Visual and Phenotypic Evaluation of Bulls

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While a majority of the emphasis in bull selection should be placed on objective performance information, visual and phenotypic evaluation of bulls remains important for two reasons. First, bulls must be evaluated for traits that affect their physical ability to breed cows. In addition, some traits of economic relevance are not included in genetic evaluation programs. Successful commercial cow-calf operators should strive to select bulls that combine the genetic potential to improve profitability with the physical ability to work and survive in their production environment.

Breeding Soundness Traits

Likely the most important reason to evaluate prospective herd sires visually is to ensure they have the physical characteristics necessary to serve a large number of cows for a number of years. Typically, bulls offered for sale will have been subject to a breeding soundness exam (BSE), conducted by a veterinarian using guidelines set by the Society for Theriogenology (Spitzer, 2000). A BSE consists of three steps, as follows;

1. A generalized physical examination and thorough examination of both internal and external portions of the reproductive system;
2. A scrotal circumference measurement; and
3. Collection and evaluation of a semen sample.

The Society of Theriogenology has established minimum acceptable thresholds for scrotal circumference, sperm motility and sperm morphology. Bulls are classified as either satisfactory (achieves minimum thresholds and is free of problems that may compromise fertility), unsatisfactory (fails to meet minimum thresholds and has a poor prognosis for improvement), or deferred (cannot be classified as satisfactory but are likely to improve with time or therapy). It is not uncommon for younger yearling bulls (less than 15 months old) to be deferred at their first examination, but bulls that are deferred should be retested before being turned out to service females. In studies conducted at university-sponsored bull testing programs, 70 to 80% of all bulls were classified as satisfactory potential breeders (Coulter et al., 1997).

While structural soundness of feet and legs is included in the BSE, producers would be wise to make their own evaluation of a bull's skeletal structure before making a purchase. The ability of a bull to walk freely and without discomfort is critical for both breeding and grazing behavior. The most critical details of soundness are correct slope and angle to the joints of the front and rear limbs. Bulls that are excessively straight-legged travel with short strides, and are somewhat prone to stifle injuries during mating (Boggs et al, 1998). Sound structured bulls, walking on smooth, level ground, will set their rear hoof down in the track of their front hoof. Straight-shouldered, straight-legged bulls will set their hind foot down in a position well behind where the front foot was set. Hocks and knees should be free of any swelling or inflammation. Structural problems in yearling bulls tend to become more severe as the bulls age and increase in weight.

Body condition, or fatness of bulls is also an important consideration. Bulls need to be in moderate body condition at the beginning of the breeding season, as most will lose weight during periods of active breeding. However, excess body condition can adversely affect fertility. Research has shown that excessively fat bulls on high-energy diets tend to deposit fat in the neck of their scrotum, interfering with temperature regulation of the testicles and lowering fertility (Coulter et al., 1997).

Visual Estimation of Breeding Value

Prior to the advent of performance testing, producers used visual evaluation to predict the breeding value of bulls for traits like growth rate and carcass composition, with variable success. The first performance-tested herds provided adjusted weights and in-herd ratios to their bull buyers, increasing accuracy of selection within one herd's offering. But only with the availability of expected progeny differences (EPD) were bull buyers able to accurately compare animals from different herds. Nonetheless, some bull buyers continue to emphasize actual weights or in-herd ratios when selecting a herd sire.

Bull buyers often incorrectly assume that the animal with the most desirable actual performance will produce the most desirable progeny. While individual and progeny performance are related, the relationship is far from perfect. The relationship between an individual's performance and their progeny's performance depends on the heritability of the trait. For highly heritable traits, like carcass traits, relatives generally resemble each other closely, and an individual's measurement is a reasonable estimator of their progeny's performance, after adjustment for environmental effects. For moderately heritable traits, like weaning weight, the relationship weakens, and data on relatives of the prospective sire add considerable information used in calculating the animal's EPD. When dealing with traits of low heritability, like maternal weaning weight or reproductive traits, considerable information on relatives and progeny is needed to evaluate animals accurately. Regardless, EPD calculations account for the heritability of the trait, and the EPD is the single best estimate of progeny performance.

When EPD are available, using the actual weights or ratios with or without the EPD decreases the accuracy of selection for several reasons. When the most recently calculated EPD (including interim EPD) are available, they are the most accurate estimate of the animal's genetics for the measured traits. The animal's actual weight or measurement for the trait has already been included in the EPD calculation. The EPD calculation appropriately weights all the relevant information, including performance of ancestors and other relatives, and progeny when available. If producers use both the EPD and the actual weight in selection, they overemphasize the animal's own performance, and underemphasize the performance of relatives and progeny. If an animal has a favorable EPD for a trait, but a less favorable actual weight or measurement for the same trait, either there are significant environmental effects influencing the actual observation that are accounted for in the EPD calculation, or there is an overwhelming amount of evidence from relatives that the animal in question has superior genetics.

However, there may be a few instances where traits of economic importance are not included in genetic evaluations, usually because the traits are subjectively measured. For example, bull buyers may evaluate feet and leg structure, not only to ensure the bull can service cows, but also to maintain feet and leg soundness in the bull's daughters. Again, the degree to which a sire's conformation for such traits will be reflected in their progeny depends on the heritability of the trait in question. For feet and leg conformation, limited data have been collected in beef cattle. One example of such a scoring system is the Genetic Trait Summary provided by ABS Global (Kirschten, 2002a). A sample of heritability estimates for type scores in Simmental appears in Table 1.

Table 1. Heritability estimates for type traits in Simmental cattle (Kirschten, 2002b).

Trait	Heritability	Trait	Heritability
Stature (height)	.60	Rear legs (hock set)	.12
Body length	.39	Foot/pastern angle	.13
Muscling	.42	Udder attachment	.23
Capacity	.44	Udder depth	.35
Femininity	.32	Teat size	.39

Heritability above 0.40 is considered high, while heritability of 0.15 or less is considered low. From the table above, height in this population is highly heritable, indicating that selecting sires that are taller or shorter in height than their contemporary group mates should result in daughters with somewhat similar characteristics. Rear leg and pastern set, in contrast, is low in heritability; so post legs and weak pasterns are more likely the result of environmental effects rather than genetics. Udder depth and teat length are moderate in heritability, offering some opportunity for improvement through visual selection. However, those traits can only be observed in females. While it may be possible to observe a bull's dam for her udder characteristics, only half of her genetics for those traits are passed to any one son, and only half of that passed from the son to his daughter. Culling the cowherd on udder traits is more likely to improve those traits than is sire selection. The exception would be when selecting AI sires that have a large number of daughters in production, if many of those daughters can be visually evaluated.

One of the traits most commonly evaluated visually by bull buyers is muscling. Koch et al. (2004) selected Hereford cattle for 20 years based on weaning weight alone, yearling weight alone, or a combination of yearling weight and muscle score. Visual muscle score was shown to be at least as heritable as carcass ribeye area (0.37 vs. 0.26, respectively). The authors reported a genetic correlation of 0.54 and a phenotypic correlation of 0.19 between ribeye area and retail product percentage, a favorable result. The correlation of visual muscle score with retail product percentage was near zero (genetic=0.06, phenotypic=-0.10), indicating visual selection for muscling would have little impact on cutability. While cattle selected on both yearling weight and muscle score had larger ribeye area compared to those selected on yearling weight alone, the differences between selection lines for retail product percentage were insignificant. Selection on ribeye area EPD, based on carcass measurements, ultrasound measurements or both will likely result in greater improvement in both carcass muscling and retail product percentage, compared to visual selection for muscling.

Obviously, bulls with overly aggressive, nervous or flighty dispositions can create management problems for producers, and should be avoided for that reason. Docility in Limousin cattle has been shown to have moderate to high heritability (0.40; Kuehn et al., 1998), indicating that the resemblance between sires and their daughters for disposition should be fairly strong. However, behavior may also be influenced by sex characteristics of males versus females. So while bulls with poor dispositions are themselves a problem, there is some likelihood that their daughters will inherit similar dispositions.

Another area in which producers might use visual evaluation or phenotypic measurement in predicting a sire's breeding value is in the area of calving difficulty, either direct or maternal. For example, a bull buyer might observe that a bull appears wider and more muscular through his shoulders, and wrongly conclude that his calves might require greater assistance at birth. Two studies at Virginia Tech evaluated the relationships between calf shape and calving difficulty, and concluded that once birth weight was considered, any measurements of the calf's dimensions or shape provided no additional information on the ability of the calf to be born unassisted (Nugent et al., 1991; Nugent and Notter, 1991). Also, pelvic area in females, measured at a year of age, has been shown to be a useful predictor of their ability to calve unassisted (Bellows et al., 1971). However, Kriese (1995) showed that using pelvic area of yearling bulls to predict their daughter's calving ease is not useful. First, pelvic area is moderately heritable, so a sire with a larger pelvic area should transmit some but not all of that advantage to his offspring. Also, pelvic area seems to be significantly affected by developmental differences between males and females (Kriese et al., 1994), so genetics that result in large pelvic area in males might not have the same effect in females.

Summary

In summary, buyers of bulls or semen should focus on genetic evaluation results in the form of EPD for selection whenever possible. Using the most current EPD will most likely result in the desired genetic change. Some traits that affect the ability of natural service sires to successfully breed cows, like breeding soundness and skeletal structure, must be visually evaluated. However, "adjusting" EPD for the actual performance data or visual characteristics of the sire biases selection, and results in less than maximum genetic progress with no reduction in risk.

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