Beef Cattle Selection and Evolution

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There is an area of cow-calf production that is very important to the economic health of this industry, and also difficult to measure and document. The area I am referring to is the phenotypic expression of characteristics that affect production efficiency, the evolutionary forces that act on these phenotypes, and the significance of selection of genetic material.

We have many people in cow-calf production today who are advocating the selection of a few characteristics which they feel are highly heritable. They believe that to select for many things at once will slow down the improvement of the characteristics desired, as well as being of no real enonomic benefit. (1) The most economically important characteristic in a beef cow is her ability to breed and wean a relatively large amount of pounds consistently and with low imputs of energy from the herdsman. This is a problem of the animal's fitness to its environment in all areas that affect its productive level and cost of production. The evolutionary process that has been going on for hundreds of thousands of years is now being affected and directed by herdsmen's ideas of their ideal.

The ideal of an animal's fitness to produce in its environment appears to have fallen out of favor for some reason, and has been replaced by the emphasis for the selection of a few characteristics that have been identified as highly heritable and economically important. The reason that we do not see a remarkable improvement in the cost of production in our cattle herds is because of factors that operate in animal species that are of evolutionary origin and are protective of change.

The idea of evolution is much older than Darwin and goes back to the time of Aristotle. Darwin's contribution was the concept of natural selection. (2) Natural selection defined a system of success and failure of individuals for the benefit of the group. It is a statistical way of looking at groups which in the wild state are hoping to accomplish survival. To survive means at least a competitive equilibrium with other species. As far as we know, this process has been going on since life began on this planet and the species we see today are a measure of the success of this system. Mechanisms have evolved to benefit species with as many options as possible to take advantage of opportunities for survival and these are part of that historic legacy. People will view the cost of these mechanisms as a loss when it results in an animals's death. They, however, do not view it as a loss when maladaption costs year after year to get an animal to survive. This is considered an expense. The point that Darwin was making was that species are adapting and surviving, or not surviving, but either way there was a cost to individual members of the group. The point I am making is that these costs are inherent in the evolutionary makeup of the animals we are dealing with and that we should be rational and take advantage of the system.

Selection for total performance has been done in domestic animals with remarkable success. (3) The biological variability of populations to adjust successfully to the conditions prevalent in the area are an asset (4) to cattle producers that need to be capitalized on. The need to better understand the method that nature has used to adapt animals and plants is the basis of rational and successful selection for long term benefits.

Phenotype is a compromise due to the need for balance. The balance referred to is the need of the animal to be able to maintain its productivity and survive in the variable climates that characterize all areas of the world from time to time. (5) This fitness needed is a reflection of the total genotype (4) of the animal and has, of course, pluses and minuses to it, as measured by what the herdsman wants, which is the cost involved. An example of the compromise is the comparison between weaning a 400 lb. and 450 lb. calf. A 5% death loss in the 450 lb. calf will have the same economic affect as weaning a 400 lb calf for the herd. The requirements of different nutrients when comparing a 900 lb. cow and a 1200 lb. cow at the last 1/3 of pregnancy are a 25% increase of T.D.N. and a 27.3% increase of crude protein in the 1200 lb. cow. There are so many other factors involved besides the above numbers that they are virtually meaningless as far as basing a management decision on. The fitness of the animal to perform in its environment is the most important economic factor.

Correlated responses (4) which are changes in phenotype that occur during genetic selection for a particular character, but affect characters independent of what is being sought after, are important in the fitness structure. The effects of this mechanism were well described by Leopold in turkeys. (6) The selection for characteristics favored for commercial qualities had to be bought at the cost of reduced survival in the wild. Range cattle are not wild, but are not raised in controlled environments either. The selection process that does not put value on fitness will buy qualities that are commercially valuable at a cost that will offset the anticipated gains. The key to this problem is to avoid one sided selection so that the balance necessary for high survival will be there. The pleiotropic nature of gene action, which is the

property of a gene to affect several different aspects of the phenotype and polygeny, which is the phenomenon of several genes contributing to the phenotype of a single character, give one an appreciation of the complex character of what is termed genetic selection. (4) Selecting animals in high cost protected environments for a few traits can and has led to poor performance when the animals or their offspring have been exposed to the challenge of survival and production in the more natural environment of the commercial herd.

Economically, sound gains that will improve the production of the herd have to be based upon the balance required in a multifactor system. There is a cost inherent in selection under all systems and the problem boils down to what are the long range rewards to compensate for this cost. Selection to increase a few important characteristics leads to either lower survivability or higher cost to ensure survivability, but also increases the characteristics sought after rapidly. Multifactor selection takes a much longer period to achieve the goals, but is progressive in its move toward the goal and has no end point. We have not reduced the cost of production in our cattle herds using the limited factor approach to select our animals and in my observations of the way selections are made the above mentioned factors are a large portion of the problem. I think that we must make better use of the knowledge of evolution and apply it to the practical problems of beef cattle production to improve the economic outcome of the industry.

If you measure the performance of a herd of cattle you will observe a bell shaped curve. This will represent the variation in that herd that year. If the same animals are represented in this herd for several years, you will see different animals occupying the low range and high range of the curve. Climatic and feed changes undoubtedly have some effect on this but there are no doubt many other unidentified factors which play a role in a cow's productivity. If you take the same herd and, using a method of selection that compares the animals performance with each other for just the year involved and cull the low end of the curve each year, you will maintain a bell shaped curve but the median will progressively be at a higher point. (3) We will not be able to identify and measure all the factors that are selected for because these factors will change from year to year due to climate, feed value and many unknown factors. The result will be a herd that is more efficient from every standpoint than we started out with. This, to me, is the point and purpose of animal agriculture and what food animal veterinarians are about.

References

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