

Breeding and Selection for Efficiency in Beef Cattle

by John Tiffin

Beef production, like any other farming activity, is a business. This fact has been brought into increasing focus by current economic realities. The aesthetic attractions of working with cattle are undeniable, but every death, failed conception, or inadequate growth rate in a herd reduces its profitability.

In most respects, the animal and its productivity are the result of its genetic make-up, or genotype, responding to the many non-genetic effects which comprise the environment in which it lives and performs. The cattleman can, and does, modify both genotype and environment in seeking to increase productivity and efficiency. In doing so, a principal objective is (or should be) the attainment of a profitable balance between the genotype developed and the environment which can be practicably offered to the herd. A balance point will always be reached, whatever the managerial input. Well-known examples of this are:

- A cow herd regularly achieving a 55 per cent conception rate when its environment does not include supplementary protein;
- The same herd achieving a regular 75 per cent conception rate when adequate protein is fed to the animals.

Implicit in working towards this objective of profitability is improvement in the efficiency of the herd. In the context of this discussion, this means the inherent, or genetic, ability of the herd to produce saleable product (kg of beef) from the resources and environment provided by the producer. The more efficient animal will produce more from the same resources than the less efficient animal.

Factors contributing to efficiency

1. The breeding cow

The ranch cow produces the saleable product of a herd, (the calf), the bulk of its food intake to weaning and 50 per cent of the genetic make-up which influences its subsequent performance. How well she completes this task will depend upon her own ability to survive and resist disease challenges and to utilise the available food resources for her own growth, reproduction and lactation - in short, how well adapted she is to the environment on offer to her.

2. The calf

How efficiently a calf grows and produces meat will depend upon the same factors as have been listed for its dam, plus, in most cases, its ability to convert high energy foods into carcass weight and quality.

3. The bull

A bull's functions are to mate quickly and successfully and to contribute 50 per cent of the genetic complement of the cows and calves.

Many years ago, the computer model of a beef suckler unit developed at the Texas A&M University clearly showed that the most important factor contributing to profit is cow fertility. Growth rate is one fifth, and beef conformation one tenth as important as fertility in their contribution to profitability. A similar model derived from Zimbabwean data showed almost identical effects.

This gives a clear direction to the priorities to be applied when breeding a beef herd towards greater efficiency. First priority must be given to maternal traits, followed by growth and, finally, beef conformation. Sadly, these priorities are often applied in the reverse order.

Selection for efficiency

Female fertility

The overriding factor contributing to efficiency and profitability is female fertility. However, it is well established that female fertility is of low heritability and, in theory, selection for fertility *per se* yields little or no progress. While this is essentially true, the factors which contribute to fertility are not necessarily of low heritability.

Whether a cow conceives or not is determined in large measure by her body condition at mating. This, in turn, is influenced by several attributes in the cow which are difficult to quantify but are nevertheless real:

- Resistance to disease;
- Ability to eat and use low quality grazing;
- Partitioning of nutrient intake appropriately between the demands of lactation and body reserve replenishment;
- The ability to accumulate and utilise body reserves efficiently.

These are all factors which determine cow body condition at mating and, in turn, conception success. None are easily measured in the commercial herd, but their effect (conception) can be readily measured.

In practice, this requires the provision of an adequate, cost-effective environment which allows a majority of cows to conceive and the strict culling of any which do not.

Efficiency of progeny growth

Much attention has been paid to weaning weight as a measure of a cow's productivity and this has contributed greatly to the increase in inherited growth rate achieved with beef cattle in recent decades. The heaviest weaner may not, however, be that produced with the greatest efficiency. A cow's nutrient requirement for maintenance is directly related to her bodyweight and even more closely related to her metabolic bodyweight. The maintenance requirement is the quantity of food needed for a cow simply to remain alive and produce nothing, without changing bodyweight. More than half of a cow's daily food intake is used for maintenance. Metabolic weight is $(\text{Bodyweight})^{0.73}$

The following table illustrates how cow weight relates to efficiency of production:

Table I. Effect of cow metabolic weight on efficiency of weaner production

Cow weight (kg)	Metab weight	Weaner weight (kg)	MJ energy maint.	MJ main./kg weaner	Weight ratio	Metab weight ratio
550	100.11	200	14370	71.85	0.3636	1.998
500	93.38	200	13243	66.22	0.4000	2.142
450	86.47	200	12136	60.68	0.4444	2.313
400	79.34	200	10988	54.94	0.5000	2.521

Table I shows that, for the same size of weaner produced, which assumes equal milk production, the smaller cow will use less food to produce one kilogram of weaner weight. A simple ratio of weaner weight to cow weight, *post partum* or at weaning, offers a simple measure of cow efficiency. The ratio is refined by the use of cow metabolic weight and relates to the amount of weaner weight produced per kg of food eaten.

This offers a more accurate indicator of a cow's efficiency of production and it is derived with relative ease on the farm. Culling for non-conception will eliminate those cows with excessive milk production and poor re-conception. Selection entirely on a cow efficiency index, such as has been described above, could lead to smaller cow size. This *per se* may be acceptable but it could also lead to lower weights in weaners, heifers and steers. Selection in cows should, therefore, be based on a combination of weaning weight and cow efficiency index within the first priority of annual pregnancy.

Selection for growth

Growth rate, while contributing less to profitability than fertility, nevertheless influences herd efficiency significantly and is readily measured on the farm. Efficiency of food use increases with increasing growth rate due to dilution of the maintenance requirement with increasing food intake. Because of the strong correlation between body size and growth rate, weight at weaning (205 days), 365 days and 540 days, have become standardised measures of growth on the farm. The weights are adjusted for measurable non-genetic effects such as age, sex of animal and season of birth, to give a closer estimate of the genetic

contribution to growth. Animals are compared by means of a ratio based on the average of contemporaries. These ratios are now well-known and widely used in selection for growth.

Birth weight

Mature body size and growth rate are strongly correlated with birth weight. Selection for increase in the former leads to increased birth weight and consequent calving difficulties, particularly in heifers. Production efficiency is affected through reduced re-conception and perinatal losses. It is possible to simultaneously select for constant birth weight and increased growth rate, as has been demonstrated in many countries, using advanced techniques of genetic analysis. Not many herds in Zimbabwe are measuring birth weight yet.

Practical application

Commercial herds

The commercial producer has no control over selection in the herds from which his bulls derive, other than to choose from the available bulls within that herd. His choice of bulls will contribute 50 percent of the genetic make-up of his calf crop and the replacement heifers he breeds. It cannot be taken lightly. The producer's principal objective is to breed efficient cows, and selection of a bull for this purpose is impossible without comprehensive records.

Until the more accurate BLUP figures are calculated for Zimbabwean stud herds, examination of the performance of a bull's female ancestry offers the only means of selecting a bull for maternal ability. Regularity of calving and progeny 205-day ratios should be examined as well as the bull's own performance figures. Bulls with excessive birth weight should be avoided. In many cases this information will not be available and, until the bull's buyer demands it, that situation is unlikely to change.

Cull cows

Selection within a commercial herd is necessarily confined to culling of the least efficient cows and choosing the heifers to replace them. Recommended replacement rate is 20 percent per annum and, unless annual conception rate exceeds 80 percent, selection will be confined to replacement heifers. When culling includes regularly calving cows, selection of culls should be based on both cow efficiency ratios and on average progeny 205-day ratios.

Replacement heifers

Selection of replacement heifers should be based on both their own performance records and on the progeny records of their dams. Extremes of postweaning growth should be treated with caution because of positive correlation between growth rate and birth weight and a negative correlation between growth rate and potential for milk production.

Crossbreeding

A commercial producer has the advantage of using crossbreeding to improve efficiency of production and most producers crossbreed in one form or another. The principles of selection outlined above are equally applicable to the crossbred herd as to a purebred herd.

Stud herds

The stud breeder generates the genetic complement of the commercial herd, whether the latter is crossbred or not, and breeding objectives must be essentially the same. It is therefore important that the environment in which stud animals are selected is similar to that in which their descendants will be required to perform. This is particularly the case for stud cows. They should be required to meet the same selection criteria as their commercial counterparts, in order to produce progeny which are adapted to the latter's conditions.

Identification of superior growth and efficiency in bulls will require the usual performance records described above, plus an assessment of growth and efficiency in pen-fed conditions - the so-called bull performance test - to assess the likely performance of steer progeny when being finished for slaughter.

Recording and management of records

All that has been described and discussed demands that appropriate and accurate records of performance are made and utilised. This task is regarded by many producers, and even some breeders, with reluctance. Yet any industrial business will rapidly lose money if a constant monitor of production efficiency is not maintained.

Current economics apply similar pressure in the farming environment. It has become essential that efficiency is constantly improved if an acceptable profit is to be made from cattle production. The data necessary for this can no longer be managed and processed by hand, and the on-farm use of computers is increasingly unavoidable.

In the stud industry it has long since become essential, both for the reasons outlined here and for accumulation of the data required for advanced genetic analysis, the so-called BLUP procedure. The first BLUP analysis in Zimbabwe will soon become available. In the USA it is almost impossible to sell a bull without acceptable BLUP figures.

Summary

The current economic climate demands increasing efficiency if acceptable profit is to be made from cattle production.

One means of improving efficiency is to breed more efficient cattle.

Breeding objectives for both stud and commercial herds are essentially the same. Stud herds should be selected in a similar environment to that of the commercial herds in which their progeny will have to perform, using the same selection criteria.

Fertility must be given the highest priority. The only effective way of selecting for fertility is to strictly cull on failure to conceive before any other traits are considered. This will tend to favour the better adapted and efficient animal.

Measures of cow efficiency and of progeny performance should be used in evaluation of cows for culling. Both own and maternal performance should be considered when selecting replacement heifers. Avoid extremes of growth in heifers.

Accurate selection for the same objectives is essential in stud herds. They provide all of the genetic complement of the commercial herds. Performance recording is of increasing importance in commercial herds and essential in stud herds if progress in selection is to be made.

The use of on-farm computers to manage and analyse the data gathered is becoming increasingly important.

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