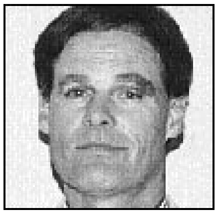

Breeding Composite Seedstock

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There is a growing interest among commercial cattle producers in the use of composite cattle as an alternative to crossbreeding. Naturally there is a parallel interest among seedstock breeders, many of whom are currently purebred breeders, in producing composite seedstock. What these breeders need to understand, however, is that there are fundamental differences between breeding composite seedstock and breeding purebreds. My purpose in this set of articles is to make these differences clear.

There are two underlying reasons why composite and purebred breeding differ. The first is that in composite breeding there are two distinct breeding stages: (1) forming the composite, and (2) breeding the composite once it is formed. The second reason is that in composite breeding we are interested not only in improving breeding value through selection¾ our sole genetic goal in purebred breeding¾ but also in maintaining a high level of hybrid vigor. These basic, theoretical differences between the two types of breeding spawn a number of practical differences. In this first article, I look at these differences in the context of composite breed formation. In the sequel, I look at them in the context of breeding the formed composite.

If you are not interested in creating a new composite breed, but simply want to breed cattle of an existing composite breed, the following discussion of composite breed formation will be of little value to you. We are at a point in time, however, when many people are contemplating creating new composites. Some of these breeds are in the initial stages of breed formation. Others are just a twinkle in a breeder's eye. In either case, the following points should be helpful.

Improving breeding value through between-breed selection

Selection of the breeds and the proportions of those breeds going into a composite is the critical step in composite breed formation and may well determine whether a breed succeeds or fails. If composite breeders do a carefully researched and conscientious job of between-breed selection, then the newly formed composite will not need much genetic change¾ change that can now only be achieved through slow-paced within-breed selection. In other words, if the composite is put together in such a way that it exhibits close to optimum performance in the economically important traits when it is first formed, then any genetic change following breed formation can be considered fine tuning. Following are some ideas to keep in mind when designing a composite breed.

Define how the breed will be used. When companies come out with a new product, they almost always know exactly how the product will be used. Without that knowledge it would be hard to both design and market the product. The same is true with composites. We need to know how the composite will be used by commercial producers. We need to define the geographical areas and environment/management niches appropriate for the composite breed.

It is also important to define how the breed will be used in the context of mating systems. Most composites are likely to be "all-around" or general purpose breeds because that is the kind of animal required for the simplest or "pure" form of commercial composite breeding systems. These breeds should be strong in all traits, or at least not weak in any important trait. They must combine good maternal characteristics with carcass quality and cutability. Other composites may be specialized maternal breeds designed to be bred to a terminal sire. They will probably be smaller, strong in maternal traits and adaptability, and have carcass characteristics¾ typically carcass quality attributes¾ that will complement the carcass characteristics of the terminal sires. We may see specialized paternal composite breeds¾ terminal sire breeds for producing either the ultimate market animal or simply live calves out of first-calf heifers. Whatever the potential use for a composite breed, those who form the breed should keep that use in mind when designing the composite.

Aim for optimums. There may not be optimum levels of performance for all traits, but common sense tells us that there are optimum levels of performance for some traits. Milk production and mature size come to mind right away. Clearly there are limits to the amount of milk a beef cow can efficiently produce and limits to the mature weight she can efficiently maintain. Admittedly, optimum levels for traits like these are not easy to determine, but to the extent that they can be defined, we should try to come close to them in composite breed formation. In other words, choose breeds and breed proportions in such a way that optimal levels of performance are reached in the first composite generation.

Exploit breed differences. One of the unique aspects of composite breeds is that they can incorporate component breeds that most commercial producers would be reluctant to use in any kind of a crossbreeding system involving purebred sires. Consider the Jersey breed. Jerseys have a lot to offer: excellent fertility and milk production, lovely udders, great paternal and maternal calving ease, low absolute maintenance costs, and highly marbled, tender meat. They also have a downside: slow growth rate, poor feed efficiency and carcass cutability, small carcasses, and a nasty disposition (in bulls). The negatives are enough to keep most commercial producers from using Jersey sires. However, a composite containing the right dose of Jersey combined with other component breeds that compensate for the Jersey's weak points could be really useful. In effect, by "mixing and matching" breeds in composite formation, it is possible to make use of complementarity¾ the production of a more desirable offspring from the mating of parents that are genetically different from each other, but have complementary attributes.

There are a number of important traits for which EPDs and other performance information are rare. This is usually because performance in these traits is hard to measure. Temperament and udder conformation are typical examples. Without performance data, it is very difficult to change these traits with traditional within-breed selection, and so it is precisely these traits that we would like to "get right" in the breed formation stage of composite breeding. Fortunately, breed differences in many of these traits are large. Herefords, for example, are quite uniformly docile (with exceptions, of course), and Jerseys are known for their strong udder suspension and small teats. Because of their performance in these traits, inclusion of Herefords and Jerseys in a composite could be very beneficial. Considering hard-to-improve traits during composite breed formation is another way of exploiting breed differences.

One of the most persistent misconceptions about composites is that they lack uniformity. Producers assume that if hybrids are mated to hybrids, the offspring will vary across the board. We know from theory and from experimental results that this is not true. Composites are as uniform as purebreds for almost all economically important traits. Only in those traits affected by few genes¾ coat color is the best example¾ will composites be clearly less uniform. Color uniformity may be something to consider when choosing component breeds. This may seem silly¾ we don't eat the coat, after all, but it is amazing how uniformity of color affects people's perception of uniformity in general.

Improving breeding value through within-breed selection

Choose the best foundation animals. The choice of what breeds to include may be the single most critical step in composite breed formation, but the breeder's responsibility does not end there. We all know there can be tremendous variability within breeds. It is important, therefore, that composite breeders be selective in their choices of foundation animals. It would not do, for example, to pick just any Hereford or Jersey bulls simply because they were purebred and available. What if they were not representative of those breeds or had some glaring faults? Furthermore, we sometimes want to include only certain types within a component breed. I can think of several breeds that have a lot to offer, but are (in my opinion) too big at birth and maturity. However, there are bulls within those breeds with atypically low birth and mature weight breeding values, and these are the bulls I should hunt for. If color uniformity is a concern, foundation animals should be screened for their color genotype as well. A good job of composite breed formation means a good job of both between- and within-breed selection.

Maintaining hybrid vigor

Sample widely. The key to maintaining hybrid vigor in a composite is to avoid inbreeding. The way to prevent inbreeding at the breed formation stage is to establish as broad a genetic base as possible. From a practical standpoint this means including in the foundation population a number of unrelated sires or daughters of unrelated sires from each component breed. To see why, consider the extreme case of a four-breed composite in which one component breed's contribution came in the form of semen from a single sire. Every member of the first generation of composite animals will be a grandson or granddaughter of that bull. He will appear repeatedly in the pedigrees of future generations, and the result is an increase in inbreeding.

What is the minimum number of sires needed to represent a component breed? I don't really know. One is too few. Four or five, if they are truly unrelated, should probably be adequate. A dozen would be plenty.

Other concerns

Order of crossing. Say you were designing a four-breed A% B% C% D composite. Would the order of the initial crosses make a difference? In other words, would it matter whether the first composite generation was (A% B)% (C% D), (A% C)% (B% D), or (A% D)% (B% C)? The answer is yes and no. If the component breeds differ in maternal ability and(or) if specific two-breed crosses differ in hybrid vigor, the performance of the first generation of composites and, to a lesser degree, the second generation will be affected by the order of crossing. The performance of the third and more advanced generations should be unaffected, however.

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Complexity. The biggest advantage of using composites is that they are easy to manage. Unfortunately,

the same cannot be said for creating composites. In assembling a four-breed composite you could be dealing with purebreds of all four breeds, two two-breed crosses, and full composites¾ all at the same time. Creating a composite breed is not something to be entered into lightly.

Time required. Composite creation can be time consuming too. I estimate that, starting from scratch, it takes a decade to make the crosses for a four-breed composite and replace the foundation animals completely with composites. If you are getting on in years, composite development may be like planting shade trees¾ the next generation will be the first to enjoy the fruit of your labor. On the other hand, if you already have a set of two-breed cross females and can find the right two-breed F1 bulls, you can have four-breed composite calves on the ground next year.

In the next article in this series I discuss breeding composites once the composite breed has been put together.