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Texas Adapted Genetic Strategies

Body Size and Milking Level for Beef Production

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Body size and milking potential 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 the Texas Agricultural Extension Service publications, "Body Condition, Nutrition, and Reproduction of Beef Cows" and "Frame Score and Weight of Cattle."

The primary measure of size used here is weight at the same degree of fatness. For cows, weight is at medium fatness, a Body Condition Score of 5 on a scale of 1 to 9. 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 relative to body size. Estimates for milk and other production functions are contained in the TAEX publication, "Characterization and Utilization of Cattle Types and Breeds."

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. But, 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 400 pound calf brings 90¢/lb, a 600 pound calf might bring only 75¢/lb or $90 more, so the extra 200 pounds is worth only 45¢/lb, half the value of the first 400 pounds. This influences the effects of body size on economics.

Packers prefer carcasses from 600 to 850 pounds, or live weights of around 950 to 1,350 pounds. About one-third of fed cattle is 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 frame score 4 heifers through frame score 6 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 to 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 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, 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. So the cowherd phase is most critical in determining overall efficiency.

Breeding Animals: Genetic Body Size

Larger animals need more nutrients just to maintain body weight, but body size and nutrient needs are not absolutely related. A 1,250 pound cow is 25 percent heavier than a 1,000 pound cow. But 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 reduced 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

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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 slaughter weight. On the other extreme, the smallest size is influenced primarily by per-head financial costs and minimum 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 at most about twice as heavy as dams in mature weight. If these values are exceeded, chances of calving difficulty 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, but 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 inefficient because of significant losses 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 dry. 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 26 and 29 pounds of a diet of 60 percent TDN and 11 percent protein.

A higher milking cow requires a higher quality diet, not just a larger quantity. On low quality diets there is no benefit from high milking genetics. But with a high 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 which are not efficient when 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 which maximize biological efficiency (product output/product input) and economic efficiency ($ return/$ spent). The optimum can be at or near a maximum level of production. But often there are significant differences between optimum and maximum in forage-based livestock enterprises.

Inputs can be easily and 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 is applicable. As forage **quality** increases, higher milking is 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 nutrient costs in different production phases. If feed is expensive, postweaning economics favors heavier, short-fed calves, but costly supplemental feed penalizes higher milkers producing heavier calves in the cow-calf phase. Cheap feed favors light weight, long-fed calves in the feedyard but may benefit heavier calves from higher milkers in the cow-calf phase. This is just one of the antagonisms between production phases.

The number of production phases 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 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 upper Medium through lower Large in the USDA Frame Size System. Cattle of this size should weigh approximately as follows: carcasses from 600 to 850 pounds; mature cows from 1,100 to 1,350 pounds; 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.

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