

Rick Bourdon, a Red Angus breeder currently involved in teaching and research at CSU, has designed this series (continued from last month's Journal) to help breeders understand and use available performance information.

A Series

Beef Cattle Breeding

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Part Eleven

Designing a Breeding Program

This article is the last in this series on beef cattle breeding. Its purpose is to tie together many of the concepts introduced in previous articles as they relate to the design of a breeding program for seed stock.

One can think of breeding program design as consisting of four steps: 1) setting goals, 2) choosing and weighing traits, 3) determining how animals will be measured, and 4) devising a strategy for selecting parents. Ideally, we would like to take each of these steps in order, design our program once and be done with it. Realistically, designing a breeding program is a never-ending process. Markets change, cattle change, technologies change and we change—presumably because we have learned from experience.

Let's look at the four steps in more detail.

Setting goals

For any breeding program to be successful, it must have a sense of direction, and that is only possible if the goals of the program are clearly defined. Setting goals is not a simple process nor one to be taken lightly. It is important that goals be well thought out and that the breeding program be consistent with them. Many programs have never really gotten off the ground either because goals were never well defined or changed repeatedly. It is no sin to

change goals, but changes in direction give the appearance of no direction.

One way for a breeder to determine his goals is to ask himself how he wants to be thought of in the future. Does he want to be known for his show winners, his high gainers at test stations, his sale averages, the number of his repeat commercial customers? Are more than one of these important, and if so, what is the order of importance?

Setting goals often boils down to deciding who the customers are. Are they commercial cattlemen, purebred breeders or a little of both? If they are purebred breeders, what kind of purebred breeders are they and what are *their* goals? It is important to realize that not all goals are fully compatible, especially if they involve more than one group of customers. It's hard to please everybody.

Ultimately, the goals which a breeder chooses for himself will reflect his particular interests. Properly determined goals should also reflect a realistic assessment of present and future markets, the breeder's promotional style and abilities, and his cattle breeding philosophy.

Weighing traits

Clearly, the traits we emphasize must be consistent with our goals. If our goal is to provide the most useful cattle for a particular kind of customer, then the information we require for selecting and weighing traits is a pre-

cise knowledge of that customer's needs. This implies a "systems approach" to trait selection, where all the factors which affect the customer's operation are taken into account. For commercial customers, these factors will fall into the following categories: natural environment, economics (costs and prices), cattle type(s), mating system (straightbreeding, crossbreeding, etc.), and management policies. Evaluating all these things is very difficult. We can learn a lot, however, by paying close attention to the preferences and reasoning of our customers. There may also be help on the way from universities as more research is focused on objective ways to solve the trait selection problem.

Before a breeder can decide how much emphasis to place on which trait, he must first evaluate his own cattle for those traits. He may feel, for example, that birth weight is a trait that should be carefully monitored, but that at this stage his cattle have no problem with the trait and he should select more for growth. On the other hand, he might be well advised to consider his cattle's light birth weights as a major strength and concentrate on keeping birth weights light. Knowing and maintaining the strengths of a breed and of particular types of cattle within a breed are very important; no cattle can be all things to everyone, and the most useful cattle are those which have found their niche.

While we tend to pay the most attention to the major production traits—size, growth rate and milk production, we should remember that cattle vary in many traits besides these. Survivability, fertility, adaptability and



convenience are general categories for many traits which are difficult to measure, yet are extremely important. One of the greatest challenges for a cattle breeder is to decide how much emphasis to place on these more subtle traits as compared to the commonly measured traits.

Other things to keep in mind when deciding the relative emphasis to be placed on any one trait are the heritability of the trait and genetic correlations between it and other traits. Since heritability is a measure of how closely an animal's own performance reflects his breeding value, lowly heritable traits can be expected to respond very little to selection for individual performance. Fertility, for example, is a trait commonly thought to be lowly heritable and therefore very difficult to change genetically. Luckily, one particular measure of fertility, scrotal circumference, is highly heritable and therefore easy to change.

If two traits are genetically correlated, selection for one will result in change in the other. Breeders should be aware of genetic correlations, especially if those correlations produce undesirable results. For example, yearling weight is highly genetically correlated with both birth weight and mature size, and selection for yearling weight will tend to increase birth and mature weights. While heavier yearling weights may be desirable, heavier birth and mature weights may not be.

As a rule, selection for more than one trait results in less than maximum change in any single trait. This is simply because the more traits that are taken into consideration, the less "choosy" one can be with regard to a particular trait. The problem is greater when the traits being selected for are unfavorably genetically correlated. For example, birth weight and yearling weight are positively, but unfavorably correlated since breeding values for heavier yearling weights are associated with breeding values for heavier birth weights. If we select for both heavier yearling weight and lighter birth weight, we can expect relatively slow progress in both traits. That's not all bad, however. If the best animal is characterized by a light birth weight and a heavy yearling weight, then even though we may not be making the most rapid change in either birth or yearling weight, we are doing the best thing possible by selecting for both traits.

Just as it is important that a breeder set his goals and then stick to them, he should carefully determine the relative emphasis to be placed on the various traits and then be consistent in his selection of parents. A breeder whose selection priorities flip flop from time to time succeeds only in undoing whatever genetic change he has managed to make.

Measuring animals

When we weigh cattle, record birth dates or do whatever else can be described as measuring animals, we should be concerned with the accuracy of measurement. The more carefully measurements are made and records kept, the more useful will be the resulting information in a selection program. Careful measurement implies not only uniform weighing

breed.

Sire selection

The only real way a breeder can improve the breeding value of his herd is by selecting the animals to become parents. Because bulls can produce many more offspring than cows, a few bulls will have contributed, in a relatively short amount of time, a high proportion of the genes in a cow herd. For this reason, selection of bulls is much more important than selection of replacement females. And by far the most useful tool for bull selection is national sire evaluation.

The great virtue of sire evaluation is that it makes it possible for breeders to find bulls to fit rather precise specifications. Consider the following data excerpted from a recently published sire summary*:

Sire	Birth		Weaning		Yearling		Maternal	
	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
A	-6.5	.91	+15.4	.89	+29.8	.86	+13.5	.62
B	+15.0	.98	+58.1	.98	+99.0	.97	+7.6	.93
C	+1	.92	+32.8	.93	+65.6	.89	+19.9	.78

*This data was included in the 1985 American Polled Hereford Assn. sire summary. Maternal EPDs will replace Maternal EBVs in the 1985 Angus Sire Evaluation.

conditions, avoidance of "estimated" birth weights and an organized record-keeping system. It implies proper accounting of contemporary groups. Whether the contemporary group information is to be used in national sire evaluation, breeding value estimation or simply in the calculation of performance ratios, it is critical that it be accurate. Whenever a pampered animal is lumped in the same contemporary group with unpampered animals, the entire set of data is devalued.

For purebred cattle, one can argue that it is as important to report records to the breed association as it is to take the measurements in the first place. Purebreds are likely to see tremendous competition in coming years both from new breeds designed for specific uses and from composite cattle—cattle which can maintain hybrid vigor without crossbreeding. The one real advantage that organized breeds have over their competitors is the ability, through records programs and national sire evaluation in particular, to locate outstanding individuals using large amounts of data from many herds. In this light, reporting information to the breed association is something like a civic responsibility, an investment in the future of the

Based on their expected progeny differences (EPDs), the three bulls listed are quite different genetically. And based upon the accuracy values (ACCs) for those EPDs, we can, for the most part, have considerable confidence that the bulls will breed as indicated in the summary. With his very low EPD for birth weight, sire A is a clear choice for calving ease, although he is still well above breed average for growth traits. Sire B is a growth bull with extremely high and well documented EPDs for weaning and yearling weight. Since his calves are expected to be 15 lb. heavier than average at birth, however, he is a poor candidate for calving ease. Sire C is what I term an "outlier," that rare bull which combines low birth weight potential with very good growth rate and maternal value.

Many breeders are rightly concerned with maintaining a rapid generation turnover, in other words, keeping short the length of time it takes for one generation to be replaced by the next. This is accomplished by using young bulls and by replacing a large proportion of the cow herd with heifers each year. Rapid generation turnover speeds up genetic change, but there are trade-offs to be considered. The gains to be made from

shortening the generation length must be weighed against the fact that keeping many replacement heifers necessarily means being less selective in the choice of those replacements, and that using young, relatively unproven bulls is inherently more risky than using proven bulls.

The second consideration is particularly important in the context of national sire evaluation. Sire summaries list a number of bulls which have been proven highly superior through extensive progeny testing. They are not the youngest bulls, but they are "sure bets." Much of the risk of sire selection is removed by using these bulls, and most breeders would be well advised to do so.

This is not to say that younger, less proven bulls should be avoided. If they are, they will never grow up to be older, proven bulls. Sires should be chosen on the basis of their promise (expected progeny difference) and our confidence in that promise (accuracy or possible change). In this regard, it is important to remember that EPDs are not simple progeny averages, but are *regressed for numbers*. The actual progeny average and therefore the possible genetic potential of a young bull with a high, but not very accurate EPD will be considerably higher than his EPD. He is a good choice for those who don't mind gambling. Regressing the EPD removes some of the temptation to use an unproven bull, but it doesn't reduce the risk. Perhaps the best compromise is to use young bulls cautiously. Don't breed the whole herd to them.

In comparing sire evaluation techniques in this series, considerable attention was paid to problems and biases in sire evaluation. It is good to be aware of these. For example, in the data listed above, the maternal EPD is not strictly a measure of milk production, but contains a component for growth. Considering his extremely high EPD for growth to weaning and relatively modest EPD for maternal value, sire B would not, therefore, be a good choice if we are interested in improving milking ability.

NOTE: Milk production and growth components should be separated in the EPDs appearing in the 1985 Angus Sire Evaluation.

At the same time, it is important not to be too critical of sire evaluation data. As a whole, sire evaluation re-

sults are very reliable, and new techniques will make them even more so in the future. We need to include more traits in sire evaluation, especially reproductive traits, but for those traits currently measured, sire evaluation is by far the most powerful tool a breeder can use to make genetic change.

There is more to sire selection than using the top bulls on sire evaluation, however. Most calves are sired not by A.I. bulls, but by bulls which have been home-raised or purchased from other breeders. The important thing to remember when buying a bull or selecting one from within the herd is that what is really being sought after is breeding value—the value of an animal as a parent. Estimated breeding values (EBVs) are the best available indicators of breeding value, and trait ratios are usually not too bad a substitute. Adjusted weights alone are not very reliable measures of breeding value because they fail to account for many environmental influences. Unadjusted weights are worse.

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Because breeding value is the important criterion for selection, we should be careful not to get carried away looking for an outcross. If the outcross bull is purchased because he has good breeding values, fine. But if he is purchased simply because he is unrelated, be prepared for a disappointment. His calves may show some hybrid vigor, but they won't be the best parents.

Female selection

Essentially, selection priorities should not be any different for females than males. Some breeders insist on selecting bulls for growth and females for maternal ability. What they end up with is a poorly defined mix of both traits. A better policy would be to decide the relative emphasis to be put on each trait and then select both sexes in the same way. There are, of course, some practical considerations in female selection that

are less important in bull selection. We might, for example, want to cull heifer calves born very late in the season since they are less likely to cycle and conceive early.

If maternal ability is an important consideration in a breeding program, maternal breeding value (MBV) should play an important part in heifer selection. And theoretically, cows should be culled on the basis of MBV as well. From a practical standpoint, however, it often makes more sense to cull cows on the basis of producing ability as estimated by MPPA. (MPPA includes information on long-term environmental effects on production; it is not included in AHIR data.) If a cow has been environmentally handicapped, say, by depositing too much fat in the udder as a heifer, she could have a better than average MBV, but a poor production record and MPPA. From a genetic standpoint, she should stay in the herd, but from a practical standpoint, she should go.

Rapid generation turnover is probably more important in females than in bulls. Clearly, if only the minimum number of cows are replaced each year, the herd is not going to change very quickly. On the other hand, if we keep many replacements, we cannot be as selective as we would be if we kept only a few. But there is not the kind of risk associated with keeping a large number of young, unproven heifers as there is with using just a few young, unproven bulls. What little risk there may be is reduced if the heifers are sired by proven, high breeding value bulls selected through national sire evaluation.

In summary

In this article I have tried to outline some of the more important points to consider when designing a breeding program, building on concepts explained and terms defined in earlier articles. The concepts are not simple, and the jargon can, at times, seem imposing. To take advantage of today's cattle breeding technology, however, it is essential to understand what the terms mean, why they are important, and how they should be used. It is comforting, though, to realize that despite all that has been described in these articles, beef cattle breeding still boils down to "breeding the best to the best." AJ

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