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Beef Sire Selection

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Introduction

Selecting a herd sire is one of the most important decisions a cow-calf producer makes. A herd bull contributes half the genetic makeup of his calves and plays an essential role in herd genetic improvement. The herd bull is the most important individual in a breeding herd. A cow or heifer typically produces one calf per year, while a mature herd bull may sire 25 or more calves per year. Thus, a herd sire may contribute more to the genetic makeup of the herd in one breeding season than a cow contributes in her lifetime. Selecting genetically superior bulls is the quickest path to herd genetic improvement. The value of a bull above slaughter value is his ability to sire live calves and transmit superior genetics to the herd.

Selection Goals

Different cow-calf operations have different goals and different resources. Yet bull selection goals for any cow herd should target an **acceptable combination of traits that complement the strengths and weaknesses of the cow herd and match markets**. When selecting a bull, consider the needs of the cow herd. Ask questions that will help match a bull to the cow herd. Do weaning weights need to be improved? If so, growth performance is a priority in the selection process. Does calf crop color uniformity need improvement? If so, color pattern inheritance is an important consideration in bull selection. Will the bull be bred to heifers and is limited labor available to assist with calving? If either is the case, calving ease is a priority. Are there plans to retain ownership of calves beyond the feedlot and market them on a value-based pricing grid? If so, attention needs to focus on carcass traits in selecting breeding animals.

Other factors that should be considered in bull selection include structural soundness, conformation, libido, disposition, scrotal circumference, sheath, frame size, muscling, breed and horn presence or absence. Try to strike a balance among various traits and avoid extremes. Base the type of bull selected on the purpose of the bull in the breeding herd. Will the bull be used as a terminal sire on mature cows, will he be bred to heifers or will he be used to sire replacement heifers?

Selection Tools

Expected Progeny Differences

Expected progeny differences (EPDs) are a useful genetic selection tool for many of the traits described below as well as many others not mentioned. Expected progeny differences provide predictions of the expected performance of the calves sired by a bull compared to the expected performance of calves sired by another bull. They are based on the performance records of an individual, its relatives and its progeny. Many breed associations publish EPDs on individual animals in sire summaries and searchable internet databases.

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Breed associations also publish tables that show where individual animals rank within the breed for specific traits, such as weaning weight or ribeye area.

Expected progeny differences can change over time as additional performance information is collected. Expected progeny differences come with accuracy values that give an indication of the reliability of the EPD. Accuracies range from 0 to 1, with values closer to 1 signifying higher accuracies. As more usable performance information becomes available for an animal, its relatives and progeny, the more accurate or reliable its EPDs become. Thus, a young, unproven bull with no calves will have lower accuracy EPDs than a proven sire with hundreds of calf records. Expected change tables are published by breed associations as part of national cattle evaluations to show how much variation can be expected for EPDs at specific accuracy levels.

Expected progeny differences are the best predictors of the genetic performance of an individual animal, and they are available for a growing number of economically relevant traits. Different breeds will have EPDs available for different traits; however, most breeds have basic EPDs, such as birth weight, weaning weight, yearling weight and milk. Expected progeny differences can be used to make herd genetic improvement in both commercial and seedstock operations. Genetic improvement can mean increased weaning weights and growth performance, enhanced reproductive performance and better performance on the rail – all of which can enhance the profitability and viability of a cattle operation.

Selection Indices

Selection indices are based on multiple traits weighted for economic importance, heritability (the proportion of the differences among cattle that is transmitted to their offspring) and genetic associations among traits. In other words, a selection index is a selection tool that integrates biology and economics. A selection index may provide a balanced selection approach when selecting for more than one trait at a time.

Selection Criteria

Beef cattle selection should be based on many factors – growth and reproductive performance, fertility, health, disposition, age, frame size, muscling, etc. Single-trait selection should be avoided when selecting a herd sire. Overemphasis on one or a few traits may reduce performance for other traits. There are several genetic antagonisms that may result in performance tradeoffs. For example, selection for high growth (high weaning and yearling weights) may simultaneously increase birth weights and calving difficulty. The reverse is also the case: growth sacrifices may be made when selecting for low birth weights. Of course, there are bulls within every breed that have the genetic potential to transmit both high growth and low birth weights to their calves. Other common performance tradeoffs include red meat yield versus red meat quality, fertility/reproduction versus growth rate/lean yield and milk yield versus cow maintenance requirement. A balanced approach to sire selection focusing on multiple economically important traits can go a long way towards herd genetic improvement.

Frame Size

Changing the frame size of the calf crop can be accomplished through sire selection and selective culling of the cow herd. Inappropriate carcass size and weight ranked second among the “top 10 quality challenges” identified in the 2000 National Beef Quality Audit. Frame size describes the overall skeletal size of cattle and is a useful tool for evaluating the lean-to-fat ratio of an animal. It is an indication of growth and is related to slaughter weights at which cattle should attain a given amount of fat thickness. Large frame steers (frame scores 7, 8 and 9) with the genetic potential to grade Choice are expected to do so at 1,250 pounds or higher, while large frame heifers with the genetic potential to grade Choice are expected to do so at 1,150 pounds or better. Medium frame steers and heifers (frame scores 4, 5 and 6) with the genetic potential to grade Choice are expected to do so at 1,100 and 1,000 pounds, respectively. Small frame steers and heifers (frame scores 1, 2 and 3) with the genetic potential to grade Choice are expected to do so at less than 1,100 and 1,000 pounds, respectively.

Frame scores are calculated using hip height measurements. Hip heights can be measured with a hip height stick or pull-down tape measure and converted to frame size scores by calf sex and age using a frame score table. Although actual hip height may increase as an animal matures, most cattle maintain the same frame score throughout their lives. This allows one frame score to be used for an animal, regardless of when that animal’s hip height is evaluated. Larger-framed cattle require more forage and feed resources than smaller-framed cattle, so matching cattle size to production resources is important. Culling extremes for frame size (large and small) can also be useful in improving herd uniformity. Bull frame size can be strategically matched to cow frame size to produce calves within a targeted frame size range. However, caution should be used when breeding a large frame bull to small frame cows or heifers due to the increased risk of calving difficulty. Some breed associations compute yearling height EPDs that can be used in predicting a sire’s ability to transmit yearling height to his calves.

Muscling

Thickness or muscling is important in beef cattle because muscle is what is sold in the retail meat case. The degree of muscling impacts yield grades, average daily gains and dressing percentages. Lightly muscled cattle are significantly discounted at sale time. Muscling can be improved through bull selection. USDA feeder cattle thickness grades used to classify muscling range from 1 to 4, with 1 being the heaviest degree of muscling.

There are several good indicators of muscling in beef cattle (Figure 1). Muscling may be evaluated in the quarter or round, stifle, gaskin, twist, shoulder, forearm and across and along the back. Do not just look in one area to determine muscling. An animal may be thick through the quarter but lack adequate muscling in the forearm. The forearm is an excellent place to look for muscling because there is usually less fat cover in this area. Extremely muscled heifers or cows may have fertility problems, so sire selection for muscling should be optimized instead of maximized. In addition, a coarse, bunchy-muscled bull may sire similar calves causing trouble at calving.

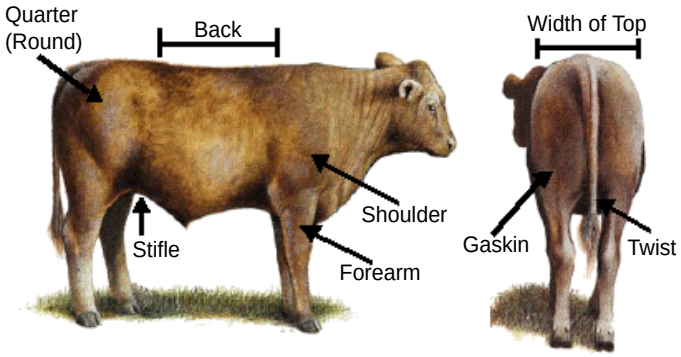


Figure 1. Indicators of Muscling in the Beef Animal

Growth Traits

Growth traits include weaning and post-weaning (yearling) growth performance. Growth performance information available on performance-tested bulls may include average daily gain, weight per day of age, adjusted weaning and yearling weights and weight ratios within contemporary groups. A contemporary group is a group of cattle of the same sex and age-managed under like conditions. An average weight ratio for a contemporary group is always equal to 100. A calf with a weaning weight ratio of 105 has a weaning weight that is 5 percent above the average of the group. A weaning weight ratio of 90, on the other hand, indicates that the calf's weaning weight is 10 percent below the average of the contemporary group. Expected progeny differences for weaning and yearling weights are a fairly standard component of national sire evaluations conducted for specific breeds.

Carcass Traits

Carcass traits are a key consideration in bull selection, particularly when cattle ownership is retained and cattle are sold on value-based pricing grids. Table 1 lists industry targets for beef carcasses outlined during the strategy workshop of the 2000 National Beef Quality Audit. Carcass traits are moderately to highly heritable, so genetic improvements can be made in a shorter period of time than less heritable reproductive traits.

Table 1. Industry Targets for Beef Carcasses

Carcass Trait	Industry Target
Carcass weight	650 to 850 pounds
Quality grade	Prime, Choice or Select
Yield grade	1 to 3

Ultrasound carcass scanning technology allows carcass information to be collected on live animals instead of having to wait until cattle are harvested. Yearling bulls out of potential herd sires may be ultrasound carcass scanned for 12th to 13th rib fat thickness, rump fat thickness, ribeye area and intramuscular fat percentage (marbling). Each of these traits is significant in the determination of red meat yield and quality, and each is at least moderately heritable.

Participants in the Arkansas Steer Feedout Program receive carcass information on calves after completion of a finishing phase. This information can be used to evaluate growth and carcass traits in the herd and compare the carcass merit of calves out of different herd sires. Expected progeny differences are also available for many carcass traits, including hot carcass weight, marbling, ribeye area, rib fat thickness and percent retail product.

Calving Ease

Calving ease is an important consideration in the sire selection process, particularly when first-calf heifers or small-framed cows are to be bred. Labor availability may influence how a "calving ease" or "heifer" bull is valued. Birth weight has often been used as an indicator of calving ease, but there can be a lot of variation in calving ease. Birth weight is just one of many factors that affects calving difficulty in beef cattle. According to the Beef Improvement Federation, other factors affecting calving ease

include age of dam, calf sex, pelvic area, gestation length, cow size, shape of calf, breed of sire, breed of dam, uterine environment, hormonal control, geographic region, season of year, environmental temperature, nutrition of dam, condition of dam, implants/feed additives, feeding time and exercise.

Birth weight and several other factors are components of calving ease EPDs. Selection based on both calving ease and birth weight EPDs is discouraged since it may put too much selection emphasis on birth weight. Emphasizing calving ease in selection rather than birth weight may make it easier to select for calving ease and growth performance at the same time. Birth weight will still be accounted for in calving ease EPDs.

The two types of calving ease EPDs are calving ease direct and calving ease maternal. Calving ease direct EPDs provide information about the expected assistance required at birth for a sire's calves and predict the ease with which a bull's calves will be born to first-calf heifers. Calving ease direct indicates the percent more or less of calves sired by a particular bull that are expected to require assistance at calving out of two-year-old heifers. For example, a bull with a calving ease direct EPD of +10 percent compared with a bull within the same breed with a calving ease direct EPD of +2 percent is expected to sire on average 8 percent (10 – 2) more calves that can be born unassisted. Calving ease maternal or daughter's calving ease EPDs, on the other hand, give an indication of the expected assistance required at calving for calves out of a sire's two-year-old daughters. In this case, the bull on which the EPD is evaluated would be the grandsire of the calf for which the necessary assistance at birth is being predicted. Calving ease maternal is also referred to as daughter's calving ease or maternal calving ease and is the ease with which a sire's daughters calve as first-calf heifers.

Maternal Traits

Milk production is an important maternal trait that directly affects calf weaning weights. Milk EPDs are expressed as pounds of calf weaned due to the milk production of the dam, not as pounds of milk produced. Combined maternal (also referred to as maternal milk and growth, maternal weaning weight or total maternal) EPDs reflect a combination of the milking ability of a bull's daughters along with the growth potential of their calves. As milk production increases, the nutritional requirements of the dam increase. Milk production must fit the forage and feed environment to ensure that nutrient requirements of lactating cattle are met and rebreeding is not hindered by inadequate nutrition.

Calving instincts and disposition are other traits that are important in replacement female sires; however, it may be difficult to select for these traits via bull selection. A few of the other EPDs available for maternal traits include heifer pregnancy, gestation length and stayability. The availability of these EPDs will vary by breed. Reproductive traits typically have a low heritability, so selection for improved reproductive performance may be slower than selection for more heritable traits, such as carcass traits.

Bull Fertility and Scrotal Circumference

Fertility in bulls can be assessed with a breeding soundness examination (BSE). A BSE is a practical method for identifying bulls with less than satisfactory breeding potential. Bulls not passing a BSE need to be culled from the breeding herd to prevent calf crop declines. A breeding soundness evaluation consists of a physical examination, scrotal circumference measurement and semen evaluation and is performed by a veterinarian. Ideally, a bull should have passed a BSE prior to purchase.

A BSE should be performed annually on each bull about 60 days prior to the start of the breeding season. This allows time to recheck or replace bulls receiving suspect scores. Do not use a bull that fails a BSE. Because the breeding potential of a bull can change over time, BSEs should be conducted on a regular basis. Disease, injury and environmental conditions can affect proper function of the testes and impair reproductive performance. An annual BSE is essential, especially when only one bull for the entire operation, one bull per breeding herd or a high female-to-bull ratio is used.

Measurement of yearling scrotal circumference provides an indication of a bull's sperm-producing capacity. Scrotal circumference is also negatively correlated with age at puberty of a bull's daughters and female sibs. In other words, the daughters of a bull with larger scrotal circumference should reach puberty at an earlier age than the daughters of a bull with smaller scrotal circumference. Scrotal circumference is a particularly relevant selection consideration when a bull is used to produce replacement heifers. Many breed associations publish EPDs for scrotal circumference.

Structural Soundness

Structural soundness is important in beef sire selection to ensure that a herd sire is physically capable of effectively breeding herd females. A breeding bull will need sound feet, legs and eyes in order to seek out and find females in heat and service them. Structurally sound bulls will walk freely and easily taking long strides and will display flex and give in the joints. Thus, it is important to watch cattle walk to observe possible defects that may impair ease of movement and cause undue stress on bone joints. View cattle from as many angles as

possible when assessing conformation and structural soundness. It may be useful to get in the pen with the cattle and move them around.

The legs of a structurally correct bull should be placed squarely at the four corners of his body. Bones should be straight and strong with the proper amount of "set" or angle to the shoulder, hock and pasterns for ample cushioning. A steep shoulder (too straight) is a good indicator of potential leg problems. A bull that is buck-kneed in his front legs will have excess stress on the shoulder. A bull that is calf-kneed in his front legs will have excess stress on his knees. An animal that is post-legged in its rear legs (not enough set to the hock) may become "stifled" and have difficulty mounting herd females. This condition is more serious than the sickle-hocked condition where there is too much set to the hind legs. Cattle may also be toed-out or cow-hocked, two additional structural problems. A narrow stance in the rear legs may affect length of stride. Hip structure also affects how easily and freely an animal moves. Cattle should be level from their hooks (hips) to their pins. Too much slope from hooks to pins is undesirable.

Conformation

Conformation is not only important in the show ring, but it also has implications for production and marketing. Shortcomings in conformation can be passed on from a bull to his calves. Severe conformation problems need to be selected against to limit conformation problems in future calf crops.

It is important to select bulls with adequate body capacity or volume. Body capacity is assessed by looking for spring of rib, width of chest floor, length of body and depth of body. Replacement females sired need ample body volume for carrying and delivering a calf along with a large rumen for consuming large quantities of forage for calf and milk production. In addition, bulls with extremely small pelvic areas can produce heifers with unacceptably small birth canals. Sires with wide shoulders can also sire similarly shaped calves that are more likely to undergo a difficult birth.

Sex character is important in beef cattle as well. A bull should look like a bull. Bulls should be masculine, powerful in appearance, display a prominent crest and appear heavier in muscle and bone than their female counterparts. Sex should be distinguishable when looking at the head of an animal, even in a calf.

Some bulls have a predisposition to being wastier than other cattle. Excessively fat bulls often lack libido. Bulls displaying large amounts of loose hide in the dewlap or brisket, excessive depth of flank and loose hide in the twist may be predisposed to being wasty. They may exhibit patchy, uneven finish.

A well-balanced bull is stylish, eye-catching and attractive, which helps in capturing favorable interest from potential buyers. Balance implies correctness of structure and a desirable blending and proportion of body parts. The neck should blend smoothly into the shoulder, and a level topline should be exhibited. Bunchy, coarse muscling should not be present. A heavy-fronted, light-ended bull is "unbalanced."

Sheath

Sheath character is an important trait to assess, particularly in Brahman-influenced bulls. Extremely loose, pendulous sheaths may be more prone to injury than tighter, less pendulous sheaths (Figure 2). Overgrown brush and spiny weeds are just some of the pasture hazards that may cause cuts or abrasions to a bull's sheath and penis. Bulls are at greatest risk for sheath and penis injuries during travel and mating. Sheath character is heritable, and many tight-hided, Brahman-influenced animals are available with minimal sheath and dewlap as a result of genetic selection.

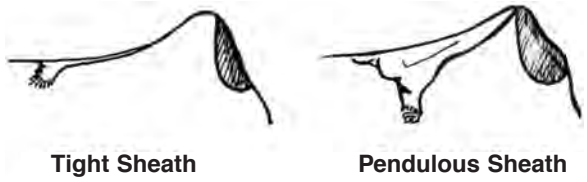


Figure 2. Differences in Sheath Character

Polled Versus Horned

Horned calves are often discounted at sale time. Horns can cause bruising and other injuries to both cattle and cattle producers during handling. Horn-related injuries may occur during shipping as well as in the feedlot and are thus undesirable to cattle feeders. Too frequent and severe bruises ranked among the "top 10 quality challenges" for the United States fed beef supply, according to the 2000 National Beef Quality Audit. Dehorned or polled cattle also move more easily through handling facilities and take up less bunk space in the feedlot. Horns can be removed from cattle through physical means (dehorning) or through genetic selection (selection of homozygous polled breeding animals).

In British or Continental breeds of cattle, homozygous polled (PP) bulls sire only polled calves (Table 2). Homozygous means that the two alleles (parts of the gene pair) are the same. Heterozygous, on the other hand, means that the two alleles in the gene pair are not alike. Just because a bull is physically polled does not mean that it is homozygous polled. Some polled bulls are heterozygous for the

horn gene (Pp) and can transmit the genetics for horn expression to their calves. It is useful to know if a polled bull is homozygous or heterozygous polled. This information may be available in breed association records. Horned bulls are homozygous horned (pp) and can only transmit the genetics for horn expression to their calves. Using a horned bull will perpetuate horn expression in the herd.

The genetics of horn expression is more complicated in cattle with Zebu ancestry, such as Brahman, Santa Gertrudis and Beefmaster. A second gene, the African horn gene, contributes to horn expression in these breeds. A proven homozygous polled bull can produce some horned calves if he is bred to horned or polled cows that carry the African horn gene.

Scurs are incompletely developed horns that are not attached to the skull. The gene for scurs is transmitted separately from the horn gene, so it has no effect on the presence or absence of horns. Not all horned cattle carry the genetics for scur expression, and not all polled cattle lack the genetics for scur expression.

Coat Color

Feeder calf prices can be affected by coat color. This is due to perceptions that coat color is an indication of performance potential or carcass merit. Despite market perceptions, cattle with the same coat color may perform very differently post-weaning and on the rail. In fact, coat color alone is not necessarily even indicative of cattle breed. For example, several breeds contain black-coated cattle including Angus, Brangus, Gelbvieh, Limousin, Maine-Anjou and Simmental. Coat color also affects perceptions of uniformity in beef cattle, and uniform groups of cattle often command market premiums. Certain value-based marketing alliances, such as Certified Angus Beef, have coat color restrictions as well.

Understanding coat color inheritance can help in designing breeding programs with specific goals for coat color. The three basic coat colors in cattle are black, red and white. Each animal possesses two genes for basic coat color, one passed down from the sire and one passed down from the dam. The gene for black is dominant over the gene for red, so cattle with one gene for black and one gene for red are black. The genes for black and white express no dominance over one another. Therefore, cattle with one gene for black and one gene for white are a black-roan color. The genes for red and white also express no dominance over one another, so cattle with one gene for red and one gene for white are a red-roan color. The gene for white is recessive. Cattle with two white genes are a true white color. There are also genes that determine whether or not the base color will be diluted. Black dilutes to gray, red dilutes to yellow and diluted white remains white. The dilution gene is dominant to the non-dilution gene. Cattle with at least one diluter gene will exhibit a diluted color, while cattle with two non-dilution genes will not have a diluted color. Additional genes determine color patterns such as spotting, brindling and white face.

Breed

There is often a focus on the differences among cattle of different breeds. There are also dramatic differences among cattle within a breed for particular traits. Within each breed, there are both superior and inferior cattle. This emphasizes the importance of assessing each potential replacement on an individual basis in addition to evaluating the use of a particular

Table 2. Inheritance of Polledness or Horns

Sire	Dam	Calves	
Genotype	**Genotype**	**Genotype**	**Polled/Horned**
Homozygous polled (PP)	Homozygous polled (PP)	100% Homozygous polled (PP)	Polled
Homozygous polled (PP)	Heterozygous polled (Pp)	50% Homozygous polled (PP)	Polled
		50% Heterozygous polled (Pp)	Polled
Homozygous polled (PP)	Homozygous horned (pp)	100% Heterozygous polled (Pp)	Polled
Heterozygous polled (Pp)	Homozygous horned (pp)	50% Heterozygous polled (Pp)	Polled
		50% Homozygous horned (pp)	Horned
Heterozygous polled (Pp)	Heterozygous polled (Pp)	25% Homozygous polled (PP)	Polled
		50% Heterozygous polled (Pp)	Polled
		25% Homozygous horned (pp)	Horned
Homozygous horned (pp)	Homozygous horned (pp)	100% Homozygous horned (pp)	Horned

breed in a breeding program. Careful consideration should be taken in choosing both breeds and cattle within breeds.

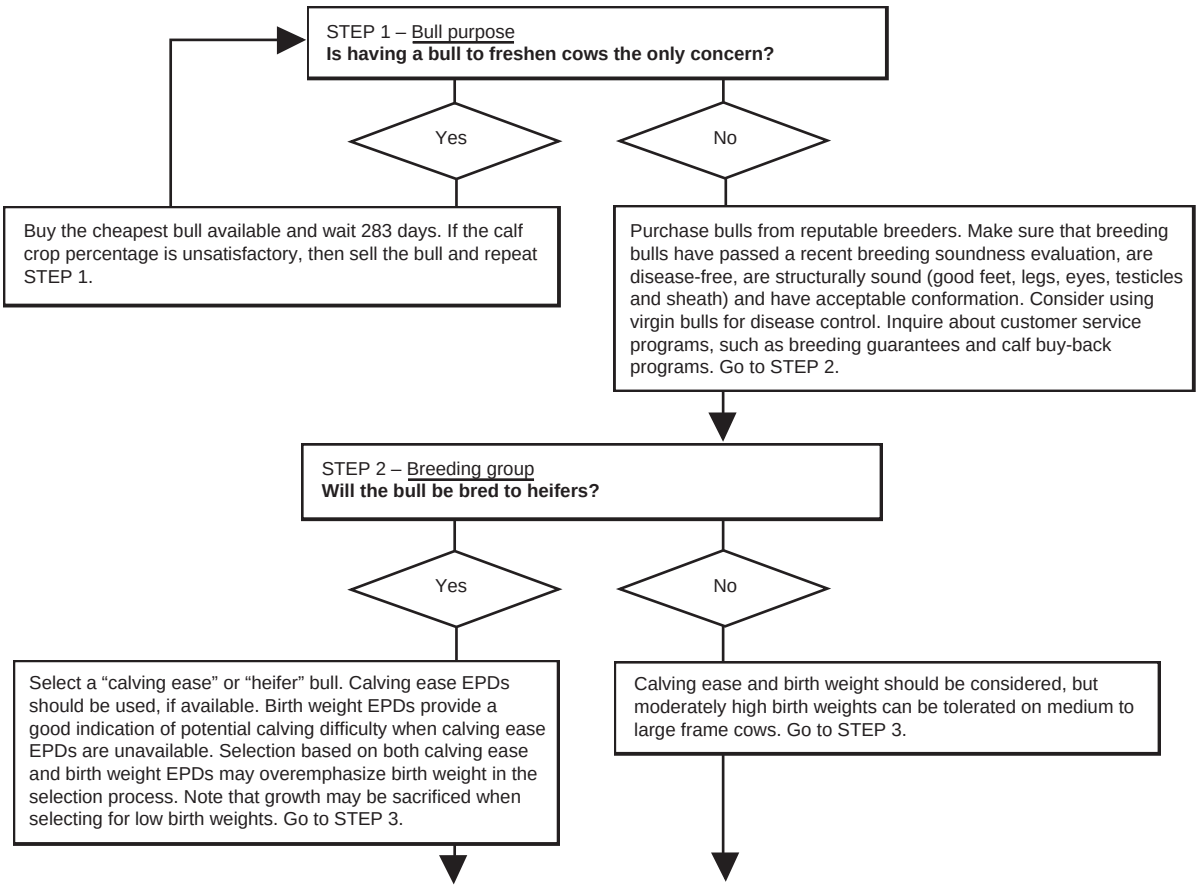
Visual estimates of breed composition may not always be accurate, but perception of breed composition often affects sale price. No breed or breed combination is necessarily always best for all production and marketing environments. A variety of breed combinations can be appropriate. It is important to be familiar with potential discounts for particular breed combinations.

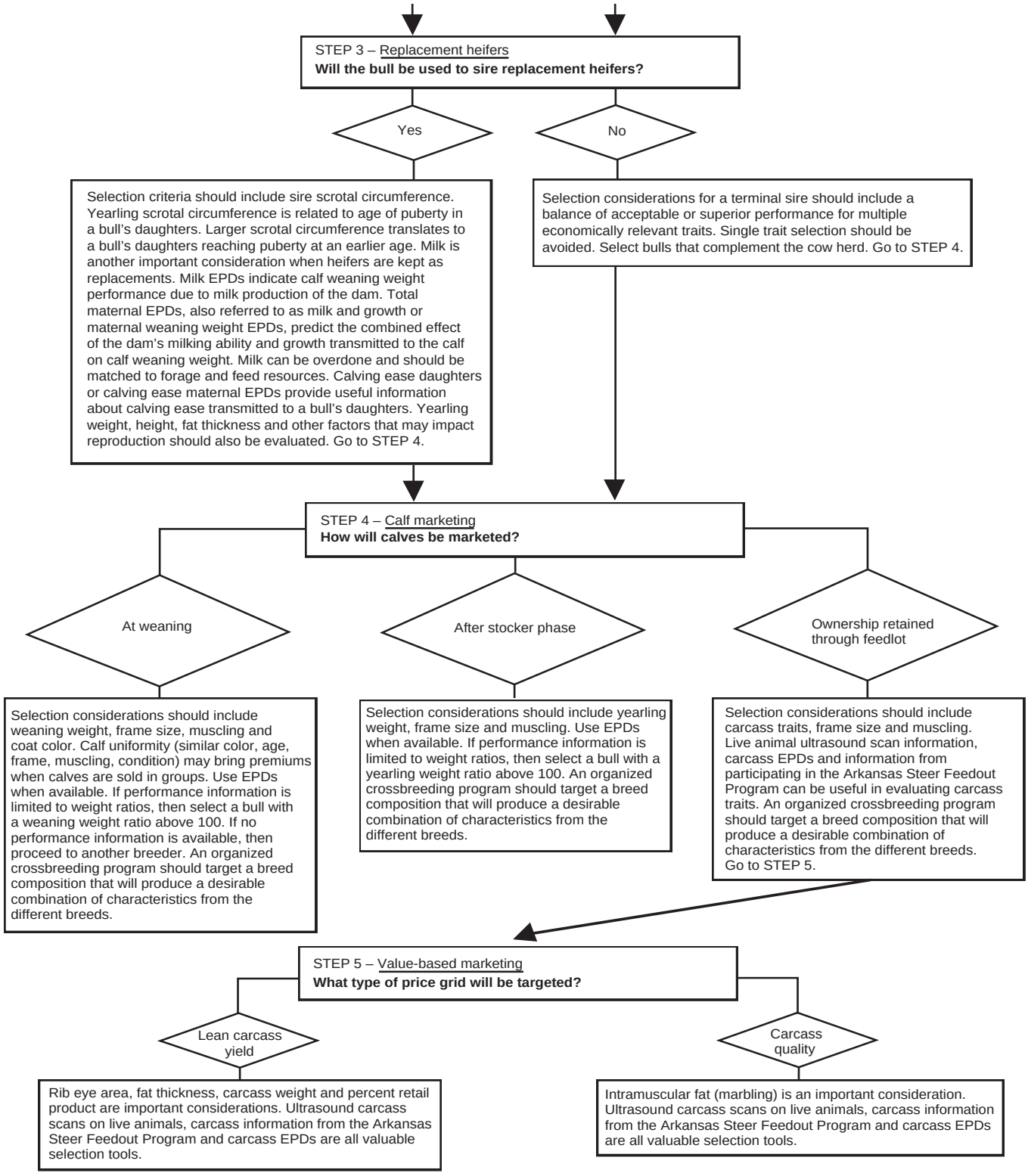
An organized crossbreeding program can capitalize on hybrid vigor while producing calves with a desirable combination of characteristics from multiple breeds. Hybrid vigor or heterosis is the amount by which the average performance for a trait in crossbred calves exceeds the average performance of the two or more purebreds that were mated in that particular cross. In addition, different breeds tend to excel for different traits. A well-designed crossbreeding program can combine the performance strengths among several breeds. Considerations for designing a crossbreeding program may include the current breed composition of the herd, whether or not replacement heifers will be kept, market targets, environmental conditions and forage and feed resources.

Summary

How much information is needed in selecting a herd sire? The more information used in bull selection, the fewer surprises. It is important to use both performance information and visual appraisal in choosing a breeding bull. Selecting solely on performance numbers may ignore structurally unsound or infertile bulls that will do little for calf crop percentage and herd improvement. On the other hand, selection only based on visual appraisal may ignore the genetic potential of a bull. Visual appraisal of cattle complements the use of performance records for selecting/culling beef cattle. Information that may be useful in selecting a beef bull includes expected progeny differences, performance test information, pedigree information, recent breeding soundness evaluation results, herd health program history and bull prices (Figure 3). For more information on beef sire selection or related topics, contact your local county Extension office.

Figure 3. Bull Selection Decision Flow Chart





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