Texas Cooperative EXTENSION
The Texas A&M University System

E-188
7-03

Texas Adapted Genetic Strategies for Beef Cattle

III: Body Size and Milking Level

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

Weight is a common measure of body size. However, weight is not constant, being especially influenced by fatness or "condition," which must be considered if weight is to accurately represent size.

Differences in fatness can be estimated using Body Condition Scores. Skeletal dimensions also depict body size using a system of Frame Scores. For discussions of these topics, see Texas Cooperative Extension publications, B-1526, "Body Condition, Nutrition and Reproduction of Beef Cows,"and E-192, "Texas Adapted Genetic Strategies for Beef Cattle—X: Frame Score and Weight."

The primary measure of size used here is weight at the same degree of fatness. For cows, weight is at medium fatness, Body Condition Score of 5 on a scale of 1(very thin) to 9 (very fat). For slaughter steers and heifers, weight is at 1/2-inch external fat.

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

Genetically larger animals gain faster and convert feed to weight more efficiently **if** fed for the same length of time or to the same weight as smaller individuals. However, if cattle of unlike size are fed to similar degrees of fatness, differences diminish in rate of gain and disappear entirely in feed efficiency. Difference in genetic size primarily affects weight at a particular level of body fatness.

In beef production, more pounds equals more money, but often at a diminishing rate of return. If a 500-pound calf brings $1.00/pound, a 600-pound calf might typically bring only around $0.92/pound or about $50 more, so the extra 100 pounds is worth only about half the price per pound of the first 500 pounds. Put another way, the price per pound of the first 500 pounds is reduced to that of the 600-pound calf. This influences the effects of body size on economics.

Packers currently prefer carcasses from around 650 to 900 pounds, or live weights of around 1,000 to 1,400 pounds. About one-third of fed cattle are heifers, which make up most of the lightest end of these ranges, while steers make up most of the heaviest end. These weights correspond to the low end of frame score 4 heifers to the low end of frame score 7 steers.

There is currently no price discount for carcasses from 550 to 950 pounds (about 850 to 1,500 pounds live, frame score 3 heifers through frame score 8 steers). These specifications assume 1/2-inch fat. If fat is reduced, cattle must be genetically larger, or growth must be extended, to maintain these ranges of weight.

Nutrition affects relationships of weight and fatness. Cattle weigh more, at the same fatness, when grown slowly in stocker or background programs before finishing. But cattle weigh less, at the same fatness, when intensively fed after weaning for maximum rate of gain. To conform to industry specifications for weight and fat, 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 fed to the same body composition, medium to large cattle often are more profitable to growers, feeders, and packers. However, of the total nutrients required to produce a pound of beef, the majority goes to the cowherd, and much of that is required merely for cow body maintenance. As a result, the cowherd phase is most critical in determining overall efficiency.

Breeding Animals: Genetic Body Size

Although larger animals need more nutrients just to maintain body weight, body size and nutrient needs are not absolutely related. A 1,250-pound cow is 25 percent heavier than a 1,000-pound cow. However, their maintenance requirement for dietary energy differs by only 18 percent if the two cows are the same in body condition and milk the same in relation to their body weight.

Weights are related at all stages of growth. Animals larger at weaning or yearling also tend to be larger at birth and maturity. Extra weaning and yearling weight has value if produced efficiently. But heavier birth weight may increase calving difficulty, and greater mature weight increases nutrient needs for maintenance. These weight relationships might be altered by genetic selection of individuals with light birth weight, rapid growth, and smaller mature size. However, such individuals are unusual and difficult to accurately identify.

In general, just as with growing animals, cows of varying size are equally efficient **if** nutrient requirements are met. If forage is adequate, larger cows can consume enough to meet nutrient needs. But larger cows may be penalized if forage is sparse, especially on arid range, dormant winter grazing, and during drouth.

The upper limit for applicable cow size depends on nutrient availability relative to requirements and on maximum acceptable slaughter weight. On the other extreme, the smallest applicable size is influenced primarily by per-head financial costs and minimum acceptable slaughter weight. Cow size and birth weight must be compatible, so any parental difference should be no more than about three frame scores, or sires no more than about twice as heavy as dams in mature weight. If these values are exceeded, chances of calving diffi-

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culty are greatly increased. Also, if sires are genetically larger than dams, cows will be larger in later generations if heifers go back in the herd as replacements. However, this is unimportant in terminal breeding systems where heifers are not retained.

Breeding Animals: Genetic Milking Potential

In beef cattle production the benefits of milk are realized indirectly through 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 usually pays, at least when cows utilize roughage, by-products, and range or pasture on marginal land.

Females of higher milk potential require more nutrients for body maintenance even when not lactating. Above maintenance, nutrient requirements increase in direct proportion to milk produced. Unfortunately, unlike the case with larger body size, higher milkers cannot consume enough extra forage to meet these demands. Low-milking 1,000- and 1,200-pound cows in mid-lactation need about 23 and 26 pounds, respectively, of a diet containing 53 percent TDN and 8 percent crude protein. High milkers of the same weights need about 27 and 30 pounds, but of a diet of 60 percent TDN and 11 percent protein.

Consequently, a higher milking cow requires a higher quality diet, not just a larger quantity. On lower quality diets, there is no benefit from high milking genetics. But with a higher quality diet, efficiency of nutrient utilization declines with low milking ability.

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 milkers to maintain condition. Also, higher milk can produce fat calves at weaning that are less efficient when subsequently grazed or fed. Consequently, fat calves often are discounted in price, except possibly when grain is expensive and short feeding periods are more economical.

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 and, usually, profitably adjusted to meet requirements of high producing animals in the livestock feedyard, dairy, swine, and poultry industries. But in forage-based systems, animals must be matched to production conditions, particularly nutritional, or efficiency suffers. Animal performance must fit forage properties. In general, as forage **quantity** increases and is less variable, larger body size may be applicable. As forage **quality** increases, higher milking may be beneficial.

Under restricted nutrition, reproduction critically affects efficiency, favoring relatively small size, low milking, easy fleshing cows. But if nutrition is abundant, where body condition and reproduction are more easily sustained, weight production is more important and higher levels of both size and milk apply. Efficiency declines if nutrition is below **or** above requirements.

Optimum size and milk are affected by relative nutrient costs in different production phases. If feed is expensive, postweaning economics favors heavier, shorter-fed calves, but costly supplemental feed penalizes higher milkers, producing heavier calves in the cow-calf phase. Cheap feed favors lighter weight, longer-fed calves in the feedyard but may benefit heavier calves from higher milkers in the cow-calf phase. This is just one of the inherent antagonisms between production phases.

The number of production phases included in an operation also has an effect. 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 efficiency in any specific phase of production.

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 for cattle varying from about frame score 3 (the smallest practical size for cows in a terminal cross) through frame score 8 (the largest terminal sires on smaller females). However, for the most part, particularly in general purpose production where heifers are retained in a continuous breeding system, most cattle should probably range from frame score 4 to 6. This range includes Medium to Large in the USDA Frame Size System. Cattle of this size should weigh approximately as follows: carcasses from about 650 to 900 pounds; mature cows from 1,100 to 1,350 pounds; and mature bulls from 1,750 to 2,100 pounds.

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

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

For further reading

To obtain other publications in this Texas Adapted Genetics Strategies for Beef Cattle series, contact your county Extension office or see the Extension Web site *http://tcebookstore.org* and the Texas A&M Animal Science Extension Web site *http://animalscience.tamu.edu*.

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