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Value of Beef Performance Records

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Editor's note: Use the XPLOR order form to purchase the printed version of this publication, which includes an "Input data form for calf crop record" and a sample "Output performance record for weaning and yearling information."

Individual performance records are useful for selecting superior performing cows and bulls and for culling undesirable animals from the herd. The Missouri Beef Cattle Improvement Programs are available to beef cattle breeders through your local University Extension center.

Flexibility of the programs helps both purebred and commercial breeders in their selection and breeding programs. The cow-calf producer can use these programs as tools to check the performance of each animal from birth until it is added to the herd or slaughtered. By using these programs, you can evaluate an individual animal's genetic merit within a herd. This is important because herd superiority comes from measuring economic traits and selecting genetically superior individuals.

These programs are not designed for the purpose of comparing one herd with another or one breed with another as environmental conditions vary from herd to herd and from breed to breed.

Of what use are records?

Records may be used to:

- cull lower producing cows,
- check on management deficiencies,
- cull lower performing bulls,
- assist in selecting replacement heifers and bulls, and
- raise the average performance of your herd for those traits that affect net income.

Objectives of breeders

The major objective of all beef cattle breeders, whether purebred or commercial, should be to increase genetically the producing ability of each cow in the herd and, as a result, to increase profit.

The beef cattle industry contributes the largest percentage of agricultural income in the United States, and beef is highest on the priority list for the consumer's food dollar. Segmental changes should be made to improve the total industry's economy. The producer's share of the consumer's dollar is distributed in the following manner:

- purebred breeder — 2 percent,
- commercial cow-calf producer — 40 to 45 percent,
- stocker-feeder — 22 percent, and
- feeder-finisher — 33 percent.

Purebred breeders, who get the least amount of the consumer's dollar, probably have the greatest impact on the total industry because they determine the genetic merit of the animals to be consumed as beef. The past success of most breeds has been determined by the total number of commercial cows of the breed in the industry. This is not likely to be as great a factor in the success of a breed in the future because there likely will be a lot more crossbreeding in the beef cattle industry. The commercial cow producer can pick up a 5 to 7 percent increase in weaning weight with production of crossbred calves and a 15 to 18 percent increase when both the cow and calf are crossbred.

The purpose of individual beef cattle performance testing records is to measure differences between individuals. Weaning weight, for example, may vary as much as 200 pounds within the same herd and under the same environmental conditions. These differences result from three major causes: genetics, environment, and interaction between genetics and environment.

Trait differences can and should be exploited by the purebred breeder through appropriate trait evaluation and selection programs. If these differences did not exist and were not inherited, there would be no market for highly superior or outstanding purebred animals. The pedigree is essential in the beef cattle industry. However, it has also probably caused more confusion in evaluation of potential performance than any other factor because a family line may be excellent by name, but all the cattle in the line are not likely to be good performers.

Traits of high economic value to the industry are: ability of cattle to grow rapidly, mature early and convert feed to meat efficiently; longevity; reproductive efficiency; structural soundness; and desirable carcass quality and quantity.

The greatest advantage for a record of performance should be in the purebred herds for the foregoing traits because purebred herds produce most herd sires. The adoption by the purebred breeder of a record of performance on each individual calf will have great impact on the beef cattle industry, and the purebred breeder needs to observe all these traits in his selection program because they are essential to the industry.

Commercial producers, in selecting a herd sire (or sires), should place emphasis on those economically important traits identified in their herds as being in greatest need of

improvement. Generally 80 to 85 percent of the selection pressure put on traits comes through sire selection. Heifer replacements in commercial herds generally come from within the producer's own herd and will usually be from the top 10 to 25 percent of the heifers produced in any given year. Selection within the cow herd should most probably emphasize fertility and maternal traits.

Trait emphasis and genetic change

Beef cattle breeders have many options in terms of the traits and numbers of traits they might consider in a selection program. In most programs, however, breeders are forced to consider multi-trait selection because the practical value of their animals is almost always a function of more than one trait.

Breeders also have options regarding the general method of selection they might employ. One of these is the "tandem" method, in which selection is on the basis of one trait until satisfactory improvement is attained and then on the basis of a second trait, disregarding the first, until its improvement is satisfactory.

A second general method of selection is called the method of independent culling levels. With this method, a level of merit is assigned to each trait under consideration, and only those animals attaining the designated level of merit for each trait are kept for breeding.

The third general method of selection open to the breeder is the "total score" or "index" method. With this method, there is simultaneous selection for a number of traits. Each trait is given an appropriate "weight" after mathematical consideration of its heritability, phenotypic variance and economic value, and the genetic and phenotypic associations among the traits in the index. This latter method is generally considered the most efficient, but there are advantages and disadvantages to each.

It should be emphasized that regardless of the method of selection, increasing the number of traits considered automatically reduces the amount of selection pressure possible on all traits. For this reason, it is important to carefully consider which trait modifications will produce the greatest economic gain.

In evaluating the progress that can be expected for a single trait, the producer figures the difference between the bull and the average performance level of the cow herd for a given trait. This difference, known as the "selection differential" or "reach" between the sire and the cow herd average, is divided by two because the bull contributes only one-half the genetic material to the calf crop. The one-half difference is multiplied by the heritability estimate, and that value is then added back to the cow herd average to get an estimate of the genetic progress in one generation of selection for a given trait. This is illustrated with weaning weight in Table 1.

Table 1.

Example: Selection for one trait.	
Sire weaning weight	600 pounds
Cow herd average weaning weight	400 pounds
Heritability estimate	30 percent
Reach or differential (sire weight minus cow average weight)	200 pounds
Formula:	
1/2 (Reach) x (percent Heritability) = Genetic progress	
Solution:	
1/2 x 200 x 30 percent = 30 pounds progress in average weaning weight 30 pounds added to the cow herd average weaning weight of 400 = 430 pounds expected average weaning weight	

Estimates of expected progress from selection for other economically important traits can be made this same way. Appropriate estimates of selection differentials for these traits should be obtained from individual producer herds. Table 2 shows average heritability estimates for some economically important beef cattle traits.

Table 2. Heritability estimates.

Traits	**Percent heritability**
Fertility	10
Birth weight	30
Cow maternal ability	40
Preweaning gain	30
Weaning weight	30
Conformation score weaning	30
Postweaning gain in feedlot	57
Postweaning gain in pasture	45

Yearling weight	60
Efficiency of gain in feedlot	40
Slaughter grade	45
Shoulder height	50
Carcass items:	
Dressing percent	45
Carcass grade	45
Thickness of fat	40
Area loin eye	70
Tenderness	60
Retail yield	60

When more than one trait is considered, potential change per trait is reduced in accordance with the number of traits considered. For example, with the method of independent culling levels, the intensity of selection for each trait is the same as if selection were directed at each trait alone, but the proportion kept for breeding is increased in accordance with the expression $p^{1/n}$. In this formula, "n" is the number of traits (assumed independent) and "p" is the proportion of animals that will be kept by the producer for breeding purposes.

It is possible to estimate general intensities of selection using a table of normal distribution and related functions if one knows the proportion of animals to be kept for breeding. The general selection intensity is in terms of the amount of variation associated with the specific trait or traits concerned.

In general, the intensity of selection, i, equals Z/P, where P equals the proportion to be kept for breeding and Z equals the height of the ordinate (a tabular value) at a point equal to P. For illustration, the reduction in selection intensity in going from a consideration of one trait to two traits will be shown in detail. In this example, it is assumed that the proportion saved for breeding is 25 percent.

One trait:

P = 25 percent, then i = 0.3177 ÷ 0.25 = 1.2708 standard deviations

Two traits:

$P = 0.25^{1/2} = 0.5$, then i = 0.3989 ÷ 0.5 = 0.7978 standard deviation

The reduction in intensity of selection when considering two traits instead of one is 1.2708 standard deviations minus 0.7978 standard deviation, which equals 0.4730 standard deviation or 37 percent (0.4730 ÷ 1.2708 = 37 percent). Selection intensity for each of the two traits, then, is only 63 percent (100 percent - 37 percent) of that possible when selecting for each trait alone.

Similarly, it can be shown that selection intensity for three traits is only 47 percent and for four traits 38 percent of that possible when selecting for each trait alone.

Reductions in selection intensity, of course, will be slightly different when different proportions are kept for breeding purposes.

What records should a breeder keep?

Because profit or loss of a cow herd operation is determined by each individual cow and bull in the herd, breeders should keep exact calf production records on each cow and bull within their herds. Often we remember only the cows that produce a highly superior calf. Many times a cow is kept that produces a superior calf only once in six or seven years and a relatively poor calf the other five or six years. Remembering the exact past performance of each animal in a herd is nearly impossible, yet breeders must have this information if they want to improve their herds and the breed.

Because of inflation in fixed production costs during the past half decade, a commercial breeder must wean at least 50 pounds more beef of the same quality to obtain the same net income. The following records should be permanent on progeny of each cow: weaning weight, grade, yearling weight and adjusted height at 205 and 365 days, plus additional carcass information if obtainable. Without actual adjusted performance records, a breeder may cull superior producing cows with poor conformation without knowing it.

An important single weight

The most important single weight to both the purebred and commercial breeder would likely be the 365-day weight. It has a heritability estimate of approximately 60 percent. The genetic association between yearling weight, weaning weight and birth weight is 0.6 to 0.8 (genetic association may range from -1 to +1).

The yearling weight, however, has very little meaning in selecting herd bulls from different herds unless the bull has been pushed to his maximum growth potential. The ratio of the individual bull's 365-day weight to his management group's average weight is more meaningful than yearling weight. In herds where bulls are grown out but not fattened, their yearling weight would be much lower than in another herd where the bulls are allowed maximum growth. In many cases, the bull placed on a growing ration and allowed to reach only 75 percent of his growth potential may be genetically superior to the bull permitted

maximum growth.

To evaluate bulls for replacements, select bulls based on their superiority to the average performance of the herd or breed. Many breed associations are reporting Expected Progeny Differences (EPD) with accuracy values for many of the economic traits; they should be reviewed before purchasing the next herd bull or making heifer selections within the herd.

Weight and height association

There is a high positive correlation between height and weight for bulls on full feed from 180 to 440 days. Data indicate that for each pound increase in on-test weight, height increases 0.010 to 0.016 of an inch, while for each inch height increase, weight increases 29 to 33 pounds with a correlation of 0.8 to 0.9.

What determines breeding value?

The best indication of a young bull's breeding potential is his own individual performance while maturing. Once the bull has produced progeny, however, they are the better measure of his breeding ability. Without performance testing records on a bull's offspring showing weaning weight, yearling weight, frame and conformation score in comparison with offspring from other bulls, predicting breeding merit is impossible.

Four essential tools in selecting a herd bull are: l) pedigree, 2) individual performance, 3) records of collateral relatives and 4) progeny performance. In most cases the latter would not be applicable because most breeders select young herd bulls. If you can get the pedigree plus individual record for EPD with relatively high accuracy value on a prospective herd bull, this will ensure a more reliable selection than pedigree alone.

How to performance-test a cow herd

- Contact your local University Extension center or your respective national breed association for information and forms.
- Identify each cow and each calf within the herd with a permanent number.
- Record the birth date of each calf.
- Arrange for scales to weigh each calf between 160 and 250 days of age. To do this, determine the average age and weigh the calves when most of them are between 190 and 210 days of age.
- In purebred herds, record yearling weights, heights, muscle score, trimness, soundness and conformation grades between 350 and 440 days of age.
- In purebred herds, yearling weights, heights, muscle score, trimness, soundness and breeding grades are reported on the same input data form as the weaning data.