

## **That's Nice – But I Raise Cows**

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### **Why do we continue to talk about crossbreeding?**

I am somewhat disappointed that we are continually revisiting the topic of crossbreeding in commercial beef production—and actual debating the merits of the practice. Crossbreeding is not a new concept and frankly, BIF needs to move past this discussion towards practices which can take us to the next level of genetic improvement. Unfortunately, it seems that this topic continues to fester, simply because we refuse to look at the issue objectively.

The inherent problem with the discussion is we have proponents and opponents rather than a simple discussion of advantages and disadvantages—where it fits and where it doesn't. We can have outstanding straightbred or crossbred cattle. I find it simplistic and a waste of time to argue one is better than the other. We need to put our resources and energy into a more productive direction. As scientists, breed associations and beef producers, we should take a step back and approach the issue rationally. It seems to me we have three failures in this discussion: 1) a failure to actually understand what heterosis means, 2) a focus on the wrong traits to evaluate the impact of crossbreeding (we are chasing a red herring), and 3) a lack of understanding of the impact of environment on crossbreeding results.

What are the genetic results of crossbreeding? Hybrid vigor or heterosis—we all know the answer. However, based on what I see in the popular press, we may know the answer but we fail to understand the definition. Heterosis is the improvement in the crossbred progeny compared to the AVERAGE OF THE PARENTAL BREEDS. Proponents and opponents of crossbreeding alike—please take note—NO ONE SAID THE CROSSBRED PROGENY WERE SUPERIOR TO EITHER STRAIGHTBRED PARENT—JUST TO THE AVERAGE OF THE PARENTAL BREEDS. So, if we cross Holstein and Hereford, the progeny don't out milk Holstein! Heterosis is the improvement above the mean of the two parental breeds.

This lack of understanding of hybrid vigor was driven home to me clearly on a visit to Queensland in Bos Indicus country. One particular producer who raised straightbred Brahms seemed delighted to show me crossbred animals that he had tried in his environment that looked absolutely miserable. His not so subtle point—crossbreeding doesn't work. “See, my Brahms are better than the crossbreds!” That view represents a lack of understanding of heterosis. The fact that the Bos Indicus cattle are better adapted to that climate doesn't mean that crossbreeding failed. Heterosis, by definition (and in practice) would be the improvement in adaptability of the F1 (in this case Brahman X Angus) over the mean of the two breeds—not over Brahms.

The biology of crossbreeding is clear and can't be changed regardless of the dialogue that occurs. The elegant research at the USMARC on germplasm evaluation will never be

duplicated. The sheer numbers, classic design and life cycle analysis should provide irrefutable evidence of the impact of planned crossbreeding. I am always amazed at how people want to disagree with the data from USMARC. That usually occurs if we don't like the results. Careful study of the data will demonstrate what we know to be true with crossbreeding—small, net improvement in many traits, but a large increase in lifetime productivity, particularly when you evaluate longevity (Table 1.)

**Table 1.** Selected individual (direct) and maternal effect of heterosis (Cundiff et al., 1970; Gregory et al., 1965, 1978)

Trait	Effect of Heterosis (%)	
	Direct	Maternal
Calving rate	4.4	3.7
Survival to weaning	1.9	1.5
Weaning weight	3.9	3.9
Post-weaning ADG	2.6	.
Number of calves	.	17.0
Longevity	.	38.0

One thing that has changed since the completion of the life cycle analysis of germplasm evaluation and utilization at MARC is that our selection tools have improved. In particular, the advances in EPD technology (accuracy, numbers, techniques) have changed dramatically—and that doesn't even include the recent additions of genomics to the mix. So, clearly, we can change things like growth rate, feed efficiency and carcass merit more accurately and faster within a breed than ever before. Does that mean crossbreeding is less valuable? No. You shouldn't be using crossbreeding to change growth rate, feed efficiency and carcass merit anyway. Those are highly heritable, easily measured traits that we have excellent tools available. That's not why you crossbreed!

On the other hand, what about the lowly heritable (e.g. reproduction and general fitness) traits where you receive the greatest benefit from crossbreeding? What tools do we have for pregnancy rate, embryo survival, calf livability and lifetime productivity? NONE. In terms of the economic bottomline from crossbreeding, we shouldn't focus on short term individual traits like gain and growth, but long term profitability. That is where crossbreeding will make the greatest difference.

One of the reasons we seem to have difficulty focusing on the issue is because of our varying experiences in vastly different environments. The data is clear. Harsher environments see a greater benefit to crossbreeding. That is why large scale western ranches that may have harsh winters or summers and limited feed at certain times of the year, see the benefits of crossbreeding more directly. If you are from a softer, more intensively managed environment, the benefits may be less obvious.

This paper primarily focused on a basic discussion of understanding heterosis. I have not even explored the value of how two or three breeds may complement one another in a crossbreeding system. Since BIF has been kind enough to invite me to talk about this topic in 2006, 2009 and again in 2013, I thought it might be easier (and more efficient) to include my paper from '09. Things haven't changed that much.

So, that's nice, but I own cows. I have the unique opportunity to practice what I preach. I run both crossbred and purebred programs in similar, somewhat challenging environments. I could care less about weaning weight, quality grade or feedlot performance as a single measurement taken out of context. By necessity, I am interested in the bottomline, long term profitability. That includes looking at the entire system—labor, feed costs, replacement costs—every input and output that affects my return. Crossbreeding reduces inputs while increasing outputs. That adds value to my particular system.

### **Crossbreeding – Back to the Future** (Adopted from Daley, 2009a)

Three years ago I was invited to address BIF regarding heterosis and how we have either ignored or forgotten the value of systematic crossbreeding to improve profitability in beef cattle production systems. In the interim period since that presentation, I am even more convinced that this incredible genetic resource has been under-utilized and devalued. At a time when all of our input costs have increased dramatically, and the value of cow efficiency is paramount, we continue to find arguments against using crossbreeding primarily centered on the concepts of consistency and marketability. Clearly, there are specific instances in the commercial cattle sector where heterosis has been used effectively. I would argue, however, that the potential is far from realized. In fact, in the past few years, we seem to have drifted away from crossbreeding to more traditional straightbred programs that intend to focus on phenotypic consistency and end product, but not necessarily on profitability. Is there a rationale explanation for our unwillingness to take advantage of a proven technique to enhance economic return? In my previous paper I outlined the “top ten” reasons that we have failed to capitalize on this important genetic attribute:

1) **A cultural bias that clearly reflects “purebreds” are 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”.** The beef cattle industry seems to choose a trait of importance and then put an inordinate amount of pressure on that trait, ignoring genetic antagonisms. If a 90 pound yearling EPD is good, 100 must be better! It is intuitive! We have already done 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 often have 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 United States.** 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 return. 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 non-cycling 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 little 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 over fifty years.** We have done a very poor job of incorporating real world economics into our models. We have EPD’s 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 application of innovative crossbreeding.

As I review this list, I am convinced that the primary drawback (among all of the others), is #3...the focus on measuring outputs rather than inputs. With a few notable exceptions, all of the individual animal traits we measure reflect “bigger, faster, more”. And certainly, the glamour traits of yearling weight, ribeye area, marbling---have accelerated at a rapid pace. You can make very rapid genetic progress in these highly heritable traits by direct selection within a breed. Therefore, many people fail to see the value of crossbreeding. The value in crossbreeding is often underestimated because it has a small positive effect on many different traits that are lowly heritable and difficult to measure. Frequently, maternal heterosis (the value of the crossbred cow) is about decreasing inputs as much as it is about increasing output. For example, longevity, livability and disease resistance are traits that impact the input side of the equation as much as the output. Our industry has been on a mission to improve product quality and quantity, focusing on carcass traits. We finally were paying attention to our consumers---a good thing! Unfortunately, that effort has been on a per animal basis rather than per unit of input. Do we ever ask ourselves how our long term selection programs affect the profitability of commercial producers?

When EPD’s became a marketing tool rather than a genetic improvement tool, a great deal was lost from beef cattle breeding. There was a decision to chase numbers in order to have the “latest and best”, and function was often ignored. Purebred breeders were constantly looking for the newest genetics. We utilized lightly proven sires throughout the breeds, before we tested them carefully. And now look.....how many genetic defects are we tracking in each major beef breed? A quick check of most of the major breeds websites are somewhere between five and ten! And we discouraged crossbreeding, while we simultaneously narrowed the genetic base of many of the major breeds. Does that make sense? Our current “trait of the month/selection effort” moves us in the direction of genomics. I applaud the scientists who do the work and I see the eventual long term value. But as a commercial cattleman, if I am not capitalizing on crossbreeding---a simple, inexpensive tool to make genetic progress---should I really be worrying about gene markers? Do I really want to select for a marker that may only explain a very small part of the variation of a complex trait ---a trait significantly influenced by

genotypic/environmental interactions. If I had a goal for gene markers it would not be for markers that identify highly heritable traits. I can make progress with those traits based on good old fashioned selection programs. The gene markers that I would like to see are for things like disease resistance, fertility, longevity---those traits that make the biggest difference in profitability. Let's not get sidetracked on what determines maximum sustained profit for all segments of the industry. It is not the amount of pounds of product per head. It is amount of product per unit of input cost. Every few years we seem to find another EPD or measurement to chase. When are we going to focus on maximum sustained profit per unit of input?

Three years ago we began a study/field trial (Daley and Earley, 2009b) evaluating the impact of crossbreeding in a vertically coordinated beef system, where premiums are paid for carcass merit. Approximately 600 predominantly Angus based cows were exposed to either Angus or Hereford bulls under extensive range conditions. DNA was used to determine parentage at weaning, and only those calves that could be definitively matched to a single sire were used in the data analysis. Collaborators included Harris Ranch Beef Company (Coalinga, CA); Lacey Livestock of Independence, CA and the American Hereford Association.

Presently we are close to collecting the third year of feedlot/carcass data and the final report should be completed by summer, 2009. However, preliminary results are not surprising. As we measured direct heterosis (heterosis of the calf), there was a small positive advantage in most traits. In particular, crossbred (F1) calves were slightly heavier at weaning, had a slight advantage in feedlot gain and feed efficiency and a lower cost of gain. The crossbred calves had lower quality grades, partially offsetting the economic advantage in the other segments. However, in the first two years of the study, there was a consistent economic advantage to crossbreeding, even factoring the reward for differences in quality grade to the Angus sired calves. The data is not surprising and mirrors decades of research.

Although direct heterosis (heterosis of the calf) is important, we must remember that the true value is maternal hybrid vigor—the incredible value of the crossbred cow. If the data in year three is consistent, it appears there will be an economic advantage in vertically coordinated beef production systems from direct heterosis of the F1. However, the most important economic return will be when the crossbred cow enters the production system. In particular, the potential increase in lifetime productivity and longevity are key to maximum sustained profit per unit of input.

In academia, it seems that we tend to want to make the simple complex. The commercial beef business is faced with a very difficult challenge to maintain long term profitability and viability. There are countless battles (unrelated to cattle breeding) in order to survive and be profitable in the long term. We need to keep cattle breeding simple. We have wonderful within breed selection tools (EPD's). We have the ability to capitalize on breed differences and capture both heterosis and breed complementarity through crossbreeding. Designing simple, long term

breeding programs to capture direct and maternal heterosis, while capitalizing on maternal and terminal lines, is a significant step in attempting to maximize sustained profit.

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