Selection and Management Practices to Increase Consistency in Beef Cattle

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Uniformity in cattle production has long been a goal for cattle producers, it results in a higher percentage of correctly finished cattle in the feedlot and higher prices at the sale barn. The National Cattlemen's Beef Association conducted a beef quality audit in 1991 that identified lack of beef consistency as a major problem. Commercial cow/calf operators are looking for management practices that will add consistency to their calf crop, and seed stock breeders are searching for selection practices that will result in herd bulls with less variation in offspring. There are two types of variation that concern the beef industry: genetic and phenotypic. (For more information on variability, see page 15 of this issue.) Genetic variation in a population (calf crop) is diversity of genotypes for a particular trait. In other words, if all calves have similar genotypes for birth weight, the calf crop would have very little genetic variation in birth weight. If calves in the crop have different genotypes for birth weight, there would be a great deal of genetic variation.

Phenotypic variation, on the other hand, would be the actual (or total) variation expressed in the calves. Genetic variation is a part of phenotypic variation, but environmental variation (management) also makes an important contribution. In effect, cow/calf producers are concerned with reducing the phenotypic variation in their calf crops; therefore, seed stock producers attempt to provide them with herd bulls that will sire progeny with less genetic variation.

This article will address:

- practices used by seed stock producers to reduce genetic variation.
- management practices available to commercial cow/calf producers for reducing phenotypic variation.

Genetic Variation

The increase of uniformity using breeding and selection practices is based on increasing the percentage of homozygous (identical) gene pairs. If all the gene pairs that control a trait are homozygous in a particular bull, the bull has no genetic variation for that trait, which means the bull will pass identical genetics to each of his offspring. On the other hand, if a bull has a large number of heterozygous gene pairs, he has the potential to pass on many different genetic packages to his offspring. If a breeding program is to be successful at producing bulls with less genetic variation, practices should be used that will increase the percentage of homozygosity in those bulls. Currently, the most common practice to reduce genetic variation is some form of stacking pedigrees.

Stacking pedigrees can be accomplished in several ways. Following are some of the methods of stacking pedigrees, the effectiveness of each method at reducing variation and potential consequences.

Maximum Single-Trait Selection

This is the practice of mating the best bull available to the best cow available for a particular trait. When using Expected Progeny Differences (EPDs), this method is the most effective way to make rapid change in the trait for which selection is being made.

Effectiveness—There is potential improvement in uniformity for the trait being selected. That potential is based on the principle that intensive selection for a trait eventually will move a population toward fixation of the genes that influence that trait. Fixation is simply the elimination of heterozygous gene pairs, resulting in a higher percentage of homozygous gene pairs. However, there is no evidence that fixation of any trait has occurred in cattle populations using maximum single trait selection.

Consequences—Due to genetic correlations, single-trait selection can have a detrimental effect on other important traits. For example, single-trait selection for maximum growth can result in increased birth weights and reduced milking ability in the cow herd.

Breeding Like to Like

Also known as positive assortative mating, breeding like to like is the practice of breeding of a bull and cow with similar EPDs for each trait. As an example, a producer has a cow of high birth weight (Angus birth weight EPD of +8.0 lbs). Instead of using a corrective mating sire (Angus birth weight EPD of -2.0 lbs), the producer mates the cow to a bull similar to her birth weight EPD (Angus birth weight EPD of 7.0 lbs). This practice is based on the common belief that if a bull's parents have similar EPDs, that bull will produce a more consistent calf crop. Therefore, a breeder with a high-producing cow with a high-birth-weight EPD who would like to produce offspring with a more acceptable birth-weight EPD would be afraid to use a bull with extremely low birth weight for fear the resulting progeny would have increased variability.

Effectiveness—Based on basic genetic principles and verified by beef cattle research, the method of breeding like to like does not significantly reduce trait variability. First perception is that animals with similar genetic potential (EPD) should have the same or similar genotypes (genetic makeup). However, when dealing with most economically important traits in beef cattle (birth weight, growth, quality grade, etc.), many gene pairs influence the trait, and many different combinations of genes may result in the same EPD. For most of the traits for which selection is made in beef cattle, mating bulls and cows with similar EPDs does not result necessarily in an increase in the percentage of homozygous genes in their offspring. Therefore, it does not improve the uniformity of future calf crops.

Consequences—If the cows in the herd are being mated to bulls with similar EPDs, their offspring on the average are expected to have the same EPD. Therefore, this herd is not making genetic progress, and the progeny produced will likely have no less variation than if corrective or progressive matings were used.

Inbreeding

Inbreeding is the practice of breeding animals that are more closely related than the average population. (Linebreeding is a form of inbreeding in which the focus is on one particular animal or line of animals in the pedigree.)

Effectiveness—Based on genetic principles, this practice should produce bulls that will sire a more uniform calf crop than non-inbred bulls. Inbreeding increases the percentage of homozygous genes, and as the percentage of homozygous genes increases, the number of possible genotypes that a bull can pass to his offspring decreases.

Genetic variation is reduced when the number of possible genotypes is reduced. Theoretically, inbreeding should be an effective means of reducing genetic variability; however, research with beef cattle has shown that this reduction in variation is slight, even when inbreeding is practiced in combination with single-trait selection for growth over many generations.

Consequences—Inbreeding can cause several adverse effects, including reduction of:

- fertility
- survivability
- longevity
- performance

If inbreeding is being practiced for the sole purpose of reducing genetic variation, the benefits are likely not worth the consequences.

Summary of Reducing Trait Variation in Herd Bulls

EPDs can be used to predictably move or maintain the average of a herd for many traits, which can lead to more acceptability in overall herd performance and a higher percentage of acceptable offspring. However, using breeding practices such as those described in this publication seems to have slight or no effect in improving the uniformity of calf crops. Individual bulls do show differences in the amount of variation observed in their calf crop, but it is not clear how to make mating and selection decisions that will consistently result in bulls with less variation.

Phenotypic Variation

Commercial producers are not necessarily concerned that genetic variation is reduced, but rather that calf variation as a whole is reduced. It is worth discussing some common practices used by commercial producers and the role of those practices in phenotypic variation.

Related Bulls

In commercial herds where multiple sires are used, one possible way to reduce variation is to use bulls that are related. The closer the relationship of the bulls, the less variation you expect to see in their calf crop. This reduced variation occurs because full sibs have half their genetics in common, half sibs have a quarter of their genes in common, and so on. Therefore, by mating the cow herd to bulls that are relatives, the calf crop will have a portion of its genetic makeup in common.

Effectiveness—Consider the best-case scenario, which would involve using full sibs and a highly heritable trait (h2=.40). The bulls would have 50% of their genetics in common; however, their calf crop would only have 25% common genetics. Therefore, in the best-case scenario, phenotypic variation in the calf crop would be reduced by 10% (.40 * 25%). If half sibs were used instead of full sibs, phenotypic variation would be reduced by only 2.5%.

Consequences—There are few adverse consequences to using half- or full-sib bull batteries other than the cost of purchasing the bulls. If purchasing related bulls costs more than purchasing non-related bulls of similar quality, it is not likely the slight reduction in variation would be cost effective.

Crossbreeding

Commercial producers are not using crossbreeding as a means to reduce variation; however, they may be concerned that crossbreeding could increase variation. Although crossbreeding may increase genetic variation slightly, research indicates that phenotypic variation is not adversely affected. However, crossbreeding systems do have the potential to increase variation if they are not implemented correctly. Using breeds with large production differences in a crossbreeding system is likely to increase variability in the cow herd and ultimately in the calves. Advantages of crossbreeding in a commercial operation far outweigh any potential increases in variation, however.

Management

A review of means available currently to reduce genetic variation in calves makes it apparent that they are not effective in reducing phenotypic variation. Therefore, management practices may be more effective in reducing calf variation. The most effective tool to reduce variation in calf weaning weight is to have a limited breeding season. Considering that if calves approaching weaning gained 2 lbs a day, it would take only a difference of 50 days in birth date to result in calves with a difference of 100 lbs in weaning weight.

In order to obtain a large number of calves born early in the breeding season, having cows and heifers in good health and condition going into the breeding season is important. To tighten the breeding and calving season even more, the use of estrous synchronization programs may be beneficial. By using practices to produce more calves born earlier in the calving season, not only is more uniformity in the calf crop achieved, but more pounds to sell are obtained.

In order to harvest cattle at the appropriate end point, it is necessary to sort the cattle either as they go into or as they come out of the feed yard. In contrast, an "all in, all out" approach to feed yard management with cattle of different frame size, weight, and/or age results in large variation in the degree of finish, and this variation will likely translate to a lack of uniformity in carcass yield and quality grade. The pen may average low Choice, yield grade 2, but there may be many undesirable carcasses in the group (yield grade 4s and 5s or Standards). Ultrasound technology has proved useful in projecting the expected finishing date of cattle, which aids in sorting the cattle into feeding pens.

Consumer Acceptance

Harvesting a larger portion of cattle at the appropriate end point should reduce the variation in several carcass traits and ultimately increase consumer acceptance of beef. Possibly the greatest key to that acceptance and return of market share is the ability to produce a consistently tender product. Improved genetics and cattle-management practices as discussed in this publication play a role in tenderness of beef, but there are also techniques available after harvest that can improve it overall. Some of these techniques are in place and others are being tested.

Conclusions

Uniformity is an important issue to every segment of the cattle industry. Reducing variation has economic impact; therefore, cattle producers strive to implement practices that will result in uniformity. Unfortunately, there is not a "quick fix" solution to achieve it. With all the breeds and breed types that are available to producers, variation within the beef cattle industry is likely to exist for some time. However, by realizing these differences and managing cattle based on their potential, a consistently acceptable beef product can be produced.

Variability

Variability exists in all cattle herds for most traits and is an indicator of how much difference from the average exists in the herd. Two herds could have the same average weaning weight, but the range of weaning weights in the herds could be different. Variability is often discussed negatively in the beef industry, but for seed-stock producers, variability is necessary to make genetic improvement. Generally, cattle that are further from the herd average are the ones that have the potential for greater genetic progress in the direction being selected. Both Herd A and Herd B have average weaning weights of 600 lbs; however, Herd A ranges from 400 lbs to 800 lbs, and Herd B ranges from 500 lbs to 700 lbs. In this example, Herd A has more weaning-weight variation than Herd B. As variation is reduced in a herd, more animals have weights close to the herd's average, with fewer animals at either extreme. If improving weaning weights is the selection goal, choosing replacements from the upper end of Herd A would likely result in more rapid genetic progress than selecting from Herd B (assuming all other variables in the herds are similar).