

Texas Adapted Genetic Strategies for Beef Cattle III: Body Size and Milking Level



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Body size or mass and milking level are primary genetic traits in beef production. In addition to their direct effects size and milk relate to many other production functions.

Weight is the best measure of body size. However, weight is not constant as an animal's body composition can vary, being especially influenced by fatness or "condition," which must be considered if weight is to accurately characterize size. Differences in fatness can be estimated using Body Condition Scores. For a discussion of this topic, see the Texas AgriLife Extension Service publication, B-1526, *Body Condition, Nutrition and Reproduction of Beef Cows*.

Another measure of size uses a system of Frame Scores based on height at the hip. This is discussed in Extension publication E-192, *Texas Adapted Genetic Strategies for Beef Cattle X: Frame Score and Weight*. However, animals of the same height can differ in body length, width, depth or composition, while animals of different leg length can

have similar bodies. Consequently, Frame Score alone is not a good measure of body size.

The measure of body size used here is weight at the same degree of fatness. For cows, it is weight at medium fatness, Body Condition Score of 5 on a scale of 1 (extremely thin) to 9 (extremely fat). (From Body Condition Score 5, cows vary about 8 percent in weight for each change in score.) For finished steers and heifers, it is weight at $\frac{1}{2}$ inch external fat.

Genetic potential for milking ability varies widely and, for accurate description, should be evaluated in

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relation to body size. Estimates for milk and other production functions are contained in the Extension publication E-190, *Texas Adapted Genetic Strategies for Beef Cattle V: Types and Breeds—Characteristics and Uses*.

Growing Animals: Body Size, Weight Gain, Efficiency and Economics

In general, genetically larger cattle can gain faster and convert feed to weight more efficiently **if** fed for the same length of time or to the same weight as smaller cattle. However, if cattle of unlike size are fed to similar degrees of fatness, differences diminish in rate of gain and often disappear entirely in feed efficiency. Differences in genetic size primarily affect weights at the same level of body fatness.

Nutrition affects the relationship of weight and fatness. Cattle weigh more, and may not be as fat, when grown in stocker programs after weaning. But cattle weigh less, and may be fatter, when intensively fed starting immediately after weaning. In one research study, steer calves weaned and grazed on wheat pasture for 112 days and then fed for 121 days finished at 1,287 pounds with 0.53 inch of fat cover. Their mates that were placed on feed for 191 days immediately after weaning finished at 1,233 pounds and had 0.64 inch of fat cover. Thus, to conform to industry preferences for weight and fat when finished, genetically small cattle should be grown before finishing, large cattle should go directly from weaning to the feedyard, and medium-size cattle can be managed either way.

Although efficiency differs little among cattle of various body sizes if fed to the same body composition, there may be a difference in efficiency among individual animals. Some animals, of all sizes, are inherently capable of gaining the same weight on less feed or gaining more weight on the same feed. Also, while small cattle can be efficient when fed to optimum levels of body composition, medium to large cattle usually are more profitable because of factors such as fixed, per-head production costs and minimum acceptable carcass weight.

In beef cow/calf production, heavier calves usually return more money per head, but at a diminishing rate of return. For example, a

500-pound calf typically sells for more per pound than one weighing 600 pounds. So the extra 100 pounds is worth less per pound than the first 500 pounds. Put another way, the price per pound of the first 500 pounds is reduced to the price per pound of the 600-pound calf. This influences the effect of weight on economics at the cow-calf level and, to a lesser extent, for stocker enterprises. However, within rather wide weight ranges, finished cattle marketed either live or as carcasses of the same composition generally bring about the same per pound.

Breeding Animals: Genetic Body Size

Most of the total nutrients required to produce a pound of beef goes to the cow herd and much of that is required merely for body maintenance. As a result, the cow herd phase is critical in determining overall system efficiency.

Although larger animals need more nutrients just to maintain body weight, body size and nutrient needs are not absolutely related. A 1,400-pound cow is 27 percent heavier than a 1,100-pound cow. However, their maintenance requirement for dietary energy differs by only 20 percent if the two cows have the same body condition and milk the same in relation to their body weight.

Weights are related at all stages of an animal's life. Animals heavier at weaning or as yearlings also tend to be heavier at birth and maturity. High weaning and yearling weight has value if produced efficiently and economically. But heavier birth weight may increase calving difficulty, especially in first-calf heifers. Also, greater mature weight increases the nutrients needed for maintenance. These weight relationships can be altered by the genetic selection of individuals with relatively light birth weight, rapid growth, and moderate mature size. However, sires that will accomplish such changes are unusual and may be difficult to obtain, especially in the large numbers needed for natural service as opposed to semen from some elite sires for artificial insemination.

In general, there is little difference in efficiency among cows of varying size **if** nutrient requirements are met. If the forage supply is adequate, larger cows can consume enough to meet their nutrient needs. But larger cows may

be penalized if forage is sparse, especially on arid rangeland.

The upper limit for efficient cow size depends on nutrient availability relative to animal requirements and on the maximum acceptable finished weight of progeny. On the other extreme, the smallest efficient cow size is influenced primarily by per-cow financial costs and the minimum acceptable weight of finished cattle. Using sires genetically larger than cows can yield more saleable calf weight per cow. However, this must be balanced against any increase in calving difficulty caused by heavier birth weights. Also, when sires are genetically larger than dams, the body size of the cow herd will increase over generations if heifers go back into the herd as replacements. However, this “cow-size creep” is not a factor in terminal breeding systems where heifers are not retained and replacements of desired body size can be obtained.

Breeding Animals: Genetic Milking Potential

In beef cattle production, the benefits of milk are realized indirectly through the saleable weight of suckling calves. This is biologically inefficient because there is significant loss in converting nutrients to milk and then milk to calf weight. However, suckling is usually economically beneficial, at least when cows use range or marginal pasture land or are fed roughage or low-value byproducts.

Females of higher milking potential require more nutrients for body maintenance even when not lactating. The nutrients required above maintenance increase in proportion to the milk produced. According to the National Research Council’s “Nutrient Requirements for Beef Cattle,” low-milking 1,100-pound and 1,400-pound cows in mid-lactation need about 24 and 29 pounds, respectively, of a diet containing 53 percent TDN and 8 percent crude protein. High-milking cows of the same weights need about 29 and 34 pounds, but of a diet of 60 percent TDN and 11 percent protein.

Therefore, a higher milking cow requires a higher quality diet, not just a larger quantity. On low-quality diets, there is no benefit, and often

penalties, from high-milking genetics. But with a high-quality diet, low-milking cows may not fully exploit the forage potential. However, beef cows generally are maintained on low- to medium-quality diets.

If nutrient requirements are not met, cows will lose condition, and thin cows are less likely to cycle and conceive. It may be more difficult, or more costly, for higher milking cows to maintain condition. High milk production may also produce fat calves at weaning, especially in calves that have low genetic potential for growth. Fat calves are less efficient when grazed or fed. Consequently, they are almost always discounted in price per pound, except possibly when grain is expensive and short finishing periods are more economical. However, extra fat on a calf increases sale weight, so the degree of price discount must be measured against the amount of extra weight in determining total calf value.

Biological and Economic Efficiency

In all agricultural commodities, there are optimum production levels that maximize biological efficiency (product output/production input) and economic efficiency ($\$return/\$spent$). Although the optimum can be at or near a maximum level of production, often there are significant differences between optimum and maximum in forage-based livestock enterprises.

Inputs can be easily adjusted to meet the requirements of high-producing animals in the beef feedyard, dairy, swine and poultry industries. The costs of such adjustments, and their effect on the value of any associated increase in production, determine whether they are profitable. But in forage-based systems, animals must be matched to production conditions, particularly nutritional conditions, or both efficiency and economic return will suffer. In general, as forage **quantity** decreases and is more variable, smaller body size generally fits best. As forage **quality** decreases, lower milking potential is a better match.

Restricted nutrition, which can critically affect body condition and reproduction, favors cows that are relatively smaller, lower milking and easier fleshing. But if nutrition is abundant and body condition and reproduction are more easily sustained, weight production becomes increasingly

important and both larger size and higher milk production may apply. Efficiency and economic return decline if nutrition is below or above requirements.

Optimum body size and milking potential are affected by relative nutrient costs in different production phases. If feed is expensive, costly supplements penalize higher milking cows capable of producing heavier calves; but when feed is expensive, postweaning economics favors heavier calves that can be fed for shorter periods to finishing. Conversely, cheap feed may benefit production in the cow-calf phase of heavier calves from higher milking cows, but favor lighter weight, longer fed calves in the feedyard. This is just one of the inherent antagonisms between production phases.

The number of production phases in an operation also affects optimum body size and milking potential. For strictly cow-calf producers, more size and milk may be optimum to increase weaning weight, if reproduction is efficiently maintained. But vertically integrated, retained ownership benefits from total system considerations, not from maximum production or efficiency in any specific phase.

Conclusions

Wide ranges of body size can be efficient, depending on production environments, breeding systems, and carcass specifications. Considering all production phases from conception to consumer, there is a logical place, on one extreme, for genetic types characterized by cows weighing about 1,000 pounds (the smallest practical size for cows in a terminal cross). On the other extreme would

be types of cattle where sires are equivalent to a mature cow of about 1,500 pounds—that is, mature bull weight of about 2,300 pounds (the upper end for terminal sires on genetically small cows to avoid producing price-discounted, excessive finished weight).

For the most part, particularly where heifers are retained in a continuous breeding system, most mature cows should probably weigh 1,100 to 1,300 pounds (which is equivalent in mature bulls to about 1,700 to 2,000 pounds). This range includes Frame Scores 4 and 5 or Medium to the lower end of Large in the USDA Frame Size System. Cattle of this size should produce carcasses of about 700 to 850 pounds, which is well within the range of desirable weight. While packing plants may prefer larger carcasses, to reduce cost per pound of product output, their perspective does not reflect overall system considerations.

Milking ability from low to high can be applicable. But considering the forage resources where most beef cows are maintained, a moderate level of milk is generally most desirable.

Inherent size and milking ability must be matched to production and market conditions. Biological compatibility and economic success require that these factors be in harmony.

For further reading

To obtain other publications in this Texas Adapted Genetic Strategies for Beef Cattle series, contact your county Extension office or see the Texas AgriLife Extension Bookstore (<http://agrilifebookstore.org>) or the Texas A&M Animal Science Extension Web site (<http://beef.tamu.edu>).

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Revision