with frame, growth (weight of all kinds), milk and carcass traits (both ribeye and marbling).

I sometimes have to ask myself, "So what is the trait of the year this time?" It is akin to the "flavor of the month" at the local ice cream shop. And, because we have often chosen relatively highly heritable traits, we have not needed to crossbreed to achieve those goals. The subtle, and cumulative improvement that heterosis provides does not lend itself to maximums.

3 We have decided that measuring outputs is more meaningful than measuring inputs, as well as easier to

do. It is certainly easier to measure calf performance on an individual basis, rather than all costs associated with that production. "I can weigh them at weaning quicker than I can determine differences in treatment costs over time."

4 Uniform phenotypes for qualitative traits (color) have a distinct and real marketing advantage that is difficult to ignore. That does not mean you cannot have uniformity of color within a crossbreeding program, but the widespread and indiscriminate planning (or lack thereof) of many crossbreeding programs certainly gave us some interesting marketing challenges. Generally, it is easier to produce a uniform color in straightbred programs.

5 Heterosis is very difficult to visualize and even more difficult to measure. Because heterosis is expressed as a small net positive in many traits, we do not know it when we see it. Slight changes in morbidity, age at puberty, conception rate and significant changes in longevity are not easily observed. However, we all know when calves gain faster in the feedlot.

6 The presentation of complicated crossbreeding systems as a "normal practice" to diverse cattle operations, especially the countless small beef herds in the U.S. Many of the systems that we teach as part of standard animal breeding or beef production courses have very limited application in the real world. Most beef herds are too small to implement the "standard systems."

7 Our penchant for telling people how to modify their environment in order to "get heavier calves, higher percent calf crop and more total pounds," rather than how to increase net worth. How many new supplementation programs can you develop in order to get your heifers bred or wean bigger calves?

In fact, we can recommend programs for noncycling females... you just have to pay for it and then pass those genetics to the next generation. Heterosis provides some improvement in traits at relatively low cost.

However, we have obscured the opportunity for producers to focus on those traits, because they are so busy masking differences with artificial environments.

8 Historically, there has been active resistance to crossbreeding from some traditional marketing outlets, some purebred producers and (in some cases) breed associations. I would like to commend many of the associations who, quite recently, have taken the risk of suggesting where their animals fit most effectively in crossbreeding programs.

9 Inappropriate use of breed diversity. Nothing undermines crossbreeding more quickly than the unplanned “Heinz 57” or “Breed of the Month Club” approach. For those who were willing to experiment in crossbreeding, there was often very poor planning of the combination of breeds and the selection within those breeds.

10 Our industry and university systems have focused on individual trait measurement for more than 50 years. We have done a very poor job of incorporating real world

economics into our models. We have EPDs for a plethora of traits, and we are adding more. Economic indices are starting to catch up, but we are still behind. Has anyone thought about measuring return per acre or return on investment? We have had a disconnect between agricultural economists and animal science that has not been well bridged. We tend to think lineally rather than laterally, which has reduced the applications of innovative crossbreeding.

Summary

So where are we now? In the Far West, as in much of the U.S., we have seen a move toward less crossbreeding and more reliance on a single breed. Generally, that has been quite positive, because many of the herds were crossbred and had high levels of heterosis.

Therefore, five to eight years of one breed has reduced heterosis, but provided a consistent, highly marketable product, with some maternal heterosis still pressing in the cow here.

Recently, I am hearing concern from some very large, progressive producers as their cows become more straightbred in a tough environment. Longevity, rebreeding and calf survivability all become important issues.

“It is time for many producers to design long term, simplistic plans that capture maternal heterosis. I would not want to manage cattle in any environment without that incredible value.”

I don’t think it is because they have bought the wrong bulls or managed their ranch incorrectly. It is because they have forgotten or ignored heterosis.

It is time for many producers to design long term, simplistic plans that capture maternal heterosis. I would not want to manage cattle in any environment without that incredible value.

And, the tougher the environment, the more critical hybrid vigor becomes. For those of us who are educators, we need to work more effectively in presenting straightforward workable solutions. We need to renew our efforts in educating producers that selection is not about maximums — other than sustained profit. Animal breeders do not need to give us one more individual EPD that measures outputs. We need to incorporate dollars and we need to measure inputs.

With all of the potential pitfalls in utilizing heterosis, I have observed success in pockets of the industry.

Producers who have developed a plan, targeted a market, understand their resources and environment and are focused on profit are successfully capitalizing on heterosis.

I see terminal systems with moderate crossbred cows under limited feed producing a successful product that performs in the feedlot. I see other ranches that are highly focused on quality, using moderate crossbred cows mated to produce $\frac{3}{4}$ -blood calves for specific market — the heterosis is lower, but the market rewards are real.

There is no single solution. However, as we turn the corner in the cattle cycle and begin to experience somewhat lower prices, I am confident that we can no longer forget how to reduce input costs — and heterosis has to be part of that equation. **HW**