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Principles of Record of Performance in Beef Cattle

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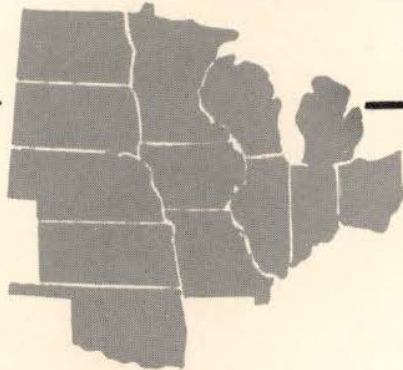
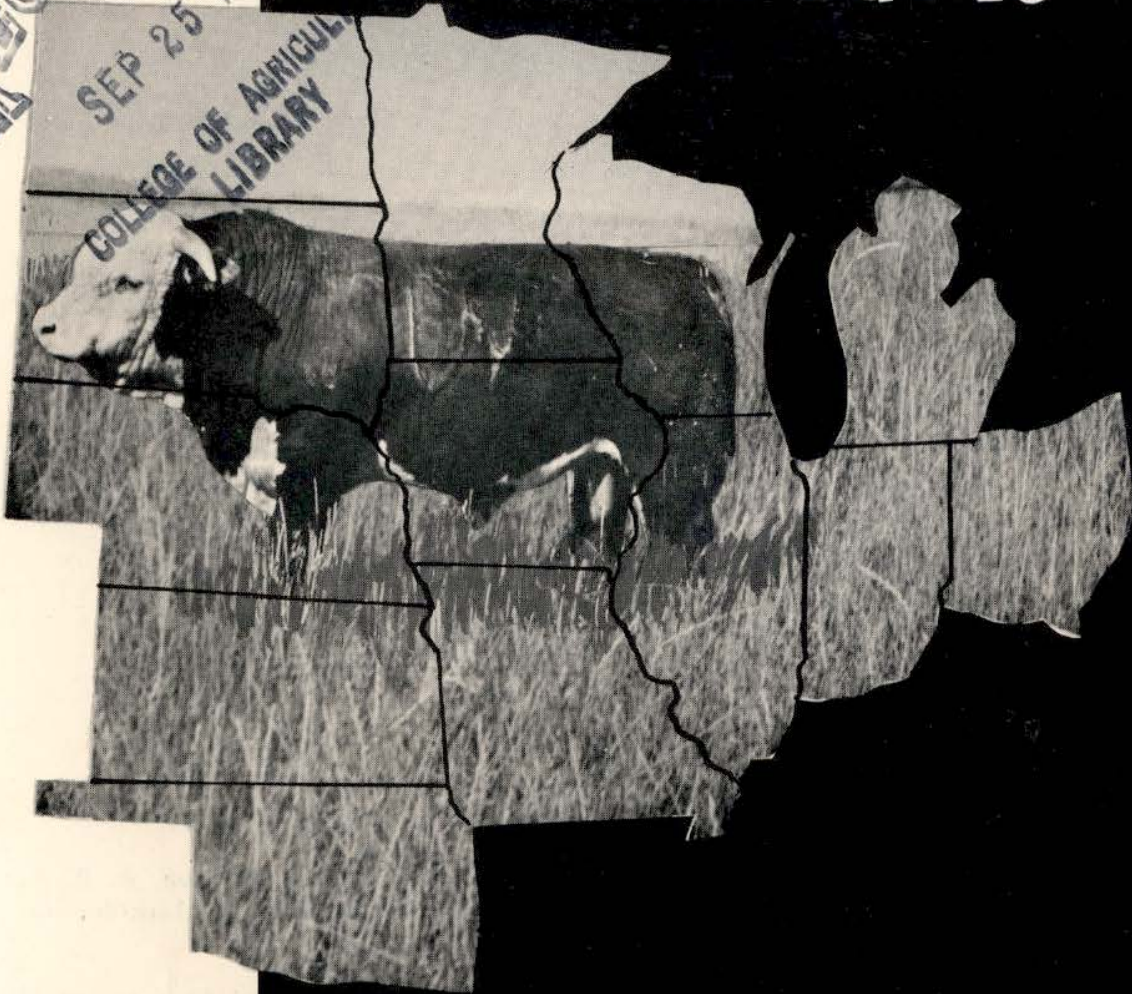
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Principles of Record of Performance in Beef Cattle

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FOREWORD

This circular is published under the auspices of Regional Project NC-1, *The Improvement of Beef Cattle Through Breeding Methods*, with approval of the Directors of the Agricultural Experiment Stations of the North-Central Region and Oklahoma and the Animal Husbandry Research Division, A. R. S., United States Department of Agriculture.

Regional Project NC-1 is cooperative between the Agricultural Research Service, U. S. D. A., and the Agricultural Experiment Stations of Illinois, Iowa, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, and Wisconsin. The primary objective of Regional Project NC-1 is to obtain information beef cattle breeders can use to make maximum genetic improvement in the traits of economic value of beef cattle. This project involves the search for new breeding facts that can be used by breeders to improve productive efficiency and carcass desirability in beef cattle.

This publication provides a summary of the basic principles that should be considered in Record of Performance Programs with beef cattle. These principles are based on the results of research being conducted under Regional Project NC-1 as interpreted by the research personnel who participate in this effort. The circular was prepared by Keith E. Gregory, regional coordinator, in collaboration with a subcommittee on Record of Performance Procedures composed of R. M. Koch, chairman, L. N. Hazel, and Doyle Chambers, and with the counsel of all leaders of contributing projects.

Principles of Record of Performance in Beef Cattle

Keith E. Gregory, R. M. Koch, L. N. Hazel,
and Doyle Chambers

INTRODUCTION

Performance in beef cattle includes all traits that contribute to the efficient production of highly desirable beef. Record of Performance is the systematic measurement of these traits and the use of such records in selection. The function of Record of Performance is to help find the genetically superior individuals within a herd so that maximum genetic improvement can be made.

The basic objective of any system of measurements is to evaluate differences between animals so that effective comparisons can be made. These measurements should provide a basis for comparing individual animals on all economically important traits that are heritable. Use of such measurements should increase the effectiveness of selection for these traits. The preferred measurements are those that give the most accurate estimate of the breeding value or genetic merit of an individual relative to the others in a herd. Such records increase a breeder's knowledge of differences between animals, thus increasing the accuracy of his selections.

PRINCIPLES OF RECORD OF PERFORMANCE

Differences between animals are due to two major causes, genetic and environmental. The observed performance of each animal in each trait is the result of the heredity that it receives from both parents and the environment in which it is raised. Even where an attempt is made to provide a uniform environment there are still accidental and unknown environmental differences between animals. These random differences result because all animals in a herd are not at exactly the same place at the same time, grazing the same area and exposed to the same environmental elements.

For example, some members of a group might be affected by some infectious organism while others are not. Another example might be injury resulting in loss of function of part of the udder of a cow, influencing milk production and resulting in decreased weaning weight of her calf. Many such random environmental factors affect some animals by chance and not others, thereby causing differences in the expression of economically important traits. A trait that is influenced relatively little by random or chance environmental differences has high heritability, while a trait that is strongly influenced by random environmental differences has slight or low heritability. Heritability is the proportion of the total variation in a trait that is actually transmitted to the offspring.

Performance records of animals should be adjusted to reduce or discount known environmental differences between animals so that genetic differences will tend to be a larger part of the total differences actually measured or observed. Adjustments should be made for "environmental" sources of variation such as differences in age, sex, age of dam, and any other environmental variable that can be measured or evaluated. Because any increase in environmental variation tends to obscure genetic differences, thus decreasing the effectiveness of selection, every precaution should be taken to measure economically important traits as accurately as possible. For example, an effort should be made to equalize "fill" in animals before weighing since such errors in weighing decrease the accuracy of selection. Fill can be equalized somewhat by removing water and feed for a twelve-hour interval prior to weighing. This would apply to initial and final weights.

Record of Performance is useful primarily for providing a basis for comparisons among cattle handled alike within a herd and not for comparing differences between herds. This is because large environmental differences due to location, management, and nutrition are likely to exist between herds. It is difficult to make accurate adjustments for these differences. Genetic differences between herds do exist, but large environmental differences make the evaluation of such genetic differences extremely difficult.

Minimum standards for levels of performance in the various production and carcass traits have been considered in some Record of Performance programs. Because of the tremendous variation in environmental conditions and production programs, standards involving between-herd comparisons tend to give recognition to herds carried under superior environmental conditions. The major function of beef cattle is to utilize our land by efficiently converting the feed that can most advantageously be produced on individual farms and ranches into a highly palatable and nutritious product. Average weaning weights of 500 pounds may be realistic in some environments and in some production programs, while 350-pound weaning weights may be reasonable under more adverse conditions. Yet, beef cattle may provide the most desirable means of utilizing the land under the more adverse conditions. Furthermore, the herd weaning 350-pound calves may have equal, or even superior, genetic merit to the herd weaning 500-pound calves. Standards expressed in terms of variation as deviations from individual herd or group averages are advisable for making comparisons within a herd, but minimum standards of performance involving comparisons between herds can be undesirable and quite misleading.

Comparing animals within a herd that are subjected to different environmental conditions, such as having part of the calves on nurse cows or other variations in feeding and management, is as objection-

able as comparing the records of different herds. If variation in treatment does exist, comparisons should be restricted to animals treated alike. It is recommended that *all* economically important traits that are heritable be evaluated for all animals in a herd. An effective Record of Performance program should be compatible with practical management regimes. Cattle should be evaluated under the approximate environmental conditions wherein their progeny are expected to perform.

The Impact of Record of Performance

From the standpoint of genetic improvement for the entire beef cattle industry, Record of Performance will have greatest impact through application by purebred breeders or in seedstock herds. Effective use of Record of Performance by commercial producers can be made where records are used to cull cows and to select replacement heifers. Commercial producers can also use Record of Performance to evaluate bulls on their progeny's performance where progeny groups are kept under comparable conditions. However, since a rather high percentage of all available heifers must be saved for replacements just to maintain a constant herd size (approximately 40 percent in most cases), opportunity for selection among females is quite limited. The commercial producer can make the most effective use of Record of Performance by selecting bulls on the basis of records from purebred herds that are on a systematic Record of Performance program. In selecting herd bulls from outside their own herd, purebred breeders should evaluate prospects on the basis of their records relative to the herd average. Over a period of time, the inherent productivity of any herd is largely dependent upon the genetic merit of the bulls used.

Attention That Each Trait Should Receive in Selection

The heritability, genetic association with other traits, and relative economic importance determine the attention each trait should receive in selection. Traits vary in their heritability and economic value. The greater the number of traits selected for, the less intensely can selection be practiced for any one trait. Traits of low heritability respond less to selection than do traits of high heritability. The greater the attention given traits of little or no economic value and/or to traits of low heritability, the less the opportunity for selection for the more important traits and/or for the traits of high heritability. The opportunity for selection should be used for traits that will result in the maximum genetic progress for the traits of greatest economic value. Obviously, little can be gained and much can be lost by paying too much attention to traits of little economic value and/or traits of low heritability.

Factors that Determine Rate of Improvement from Selection

Factors that determine rate of improvement from selection are: (1) Heritability, (2) Selection Differential, (3) Genetic Association Between the Traits, and (4) Generation Interval.

As indicated previously, heritability is the proportion of the differences measured or observed between animals that are transmitted to the offspring. Selection Differential is the difference between the selected individuals and the average of all animals from which they were selected. Selection Differential is influenced by the proportion needed for replacements, the number of traits that are considered in selection, and the differences or variation that exists among the animals. In regard to genetic association between the different traits, an association may or may not exist; and, if it does exist, it may be either positive or negative. If no association exists, the traits are said to be inherited independently. If the association is positive, the rate of improvement is increased; and, if it is negative, the rate of improvement is decreased. Generation Interval is the average age of all parents when their progeny are born. Generation Interval will average near five years in many beef cattle herds.

The expected rate of genetic improvement in beef cattle is relatively slow. This is primarily because of the inherently low reproductive rate, the large number of traits of economic value, and the long generation interval. The low reproductive rate (which makes it necessary to keep a high percentage of the offspring, especially females, as replacements), and the large number of traits involved limit the amount of selection that can be practiced (Selection Differential). The major encouraging feature is that most of the economically important traits seem to have reasonably high heritabilities (fertility being the most notable exception). The limited research information obtained to date does not indicate major negative genetic associations between the various traits.

The average heritability estimates obtained from many research herds for some of the economically important traits are shown in Table I.

These heritability estimates may be interpreted to mean that of the total variation actually observed, the percent indicated for each trait is the part due to genetic differences between animals that is actually transmitted to the offspring. Considered another way, they are the part of the difference between the selected individuals and the average of the population from which they were selected that is actually transmitted to the offspring of the selected individuals. For example, if the selected bulls and heifers were 30 pounds above herd average in weaning weight, their progeny would be expected to average nine pounds heavier than if no selection had been practiced for this trait ($30\% \times 30 = 9$).

Table 1. Economically Important Traits

TRAIT	HERITABILITY (per cent)
Calving Interval	10
Birth Weight	40
Weaning Weight	30
Cow Maternal Ability	40
Feedlot Gain	45
Pasture Gain	30
Efficiency of Gain	40
Final Feedlot Weight	60
Conformation Score:	
Weaning	25
Slaughter	40
Carcass Traits:	
Carcass Grade	30
Rib Eye Area	70
Tenderness	60
Cancer Eye Susceptibility	30

These heritability estimates were obtained under carefully controlled environmental conditions with adjustments made for known major environmental sources of variation. The heritability of any trait can be expected to vary slightly in different herds depending on the genetic variability present and the uniformity of environment.

However, there has been reasonable consistency in the estimates obtained from different research herds, and the estimates presented probably represent average expectations for many herds, provided the general environment is similar for all cattle within the herd. Even though rate of genetic improvement is slow, it tends to be permanent in nature and accumulates from year to year and is transmitted to future generations. Thus, over a period of 15 to 20 years, production in a herd or breed that has been subjected to systematic selection should be noticeably superior to that where such effort is not made.

ECONOMICALLY IMPORTANT TRAITS

Traits of major importance in the economical production of highly desirable beef that should be evaluated and given attention in a Record of Performance Program for genetic improvement are:

- (1) Fertility or reproductive performance.
- (2) Mothering or nursing ability.
- (3) Conformation as it contributes to carcass desirability and structural soundness.
- (4) Rate of growth.
- (5) Efficiency of growth.
- (6) Longevity.



Permanent identification is necessary in a Record of Performance program. Tattooing a calf in the University of Illinois research herd at the Dixon Springs Experiment Station.

Reproductive Performance or Fertility

The heritability of fertility seems to be quite low. Fertility is a complex trait with percentage calf crop depending upon many factors. There are so many random or chance environmental factors that affect fertility from the time a cow is turned with a bull until her calf is normally weaned that fertility in any given year reveals little of the real genetic differences between cows. Better measures of fertility are needed for both cows and bulls. Research is underway on this subject.

Because of the importance of this trait to efficiency production, it must command some attention in a breeding program. In purebred herds, consideration should be given to the culling of open cows if they are much below average in production and all cows open in successive years regardless of production. This assumes that no reproductive disease problems exist. Herd bulls should be selected from cows with good fertility records, should be sired by bulls of high fertility, and should themselves show a high degree of fertility.

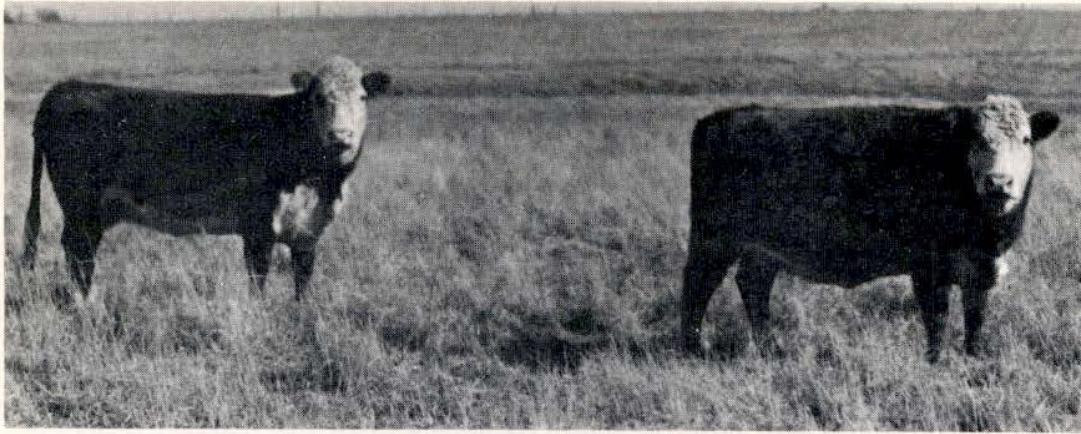
Birth Weight

The recording of birth weight is optional in a Record of Performance program. The main advantage of knowing birth weight is



Recording birth weight in the research herds at the Fort Robinson Beef Cattle Research Station, Crawford, Nebraska.

in having a more accurate measure of gain from birth to weaning. Selection for traits that are of major economic importance should favor selection toward the optimum birth weight.



Differences in Lifetime Production of Cows May Be Large

COW NO. 44

**11 Calves with Average
Weaning Weight of
533 Pounds**

COW NO. 125

**11 Calves with Average
Weaning Weight of
384 Pounds**

These two cows were from the same calf crop and managed as nearly alike as possible. Both calved first as two-year-olds and have calved each year for 11 consecutive calf crops. Both have demonstrated a high degree of fertility, yet the cow on the left (No. 44), has produced 11 calves with an average weaning weight of 533 pounds, and the cow at the right (No. 125), has produced 11 calves with an average weaning weight of 384 pounds. Weaning weights were adjusted to 210 days of age and to a steer basis. Cow No. 44 has produced 1,639 pounds more calf at 12 years of age. These differences were apparent in their first calves. The two cows are in the research herds at the Fort Reno Livestock Research Station, El Reno, Oklahoma.

Nursing or Mothering Ability

Because of the trend to slaughter cattle at younger ages, pre-weaning growth tends to make up a higher percentage of total growth. Thus, weaning weight has become an increasingly important trait affecting total industry efficiency because a higher percentage of a slaughter animal's life is in the pre-weaning period. Nursing or mothering ability is reflected in the weaning weight of the calf. The calf's own genetic impulse for growth is confounded with mothering ability by this procedure, but this is not a serious handicap since half of the growth impulse of the calf is transmitted by the dam.

Research indicates that mothering ability of cows can be evaluated reasonably accurately by the weaning weight of their calves since the repeatability of weaning weights as a characteristic of the cow is quite high. Differences in mothering ability can be evaluated about as accurately on the basis of 112-day calf weights as the conventional weaning age of approximately 200 days.

Because age of calf, age of dam, and sex of calf influence weaning weight, adjustments for variation in these factors make comparisons more accurate. In adjusting for differences in calf ages, it is recom-

mended that average daily gain from birth to weaning be used for each calf—(subtract constant or actual birth weight, calculate average daily gain, and adjust to standard age for the group).

Mothering ability of cows may be compared within groups of the same sex of calf and within ages of cows if numbers are large. This avoids an adjustment for differences in sex of calf and age of cow. The most accurate adjustment factors for sex of calf and age of dam are those developed in the herd in which they are used, provided the data are not biased and the herd is sufficiently large to give reliable estimates of these effects. For herds that are not large, adjustment factors should be developed from herds with similar management regimes. Records are more accurate where the calving season is relatively restricted so that major differences in age and seasonal influences are avoided.

Growth Rate

Growth rate is important because of its high association with economy of gain and its relation to fixed costs, such as veterinary, building, and labor that tend to be on a per head or per unit of time basis. In most instances, growth rate has been measured in time constant, post-weaning feeding tests. Results indicate that growth rate can be appraised rather accurately in this manner. A post-weaning period of at least 140 days is required to measure growth rate. This minimum length assumes rather uniform initial weights, condition, ages, and previous treatments. Results show that final weight at 12 to 18 months (standardized for age differences) is probably a better measure of growth rate than any individual component of final weight (i.e., birth weight, pre-weaning gains, and post-weaning gains).

Final weight at a standard age of 18 months seems to be a logical measure of growth rate, and it fits the management programs of many purebred herds. In such a program, bulls can be carried on a relatively low level of concentrate feeding (4-5 pounds of concentrates plus full feed of roughage) their first winter and fed at a higher level of concentrate either on grass or in the dry lot during their yearling summer. By this procedure, bulls are developed at a high enough level of feeding and over a long enough period for genetic differences in growth rate to be expressed, giving a good appraisal of growth. Bulls handled in this manner are in good sale condition at a desirable age and season. In such a program post-weaning gains are measured for approximately 350 days and, for example, gains made in this period can be added to 200-day weaning weight, unadjusted for age of dam, to arrive at something like an adjusted 550-day weight. Final weight and grade at somewhere near normal market age for a high percentage of slaughter cattle seems to be of most interest on an industry-wide basis. The use of *post-weaning gain alone* as a measure of growth could foster poor milking ability because of compensatory gains, in that a poor feed



Sire 247

Differences Between Sires Are Important

Sire 311

	<i>Sire 247</i>	<i>Sire 311</i>
Number of Calves	25	21
210-Day Weight	542	514
Appraised Value/Lb. at Weaning	\$.20	\$.19
Appraised Value/Head at Weaning	\$108.40	\$ 97.66
Average Daily Gain of Steers in Feedlot	2.30	2.02
Selling Price per Lb. for Steers	\$.24	\$.23
Selling Price per Head for Steers	\$222.48	\$195.73

It is estimated that the steers by sire 247 required six dollars worth of additional feed to make the additional gain in the feedlot, leaving a difference in profit per steer from the two sires of \$20.75. In addition to the difference in growth rate and value per pound, nine daughters of sire 247 were saved from the same calf crop and as two-year-olds produced calves weighing 449 lbs. at 210-days of age, adjusted to a steer basis. Eleven daughters of sire 311 were also saved and as two-year-olds produced calves weighing 424 lbs. on the same basis. Daughters of both bulls were bred to the same sires and the records were made in the same season. Sire 247 was later used in the purebred herd where he also proved to be a sire of outstanding merit. These bulls were used in the research herds at the Fort Reno Livestock Research Station, El Reno, Oklahoma.

supply in one period tends to be followed by a period of increased rate of gain.

An alternate program for measuring growth rate in bulls is to feed at a higher level and for a shorter period immediately after weaning. By this procedure, bulls may be put on feed when they are weaned and full-fed a ration of from approximately equal parts of concentrates and roughage to two parts concentrates and one part roughage for five to six months. In this program an adjusted final weight at something like 365 days can be used as a measure of growth rate. For example, adjusted 365-day weight may be obtained by adding the gain made in 165-day post-weaning period to 200-day weaning weight, unadjusted for age of dam.

Research results indicate that a reasonably high level of feeding is desirable to appraise growth rate most accurately. If a lower level of feeding is used, the period for measuring growth rate should be longer. However, it is recommended that only a relatively low level of feeding (adequate to promote gains of one-half to one pound per

day) be used for heifers during their first winter. The reason for this low level is that research results indicate that full-feeding a high concentrate ration during the first winter may interfere with future productivity, i.e., reproductive performance and mothering ability. Because such a high percentage of heifers must be kept for replacements, there is not much opportunity to select among heifers for differences in growth rate. Hence, very little can be gained from the heavy feeding of heifers from this standpoint. In selecting heifer replacements for growth rate, it is suggested that long yearling age (approximately 18 months) be used, with adjustments in the same manner suggested for bulls (by adding the gain made after weaning to weaning weight, adjusted to a constant age and unadjusted for age of dam). This assumes that heifers are carried at a relatively low level of feeding during their first winter.

Economy of Gain

Economy of gain is one of the most important traits of beef cattle. Economy of gain is rather difficult to measure directly in that it requires individual feeding, with adjustments for differences in weight, since increased weight is associated with higher feed requirements per unit of gain. Present information indicates that economy of gain is rather highly associated with rate of gain in cattle of the same general weight. Since rate of gain is a rather good indicator of economy of gain, it is recommended that breeders depend on differences in rate of gain as an indicator of economy of gain and not incur the added expense of individual feeding. Genetic improvement can be made in economy of gain by selecting for it through rate of gain. If a breeder desires to feed individually and adjust for differences in weight in order to measure differences in economy of gain, this is more accurate.



Bull calves on individual self-feeders on Record of Performance test at the University of Missouri.



Portable scales are used extensively and have proved to be satisfactory.

Conformation As It Contributes to Carcass Desirability, Structural Soundness, and Longevity

Performance traits other than carcass desirability, soundness and longevity should be measured directly or through the indicators that have been discussed rather than through the items of conformation. By this procedure, more productive cattle that yield a more desirable product should be produced. Basically, the important conformation items are structural soundness that may contribute to longevity, and

beefiness (thickness of natural fleshing or muscling), particularly in the region of the cuts (back, loin, rump, and round) that contribute most to carcass value.

Research is in progress on development of new tools that may be used to measure differences in fat and muscling in live beef cattle. Even though it can be expected that research will give some new tools that will result in improved methods of conformation evaluation, it is definitely recommended that breeders use the best current procedures for evaluating the *major* items of conformation. The term *major* is emphasized and intended to include only those items of conformation that contribute to carcass desirability and longevity, i.e., correct skeletal structure or structural soundness, beefiness or thickness of natural fleshing, particularly in the regions of the high-priced cuts, and a satisfactory finish at a relatively young age.

In evaluating conformation, it is recommended that a score at weaning and one at the time of final weight (12 to 18 months of age) be obtained. The weaning score is probably of less value than final score, therefore, the greatest emphasis should be placed on the final conformation score at 12 to 18 months of age. At this age the items of conformation mentioned previously can be evaluated more accurately. Since this is somewhere near normal market age for a high percentage of slaughter cattle, it should help guard against producing



Recording conformation score on yearling bull that is completing post-weaning Record of Performance test.

the "wrong kind," i.e., either too early maturing or too late maturing. Size or weight should not be a factor in conformation evaluation, since this is obtained by the measure of growth rate. However, it is difficult to score completely independent of growth, since a thrifty, growthy animal that has been doing well just naturally looks better than one that has not done as well, even though they may be basically the same in the major items of conformation.

A scoring system may be simple or it may include considerable detail, involving independent scores of each of the major items of conformation. One with greater detail helps to point out the items of conformation that are good and those that are deficient, such as feet and legs or other structural soundness, natural fleshing, etc., whereas a simple one tends only to group animals of equal desirability from a conformation standpoint without indicating where they are deficient or superior. Each breeder should use a systematic scoring system, choosing for himself whether to use a simple or more complex one.

CENTRAL TESTING STATIONS

Central testing stations can perform a useful function in Record of Performance programs where the tests are conducted properly. First, they can provide a method of obtaining some information on genetic differences between herds for a limited number of economically important traits. If this is to be accomplished, the tests must be conducted in such a manner that good estimates of genetic differences between herds can be obtained. Second, they can be useful from an educational standpoint, since they can help acquaint breeders with good performance testing techniques and the effectiveness of Record of Performance programs. Third, they provide a source of bulls which have been tested under comparable conditions.

Central testing stations have received such wide publicity that some of their disadvantages and limitations need to be specified and procedures indicated for correcting some of these deficiencies.

First, pretest conditions on home farms and ranches vary so widely that a long adjustment period is necessary at the station before the test begins. This has been such a serious weakness with some central testing stations that observant cattlemen have justifiably tended to discredit their results.

Second, only a small number of animals can be tested at central testing stations, and a special effort should be made to obtain a representative sample of the herds involved. Unless a representative sample is obtained, little real information about herd differences may be accumulated.

Third, results may have been overpublicized in regard to what can really be expected of bulls evaluated at central testing stations, since even under the most standard conditions an appreciable fraction of the differences in records is not hereditary.

Fourth, many of the bulls at central testing stations, particularly those with the lowest rank, have breeding values well below breed average. These should not be sold as tested bulls for breeding purposes. Points three and four would also apply to bulls evaluated on the farm or ranch.

Fifth, only a limited number of the economically important traits can be evaluated at central testing stations.

Central testing can have real meaning only when done in conjunction with complete herd testing in on-the-farm or ranch programs by participating breeders. In this way large numbers can be sampled, only the best being brought to central testing stations for final testing. This provides for better estimates of genetic differences between herds. If central testing stations are not tied in with complete herd testing, the limited number of animals that can be tested and the limited number of traits on which they can be evaluated makes central testing stations of doubtful value. It is recognized that central testing stations can increase problems in regard to the maintenance of herd health. Proper precautions are essential to keep this problem at a minimum.

Central testing stations can perform a function as an additional tool in Record of Performance if these standards are met:

1. Entries qualify as follows:
 - a. Individual should be in upper 50 percent of herd for weaning weight or pre-weaning daily gain.
 - b. Individual should be between 180 and 240 days of age on entry.
 - c. Dam should have a record of regular production with at least two earlier calves with records above herd average.
 - d. All individuals should be treated similarly and in a practical manner during the pre-weaning period.
2. An adjustment period of 90 days should be required before beginning of test period. A submaximum grain ration (4 to 6 pounds daily), with hay fed free choice during this period. Test period should be at least 150 and preferably 180 days.
3. Participating breeders should conduct Record of Performance by obtaining records on all animals in the herd for all economically important traits.
4. Bulls that rank lowest in overall performance should not be offered for public sale.
5. Educational activities, such as extension programs, associated with central testing stations, should be directed toward clarifying the meaning and usefulness of records as they pertain to the genetic improvement of beef cattle.

If central testing stations fail to meet these requirements, their usefulness is seriously impaired and their activities may actually be detrimental. One of the primary measures of the effectiveness of central testing stations should be the impact that they have for increased complete herd testing for all economically important traits.

RECORD OF PERFORMANCE AS AN ADDITIONAL TOOL

Even as trapnesting in poultry and milk recording in dairy cattle has led to the high percentage of production-bred animals in those species today, Record of Performance can lead to more economical production of more desirable beef. While some breeders will be unable to participate or will prefer not to participate, systematic programs in a relatively small percentage of the superior herds can set the pattern and lead the way for the entire industry.

The goals of Record of Performance are not greatly different from those that have always been sought by leading breeders. The principal differences lie in a systematic recordkeeping program and the use of these records in making selections. Record of Performance requires no new or additional facilities except a scale and forms for keeping records. The principal features of a good Record of Performance program are:

1. All animals given equal opportunity.
2. Systematic, written records kept on all animals in a herd.
3. Adjust records for known sources of variation such as age of dam, age of calf, sex, etc.
4. These records used in selecting replacement stock and in culling poor producers.

5. Nutritional program and management practices be practical and compatible with those where progeny of herd are expected to perform.

This report is intended to specify the basic principles which will help Record of Performance programs have greatest usefulness to the beef cattle industry. Additional research results will supplement this circular to make it of greater value in Record of Performance programs. No effort has been made to include sufficient detail to provide sole guidance for an individual program. Methods will differ slightly in different areas, and breeders are advised to adopt those generally in use in their areas which best fit their individual needs. For example, breeders in the extreme southern states may wean calves at 7 or 8 months, while those in northern states will wean at about 6 months. Some states may use an adjusted weaning weight, others an adjusted gain per day of age. Each breeder can consult his county agricultural agent, extension livestock specialist, or breed association to develop a program to meet his individual requirements.

Record of Performance, if properly used, can be an effective tool for increasing the rate of genetic improvement. It is recognized that the relative emphasis put on the different traits may vary somewhat in different herds, but the attention that each trait receives should be based primarily on its heritability and economic importance to the entire beef cattle industry. The keeping of records does not change what an animal will transmit, such records must be used to locate and use the genetically superior individuals if genetic improvement is to be accomplished.