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### Beef Cattle Performance Testing

Cooperative Extension South Dakota State University

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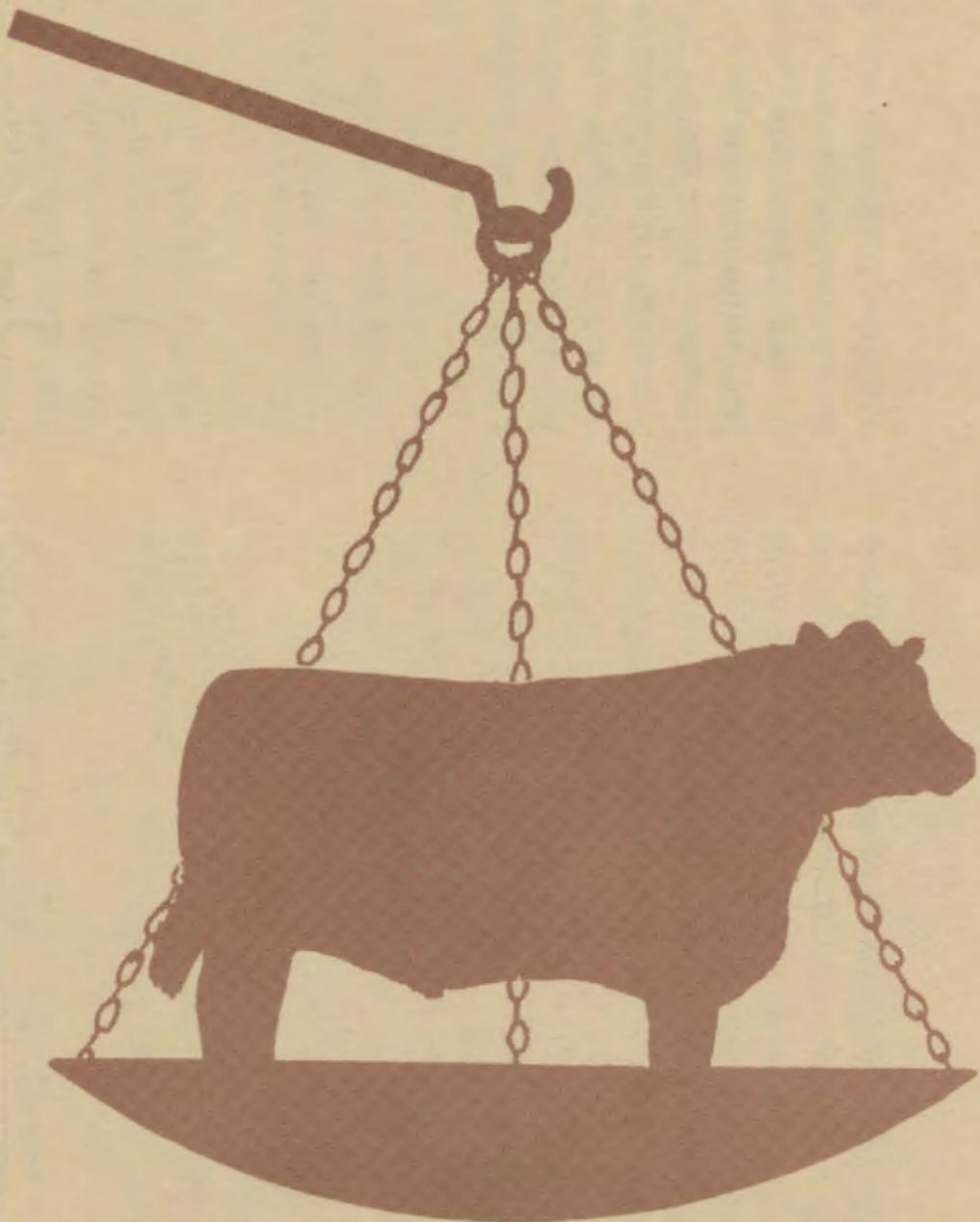
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# BEEF CATTLE PERFORMANCE TESTING



Cooperative Extension Service  
South Dakota State University  
U.S. Department of Agriculture

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Differences or variations among animals are due to either genetics or environment. The performance of each animal in each trait is the result of its heredity and the total of the environment in which it was raised. Genetically superior animals can be identified when cattle are kept under equal conditions and recorded measurements are adjusted for known sources of variation such as age, sex and age of dam. Despite all efforts to create a uniform environment, accidental or unknown environmental differences will appear, because all animals are not at the same place at exactly the same time; consequently, some animals within a group may be exposed to an infectious organism or may suffer an injury while others will not.

Performance testing offers beef cattle breeders a way of measuring differences among animals for traits that have economic significance. The economic traits are those that contribute to production efficiency, carcass desirability, rapid growth rate, efficient use of food, regularity of reproduction, and carcass quality desired by the packer and consumer. The differences measured in these traits are inherited differently. The systematic measurement of these differences, the recording of the measurements, and the use of the records in a selection program will increase the rate of genetic improvement in a herd.

## Rate of Improvement Factors

The rate of improvement within a herd, breed or population is dependent upon: (1) the percentage of the variation that is due to heredity—**heritability**, (2) the difference between selected individuals and the average of the herd or group from which they come—**selection differential**, (3) the genetic association among traits upon which selection is based—**genetic correlation**, and (4) the average age of parents when the offspring are born—**generation interval**.

Record of performance is primarily used to compare cattle of similar age that have been treated *alike* within a given year in a herd or group and only secondly to estimate differences between herds or between groups within a herd that have been treated *differently*. Large environmental differences are likely to exist between herds or different management groups within a herd due to location, nutrition and management. Cattlemen may find that records will prove to be valuable for promotional purposes in the future, although between-herd comparison is not completely valid.

An effective record of performance program should be compatible with practical management. The principal features are:

- All animals of a given sex and age are given equal opportunity through uniform feeding and management,

- Systematic written records are kept on trait measurements of economic value for all animals,
- Records are adjusted for known sources of variation, such as age of dam, age of calf, and sex,
- Records are used in selecting replacements (bulls and heifers) and in culling poor producers,
- Nutrition and management programs are practical and compatible with those where progeny are expected to perform and are uniform for the entire herd or group being tested.

Performance records can have the greatest impact through use by seedstock producers from the standpoint of total genetic improvement in the industry. The greatest improvement in the shortest time is attained through bull selection. Since far fewer bulls than heifers are needed as replacements, greatest selection pressure can be applied and the selection differential widened.

Performance records can be used by commercial breeders to select replacement heifers and to cull low producing cows. Greatest benefit of the performance record will be derived by selecting superior performing bulls from seedstock producers that are on a systematic record of performance program.

Seedstock producers, when selecting herd sires, should evaluate the prospects on the basis of their performance relative to the group or herd average in which they were tested. Over a period of time the inherent productivity of any herd of cattle depends to a high degree on the genetic merits of the bulls that have been used in the herd.

## Record of Performance Program

A performance record program usually will begin by permanently identifying the individual brood cows in the herd. Methods of identification may employ hot or cold branded numbers, ear tags and neck chains but should also include an ear tattoo for permanent record.

Positive identification of the new-born calf also can be done by tattooing or by using one of many types of available tags. The type of tag to be used usually is decided by the cost of the tag and the ease with which it can be read at a later date. After the calf has been identified, the identification number, date of birth, sex, sire, and dam should be recorded in the manner most convenient to the person keeping the record. It is simplest to mark calves shortly after birth, but it will have little or no influence on subsequent weight records if it is more convenient to mark only once or twice a week.

## Fertility

Fertility and the various components which contribute to it generally have been found to be low in heritability on a within-herd basis. However, there is a possibility that *low* fertility may be more heritable than *high* fertility. Maintaining complete calving records on all cows and fertility records on bulls in the

breeding herd is recommended. Prospective herd bulls or replacement heifers should not be used from either sires or dams that show subnormal fertility.

### Birth Weights

Birth weights are optional measures in a record of performance program. Most computerized programs use a standard birth weight when adjusting records for known environmental differences. The advantage of knowing birth weight is that you will have a more accurate measure of gain from birth to weaning. There is a positive relationship between birth weight and weaning weight; calves born heavier usually maintain that advantage.

Birth weights may be useful in selecting for optimum size; that is, to get as heavy a calf as possible without getting calves so large that it increases the incidence of calving difficulty. This becomes more important when selecting sires to use on first calf heifers as birth weight is fairly high in heritability.

### Weaning Weights

Every breeder should take weights at or shortly before weaning time. Weaning weights are greatly affected by the milking ability of the cow, a trait that is influenced to a sizable degree by heredity. Weights taken at weaning time will assist the breeder in selecting heifers with good milk producing potential and in culling low producing cows from the herd. This will tend to increase the average productivity of the herd.

Weaning weight is measured to evaluate the difference in growth potential of calves as well as the mothering ability of cows. On most operations it is impossible or extremely inconvenient to weigh each calf as it reaches an exact age. Since the ages will vary considerably, it is necessary to adjust these weights to a standard age basis.

The standard age generally acceptable by performance test programs throughout the United States is 205 days of age. The object of this adjustment is to arrive at the best estimate of what a calf would have weighed at exactly 205 days of age. The weight should be taken when the calf is between 160 and 250 days of age but as near the 205-day age as possible. Weights are usually taken 2 or 3 weeks prior to actual weaning at which time any pending shots or vaccinations are given. Calves then are allowed to return to the cow to lessen the adverse effects of the treatments. Weights can be taken at weaning, or prior to weaning but should not be taken after the calves are taken off the cow as calves will vary in their response to their post-weaning environment. This tends to influence the best estimate for the traits being measured. Calves weaned outside the 160- to 250-day range will be designated as irregular plus (+) or minus (—) and will not be ratioed with the rest of the group.

Research is being conducted on earlier weaning of heifer calves. Preliminary results indicate that early weaning may enhance subsequent mothering ability. Should sufficient data prove that heifers should be

weaned at earlier ages than the 160- to 250-day range allows, appropriate changes in the program will be made.

### Adjusting Individual Weights

To adjust an individual weight to a standard 205 day basis the average daily gain from birth to weaning is computed. This is done by subtracting actual birth weight or a constant birth weight from the actual observed weight, then dividing that figure by actual age in days when weighed to get the average daily gain. By multiplying the average daily gain by the standard 205 days and adding the actual or a constant birth weight which was originally subtracted, the 205-day weight is obtained. This procedure can be summarized by the following formula:

$$\frac{\text{Act. Wt. (lbs.)} - \text{birth weight}}{\text{Age in days}} \times 205 \text{ days} + \text{birth weight} = 205\text{-day adj. wt.}$$

The weight is adjusted for age only. No adjustment has been made for sex or age of dam.

### Age of Dam Influence

The age of dam greatly influences the weaning weight of a calf. In most herds, cows will vary widely in age; therefore, adjustment for these differences is necessary. Research indicates that a cow reaches her productive potential at about 5 years of age and that there is little decrease in her productivity until she has passed 10 years of age.

A mature dam is considered to be a cow that is not less than 5 or more than 10 years old. To adjust for variations that might be due to differences in cow ages it is advisable to adjust all cows to a mature basis.

To adjust for age of dam the following factors are generally used.

Age of Dam		Sex of Calf	
		Male (lbs.)	Female (lbs.)
2	add	60	54
3	add	40	36
4	add	20	18
5-10	add	0	0
11+	add	20	18

### Sex Adjustments

Sex adjustments primarily are made to allow comparison of cow production on a herdwide basis. Bull calves normally attain greater weights than steer calves, and steer calves weigh more than heifer calves. Records for growth of individual animals can be reported within sex group or adjusted to a common sex. When converting 205-day weights to a common sex, calculations should be based on a 10% difference between bulls and heifers with steer weights being 5% less than bulls and 5% greater than heifers. To convert 205-day weights adjusted for age and age of dam from one sex to another, the following factors are used:

Heifers multiplied by 1.10 = bull

Steer multiplied by 1.05 = bull

Heifer multiplied by 1.05 = steer

Bull multiplied by .95 = steer

Weaning weights recorded in commercial herds usually are adjusted to a steer basis. Purebred herds are either reported as within sex groups or converted to a bull basis.

### Computing Yearling Weights

Yearling or 365-day weights are computed separately for each sex. The post-weaning should begin on the day weaning weights are taken. The period between weaning and final weight should be at least 160 days and the final weight should not be taken when the animal is less than 330 days of age. A longer post-weaning rate of gain period is desirable, but it should be the same for all animals of the same sex within a herd.

The procedure for computing 365-day weights involves subtracting the actual weaning weight from the actual final weight and dividing by the number of days between the weights. This provides the average daily gain. Multiply average daily gain by 160 days and add to it the 205-day weight adjusted for age and age of dam to obtain the 365-day adjusted weight. The following formula is appropriate for computing adjusted 365-day weight:

$$\frac{\text{Act. final wt.} - \text{Act. wn. wt.}}{\text{Days between wts.}} \times 160 + 205 \text{ day adj. wt.} = 365\text{-day adj. wt.}$$

Yearling weight (365 days) is used primarily by breeders developing bulls on a fairly high plane of nutrition, beginning at weaning time. For herds that prefer to develop bulls at a slower rate or to develop replacement heifers at a more practical level, a long yearling weight (550 days) is more desirable than the yearling weight (365 days). This is accomplished by measuring growth over a period of approximately 345 days immediately following weaning. Adjusted long yearling weight can be calculated in the same manner as yearling weight, except that 345 days are substituted for the 160 days previously used. The formula becomes:

$$\frac{\text{Act. final wt.} - \text{Act. wn. wt.}}{\text{Days between wts.}} \times 345 + 205 \text{ day adj. wt.} = 550\text{-day adj. wt.}$$

### Weight Ratios

Weight ratios or index values are valuable as a means of readily determining the relative position of any animal in a test in comparison with the rest of the group. Such information is valuable in a selection and culling program and may be valuable for sale purposes. For instance, if we say that a certain animal had a weaning weight of 460 pounds and made a gain of 2.4 pounds a day on test, we have said nothing about the relative value of this animal compared with the

rest of the animals that were tested. On the other hand, if we assign an index value or calculate a weight ratio for each factor, we establish the relative value of this animal in relation to the balance of the group.

The South Dakota program uses weight ratio figures rather than indexing each factor. Weight ratios are calculated by dividing each individual adjusted weight by the average weight of the group in which it is tested. The average adjusted weaning weight of all calves in a herd is equal to 100. By dividing the individual adjusted weaning weight by the average, we arrive at a number either greater or less than 100. For instance, if the average adjusted weaning weight for a herd is 400 pounds and an individual's weight is 460 pounds, we divide the 460 by 400 and arrive at a figure of 1.15. This is multiplied by 100 to arrive at the 115 figure that is entered on the weaning weight summaries. The procedure is the same as that used to calculate percentage. The formula below summarizes the procedure to compute a weight ratio.

$$\frac{\text{Individual record}}{\text{Ave. of all animals in the group}} \times 100 = \text{Trait Ratio}$$

Weight ratios calculated on this basis are often termed index numbers. They are *not* index numbers, however, since there has not been an adjustment of the actual percentage figure. Index numbers indicate the rank of each individual within the group and offer assistance to the producer in selecting animals on the basis of relative performance within the group in which they were tested. Since several managerial and environmental factors enter in, ratios are not valid for comparing animals from different herds or animals from different groups.

Weight ratios should be calculated within sex groups. If the group includes more than one sex, weights should be adjusted to a common sex before weight ratios are calculated. Sire, dam and sex group summaries are made by averaging the weight ratios of the animals involved in each group.

### Type Scores

Conformation, grade, or type scores are used in many of the performance record programs. Research data indicates that there is little if any relationship between an animal's ability to grow or gain weight and his conformation score. Conformation or type evaluation must be done by visual appraisal and is subject to opinion and error. It does have value as an assurance for selecting structural soundness and thickness of natural fleshing or muscling.

Weaning weight scores probably have less value than scores assessed at a later age since they can be influenced by condition and bloom to some degree. Scores should be made by at least three individuals independently observing the cattle, and the final score the result of averaging the three individual scores.

South Dakota's program reports these scores as actual values. Scoring is done by assigning numbers to each animal; the numbers range from 0 to 17 with zero being the lowest possible score and 17 being the highest. Generally, 15 to 17 indicates animals that are in the purebred fancy feeder grade of show quality. Grades 12 to 14 are feeder cattle in the choice grades or animals suitable for breeding stock in purebred herds. Scores of 9 to 11 are good grade feeder animals or purebreds suitable for use in commercial herds. Type or conformation scores below those mentioned indicate animals that are unsuitable for breeding stock in either a commercial or seedstock herd.

### Sire Summaries

In all herds that have positive sire identification on calves in the program, a summary of the nursing period weights is calculated for each sire. This is accomplished by listing all progeny of a particular sire in one group and calculating the average adjusted weight for the group. When this is done for each sire group, a weight ratio for each sire group is calculated by dividing the average weight of each group by the herd average.

Sire summaries are of greatest value in herds using several sires if the cows to which each sire is mated are randomly selected. The tendency persists to mate the higher producing cows to a bull whose prepotency is already known. This adversely affects the best

estimate of the breeding value of the bulls being compared.

### Most Probable Producing Ability (MPPA)

Cow summaries are a listing of the performance data for all calves produced by each cow and an average weight ratio for each trait measured. This allows a breeder to compare productivity of the cows in a herd. Since cows in a herd will not have produced the same number of calves, it is recommended that Most Probable Producing Ability (MPPA) be included.

MPPA for weaning weight ratio is computed by the following formula:

$$MPPA = \bar{H} + \frac{N R}{1 + (N-1) R} \times (\bar{C} - \bar{H})$$

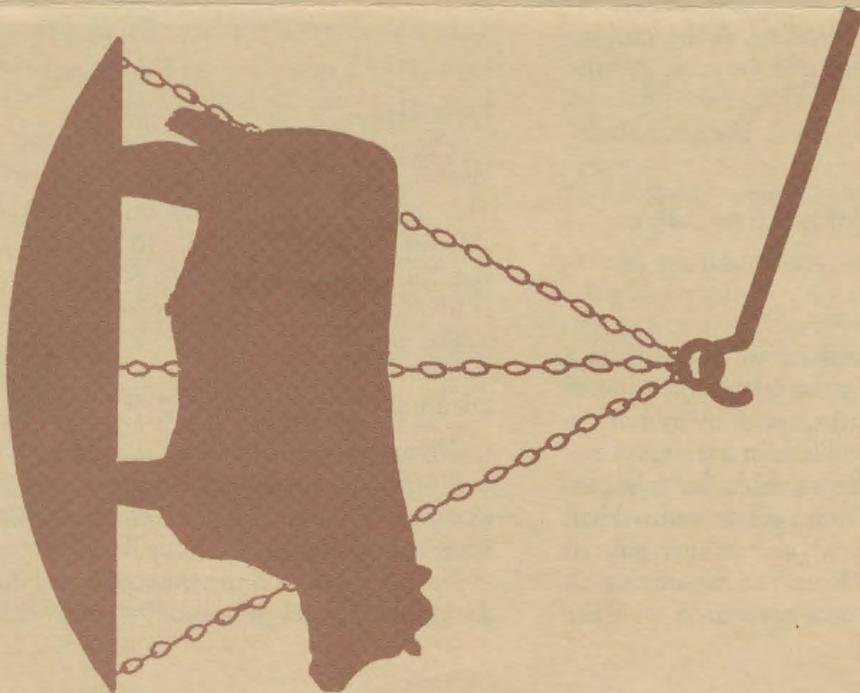
Here  $\bar{H}$  is equal to 100, the herd average weaning weight ratio;  $N$  is number of calves included in the cows average;  $R$  is equal to .4, the repeatability factor for weaning weight ratio and  $\bar{C}$  is equal to average for weaning weight ratio for all calves produced by the particular cow.

### Services Available

A number of breed associations and a state beef improvement association are available for processing a complete herd analysis. Further information may be obtained from your county Extension agent or state livestock specialist.

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