Size, Efficiency, and Complementarity

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The following is from an invited presentation at the 2012 Beef Improvement Federation Annual Meeting. It is based on the findings and ideas of many notable investigators and thinkers, and the reflections and opinions of the author.

Size. Size can be assessed by visual estimates, measurements, or weight. Measurement of volume or capacity appraises body size more accurately than a measure of skeletal size such as height. But weight (or some function of weight) is most useful since that is what is relevant in nutritional requirements and also in marketing beef. Size has varied over the years, depending largely on what cattle are asked to do.

Cattle became smallest in the 1950s in response to demand beginning in the 1930s for smaller, early maturing, quickly fattening types. Beginning in the 1960s, interest developed in changing direction. Selection began for larger breeding stock in our traditional breeds and several large Continental breeds were introduced in the late 1960s-70s. Today, not only have all breeds become larger in the last 40 years, and are still increasing in size, but also differences among breeds have largely disappeared.

Efficiency. The most common measure of biological efficiency of growing animals has been feed:gain (feed conversion). Time-constant periods have been and continue to be the norm for evaluation of potential breeding stock. Over the same period of time, larger animals tend to gain faster and convert feed more efficiently. But when cattle of varying size are fed to the same level of fatness, smaller animals often convert feed more efficiently. A relatively new measure, residual feed intake, appears to reduce misleading conclusions that can occur when comparing different types of animals for the same length of time. In short, research has not shown any simple biological relationship in growing animals between size and efficiency. The same is true of the cow.

Biological efficiency of the cow has most often been measured as pounds of calf weaned per cow exposed to breeding, a trait of an individual cow. This value can mislead. Larger cows can potentially wean heavier calves. But fewer large cows can be maintained on the fixed forage resource of a cow herd. Consequently, cow-calf producers should think of efficiency in terms not of the individual but of the total herd.

Just as with growing animals, size and efficiency interact. Larger (and higher-milking) cows tend to be more biologically efficient when forage supply, quality, and consistency are high and environmental stress is low. Smaller (and lower-milking) cows are favored where those conditions are reversed. Optimum size also is affected by acceptable range of carcass weight. For both the cow-calf and growing-finishing segments, economic efficiency often differs from biological efficiency.

Complementarity. Breeds can be combined to create new genetic packages more useful for some applications. Some combinations may eventually be considered to be new breeds. Merely combining results in progeny with both the strengths and weaknesses of the base breeds. However, breed strengths can be exploited and weaknesses minimized through *complementarity*, which derives not just from combining but from how combinations are made.

An example of complementarity is the use of large sires on small dams. In this way, more calf weight can be produced from the cow weight maintained, so efficiency is improved. This benefit declines if heifers are retained since they are larger than their dams. So, maximum complementarity requires a terminal breeding system. Some terminal systems can be complex and difficult to carry out. For these reasons and since breeds are now more similar, there will probably not be much complementarity obtained due to size. In subtropical climates of the U. S., complementarity will continue to be realized from crossing British and Continental sires (to improve market advantage) on well-adapted Brahman-base cows.

Final Thoughts. It has been estimated that the cow-calf segment requires about two-thirds of the total nutrients consumed from conception to product. Economics dictates these nutrients must come primarily from relatively low-cost forages. The U. S. beef industry will not be sustainable if this is ignored. Market preferences are important, but size of cattle will ultimately rest on what is feasible in the nation's cow herds.

Among other resources, the author relied extensively for this presentation on the following symposia:

- "Crossbreeding for Beef" – 1969 ASAS Annual Meeting, in May, 1970 JAS
- "Beef Cattle Type for Maximum Efficiency" 1971 ASAS Annual Meeting, in May, 1972 JAS
- "Size as a Component of Efficiency" – 1977 ASAS Annual Meeting, in April, 1979 JAS
- "Beef Cow Efficiency Forum" – Proceedings, May, 1984 Michigan St. Univ. and Colorado St. Univ.
- "The Optimum Beef Cow" - 1995 BIF Annual Meeting
- "Measuring Beef Cattle Efficiency" - 2002 BIF Annual Meeting