Guidelines For Developing New Composite Breeds
For The Grassfed Industry

By Steven D. Lukefahr

KINGSVILLE, Texas: The perfect breed does not exist. While some breeds certainly do excel for one of few traits, no one breed is superior for all traits of importance. Moreover, the value or demand of a trait changes over time.

These key points are the basis for developing a new “composite” breed. So what does composite mean?

The Merriam-Webster dictionary defines composite as follows: combining the typical or essential characteristics of individuals making up a group. In the genetic sense of the word, this means combining the best genes among breeds for several traits of importance. In fact, many heritage and modern breeds started this way.

Examples include Beefmaster and Santa Gertrudis beef cattle, Cornish-Rock broilers, Katahdin and Polypay sheep, and Chester White and Poland China swine composite breeds.

In addition, the term “purebred” is a misnomer. The fact is that there is little that is pure about a breed. Generally, purebred animals are genetically fixed for only a few simply inherited traits, such as color, absence or presence of horns.

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combs, and wattles.

However, it is true that certain breeds tend to breed rather consistently for specific traits, such as low birth weights, marbling and tenderness, and high egg, milk, and wool production. That said, it is well accepted that there is more genetic variation within breeds than among breeds.

If animals of the same breed were pure - such that they shared all of the same genes - there would be no opportunity for selection to advance genetic improvement. In reality, such is not the case. For these reasons, some geneticists prefer the term straightbred over purebred, which of course parallels the term crossbred.

Developing a composite breed is, at least initially, a form of crossbreeding. Most meat animals in industry are crossbred. This is because it is hard to beat a good crossbred - to borrow the common phrase.

Generally, crossbred performance relates to increased profits due to the genetic merit of outstanding parental breeds. This is known as breed complementation, which is described as the combining of breed strengths. Another reason for the increased performance is heterosis, also called hybrid vigor. These two genetic factors will be discussed in this article.

Composite breed development is a timely topic especially for grass-based breeding businesses. How is a composite breed developed? Like any project it requires a clear goal and a good plan.

An example of a goal involving swine is to cross the best breeds for litter size and mothering ability, rapid growth, and quality pork produced on pasture. In forming a composite breed, a good plan addresses certain key aspects, which include: fitting the environment, genetic merit, heterosis, selection accuracy, breeding objective, and simplicity.

FITTING THE ENVIRONMENT

First, focus on the environment. A good composite should be custom-designed by initially choosing breeds that match specific environmental conditions. Too often the opposite occurs where the environment is manipulated to pamper animals that are not well adapted. In favorable environments,
breeds may be chosen that offer genes for higher performance. But in less favorable environments, other breeds should be chosen that offer genes for optimal performance whereby the emphasis is on minimal inputs and efficiency of limited resources.

In south Texas, Spanish goats are popular because they are so well adapted and easy to manage. Some breeders have crossed Spanish with the Boer breed to improve meat-type, although enough Spanish influence is maintained for reasons of critical adaptation.

Under range conditions, animals within adaptable breeds should be chosen that maximize profit per acre. For example, three 1,000 pound cows that are well adapted (without use of costly supplements) that wean calves averaging 450 pounds are more profitable per acre than two 1,500 pound cows that are also poorly adapted (requiring costly pampering in order to rebreed each year) that wean calves averaging 500 pounds.

Recipe for cows like this:

Just add Diamond D Angus Bulls to your herd, then a little grass and water, then wait for the daughters to arrive. No grain or supplements necessary.

Production Sale
Thursday Nov. 12, 2015

Selling:
◇ 120 Forage developed coming two year old bulls
◇ 100 bred females

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Granted, while 1,000 and 1,500 pound cows can be found in most cattle breeds the point is to identify breeds that are well adapted for a variety of traits, and use animals within these breeds that have sustained fertility and survival.

In addition, choosing genes for novel traits from candidate breeds should be considered that can enhance adaptability.

Trait examples include, heat tolerance (slick hair coats), resistance to specific insect-borne diseases, ability to readily marble on grass, and nutrient and organoleptic (i.e., sensory perception such as smell, taste, and texture) profile of animal products.

**GENETIC MERIT**

On the subject of composite breed development, genetic merit is no doubt the most important genetic aspect to consider. Herein, there are several pivotal issues that include the number of breeds, the breed composition, and breed availability. To keep the plan as simple as possible, the number of breeds should be limited.

Most composite breeds consist of four or fewer breeds. The basis for choosing any breed is that it truly possesses superior genes for desired traits. Of course, it requires time for the breeder to do their homework in identifying the
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breed. In determining the percentage of genetic contribution from each breed, I will use the analogy of baking a great cake. The correct combination of ingredients (typically not in equal portions) is critical. The more simple approach is to use equal breed percentages.

Several years ago, my former graduate students and I developed a commercial terminal sire breed of rabbit called the Altex (named after the two states where the breed was developed, Alabama and Texas). The breed composition of the Altex is Flemish Giant, Californian, and Champagne d’Argent.

Genes for rapid growth to market age were sought from the Flemish Giant breed. The Californian and Champagne d’Argent breeds offered superior genes for carcass meat yield. Equal emphasis was placed on growth and meat yield as sire traits.

The first recognized beef breed in the USA was the Santa Gertrudis. It consists of only two breeds involving 5/8 Shorthorn and 3/8 Brahman. The reason for the higher influence of Shorthorn was to emphasize beef-type conformation, whereas 3/8 Brahman was considered just enough influence to confer heat tolerance and parasite resistance.

This example reflects the essence of breed complementation, which again is the combining of breed strengths. Moreover, the breeds must not only be complementary, they should also be compatible.

For example, including two or more breeds that vastly differ in body weight would not be logical as this would later result in tremendous variation within the composite population. For example, crossing West African Fyngy with Boer goats would make little sense. The resultant composite would have tremendous variation for body weight and other traits (e.g., nutrient requirements and efficiency).

HETEROESIS

First, what is heterosis? The term literally refers to an animal’s genotype being heterozygous, meaning that at each gene pair location the gene that is inherited from the sire is likely different than the gene that is inherited from the dam.

Often times a favorable dominant gene inherited from one parent prevents the expression of an unfavorable recessive gene inherited from the other parent. This condition is called complete dominance. This phenomenon is largely the basis for heterosis.

A recessive trait can only be expressed if two recessive genes are inherited, one from each parent. Numerous simply inherited recessive traits are known to exist, such as albinism, curly calf syndrome, and dwarfism.

Unfavorable recessive gene expression is also manifested at the less detectable physiological level. This may result in, for example, lower levels of imbalances of antibodies, enzymes, and hormones, which decreases animal performance or vigor.

With respect to performance, heterosis is a bonus from crossbreeding, which again explains why most commercial bred animals are crossbred. Using my cake analogy, while genetic merit represents the cake from a breed complementation standpoint, heterosis is the icing on the cake.

Heterosis exists when crossbreds, on average, outperform the average performance level of the parental breeds. Crossbreds benefit from heterosis mostly for reproductive and health related traits, which tend...
The issue of breed availability implies that a breed of strong merit should be found in the area and at an affordable price. An exception is the use of germ plasm, embryos and semen. In the case of my Star composite cattle (which consists, on average, of near equal 33.3% influence of Red Angus, Senepol, and Tuli breeds), the latter two breeds were mostly introduced using AI. Semen was purchased mostly at $15 a straw.

Senepol and Tuli cattle are African-derived and were chosen for their desired characters that include heat tolerance, drought adaptation, parasite resistance, grazing behavior, early age at puberty, light birth weights, moderate cow mature size, gentle dispositions, and optimal performance based on minimal inputs.

and health related traits, which tend to be the most important economic traits in livestock production.

In the beef industry it is widely publicized that crossbred cows wean about 25 percent more total weaning weight of calves produced in their lifetime compared to purebred cows, largely as a function of higher fertility, mothering and milking ability, and health levels. Conversely, there is little heterosis for carcass traits, so performance of the crossbred should be close to the parental breed average.

One rule about heterosis: the wider the cross the higher the level of heterosis. The three breeds used to develop Star cattle - Red Angus, Senepol, and Tuli - are distantly related (unlike Angus and Hereford), so potentially there could be considerable heterosis that provides a critical boost to ani-
nal vigor to meet the environmental challenges in south Texas.

In composite bred animals, after several generations the level of heterosis stabilizes, called retained heterosis. However, another rule applies: the more breeds that are used to form the composite, the higher the level of retained heterosis. This means that for any gene pair the genotype of the composite bred animal is more likely to be heterozygous.

Although of lesser influence than the number of breeds used, it is also true that the level of retained heterosis is somewhat higher if equal breed percentages are initially used. However, it is more important to make a great cake using only the best ingredients (usually in unequal portions) than to add too many ingredients. Applying more icing to an inferior cake will fool no one!

The Stabilizer is a composite breed of beef cattle developed by Leachman Cattle of Colorado. It is a four-breed composite that involves Angus, Gelbvieh, Simmental, and South Devon breeds. These breeds were chosen based on breed evaluation studies conducted at the USDA-MARC research station in Clay Center, Nebraska. Each breed made an equal 25 percent contribution initially. The level of retained heterosis is 75 percent, which is considered high, relative to an F1 animal that expresses 100 percent of potential heterosis.

However, it must again be emphasized that qualitative traits of value should also be considered. Moreover, animals must be sound and functional in their environment - not just have great numbers!

Another strategy is to consider including one very popular breed in the composite. This way it may be possible for the breeder to submit records from composite animals to a breed association so that EPDs can be computed. By making such genetic ties to a popular breed, animals of the new composite breed would be expected to have higher accuracies for economic traits, making early selection efforts more predictable.

Again, caution is advised involving use of EPDs. Do traits such as body condition score, weight gains, and marbling, as measured on animals raised exclusively on pasture, involve the same traits as measured on conventionally raised animals of the popular breed that are fed grain? Yes, an animal than can get fat on grass can also get fat on corn, but is the opposite true?

If different genes for these traits are involved, then combining records into a larger data base could yield disappointing results or trends with regards to genetic response to selection.

One alternative would be to conduct within-herd genetic evaluations to compute EPDs, which is what I do in evaluating my own Star cattle.

I promote my cattle that have negative birth and milk EPDs, which
SELECTION ACCURACY

Once the breeds have been chosen, which animals as founders should be used to form the composite breed?

An option for breeders is to consider the initial use of foundation sires of each breed that have desirable EPDs with high accuracy values. For example, some purebred sires have produced thousands of offspring by AI and have accuracy values for some traits above .90 (i.e., an accuracy value of 1.0 means 100% total accuracy).

If the breeder effectively uses this strategy of using high accuracy purebred males, then the overall genetic merit of the composite breed will likely make a more favorable first impression to reputable breeders because of more consistent breeding results. This approach will likely spare the breeder many generations of selection to achieve the same results.

negative birth and milk EPDs, which reflect easy-care cattle. I am confident that performance records on my animals reflect genetic expressions for the same trait(s) in my own environment. Some large producers hire geneticists to routinely perform this genetic evaluation. Yet, another alternative is not to use EPDs at all.

BREEDING OBJECTIVE

Later, once the composite is formed, a clear long-term breeding objective should be established to advance genetic improvement. In the 2015 March and April issues of SGF, I described in goody detail the importance and application of the breeding objective.

A breeding objective is a statement about how genetic progress will be achieved by the breeder. It calls for a long-term commitment on the part of the breeder, requiring several generations of cumulative results in order to

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realize genetic progress. The breeding objective for Targhee sheep, a composite breed, is to select for desirable meat, carcass, and fleece characteristics. It should be emphasized that for minimal input systems, selection should focus on animals with optimal rather than maximal performance values. This method is referred to as stabilized selection.

For non-grain, grass-based dairy production, neither too little nor too much milk per animal is desired. Allow the environment to guide the breeder in identifying the best animals. Once desired progress is realized for one trait, the breeder can focus selection efforts on other traits for further improvement. This is called the Tandem method of selection.

Another key point is that the initial breed composition of the composite is likely to change over many generations, largely as a result of selection by using the breeding objective. Over time, Nature should be given the opportunity to expose the ideal genotype for the environment with regards to physiological adaptation to sustained fertility and survival. It is the breeder's role to identify and select such animals.

Gulling of inferior animals is also critical. Obviously, selection is more effective for breeders with large herds. For small producers, selection per se is not so critical because better animals can be purchased from larger composite breeders.

Of relevance, if the foundation composite herd is not large it would be wise to maintain an open herd by periodically introducing superior purebred or F1 animals. This flexibility will also allow the breeder to make certain timely and rapid adjustments, such as reducing mature body weights, and also minimize inbreeding.

One myth about composites is that they are highly variable. While this may be true for certain simply inherited traits like coat color, if compatible breeds are initially chosen with very similar values for traits like birth weight and carcass dress-out percent, the composite population itself may be remarkably uniform in performance. Heterosis also contributes to increased uniformity.

A key advantage of using composite breeds lies in its simplicity. In other words, composite animals can be mated together as if they were 'purebred' and the best male and female offspring can be selected as herd replacements. This advantage is not found in popular crossbreeding systems such as terminal crossbreeding where all offspring go to market.

In addition, composite animals perform well like crossbreds - due to breed complementation and heterosis. This feature should be especially appealing to small producers. In short, composite animals can be mated as if purebred but they perform like a crossbred. Composite breeders can have their cake and eat it too!

CONCLUSIONS

Earlier in this article it was mentioned that developing composite breeds is a timely topic with respect to the grassfed industry. Opportunities presently exist to combine the best genes from various breeds to impact a producer's economic bottom line and to meet niche market consumer demand. However, there is a plethora of traits that relate to the grassfed industry that are not being measured or recorded by breeders.

To name a few, fleshing and marbling ability on only grass, foraging ability, docile behavior during pasture moves, maternal training of offspring, body condition while wintering offspring and nutritional values and organoleptic properties of artisanal quality products. Certainly these characters have economic value.

Breeders could be rewarded for genetic improvement by more consistently producing, for example, the best quality pastured eggs, milk, pork chops or hams or the juiciest and most flavorful grass-fed steaks.

As opposed to commercial breeds, heritage breeds already possess genes for such characteristics, so a good composite could involve two or more heritage breeds that each contribute unique genes for valuable traits to satisfy growing consumer demands and to further promote the grassfed industry.

In conclusion, the development of a composite breed is pursued by progressive breeders. It requires a lot of planning, resources, time, and patience. But as I frequently tell my students, Rome was not built in one day.

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