Zollner

PROCEEDINGS

BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM & ANNUAL MEETING

B I F

May 3-4, 1984
Ramada Renaissance Hotel
Atlanta, Georgia

BEEF IMPROVEMENT FEDERATION
ANNUAL CONVENTION

May 3 and 4, 1984
Ramada Renaissance Hotel
Atlanta, Georgia

WEDNESDAY - MAY 2

5:00-8:00 p.m.-BIF Board Meeting (Dinner included) -University of Georgia Room

5:00-9:00 p.m.-**REGISTRATION** - Convention Floor Registration Area

THURSDAY - MAY 3

7:00-9:00 a.m.-**REGISTRATION** - Convention Floor Registration Area (Open all day)

8:15-11:45 a.m.-SYMPOSIUM - **MATERNAL EVALUATION** - Renaissance Ballroom - Harvey Lemmon, Chman.

"**MATERNAL BREEDING VALUE - IMPROVING METHODS FOR ACCURACY**" - Roy A. Wallace, Select Sires, Plain City, OH

"**PATERNAL EFFECTS--FERTILITY & CALVING EASE**" - Jim Brinks, Colorado State University

"**GENETIC IMPLICATIONS OF EMBRYO TRANSFER**" - Dale VanVleck, Cornell University

10:00 a.m.-COFFEE BREAK - Courtesy of Ramada Renaissance.

"**GENETIC-ENVIRONMENTAL INTERACTION CONCERNS**" - Bill Turner, Louisiana State University.

"**ACROSS-HERD ANALYSIS - CONCERNS & POSSIBILITIES**" - Larry Benyshek, University of Georgia

12:30 p.m.-**LUNCHEON** - Renaissance Ballroom. Bill Borror, President, Presiding.
Welcome to Atlanta & Georgia
SEEDSTOCK & COMMERCIAL NOMINEE INTRODUCTIONS - Craig Ludwig & Daryl Strohbehn
Charge to Committees - President Borror

2:00-5:00 p.m.-**COMMITTEE MEETINGS** (Open meetings) - Attend the meeting of your choice.

-**SIRE EVALUATION** - Larry Cundiff, Chairman, -Renaissance West Room.

-LIVE ANIMAL EVALUATION - Greg Martin, Chman, -Camillia-Wisteria Room.

-**CENTRAL TEST** - Roger McCraw, Chairman -Laurel-Mimosa Room.

-SYSTEMS - Jim Gibb, Chairman - Peach Room.

3:00 p.m.-COFFEE BREAK - Compliments of AI Organizations

5:00 p.m.-**CAUCAS FOR ELECTION OF DIRECTORS** - Renaissance West Room. Bill Borror in charge.

6:00 p.m.-**HOSPITALITY HOUR** - Atlanta Ballroom - Sponsored by Breed Publications.

7:00 p.m.-**AWARDS BANQUET** - Renaissance Ballroom
M.C.: M. K. Cook, University of Georgia
Awards: Dr. Frank Baker
Address: Bill Borror - "**WHERE WE ARE & WHERE BIF MUST LEAD**"
Entertainment: Georgia 4-H Group.

FRIDAY - MAY 4

6:00 a.m.-**BIF BOARD MEETING** - University of Georgia Room.

7:00 a.m.-**BREAKFAST** - Renaissance Ballroom.
Compliments of C&S National Bank, Farm Bureau Insurance, Production Credit Association, Federal Land Bank Assn., Ralston Purina, Gold Kist, Inc., and American Cynamid.
M.C.: Gene Schroeder, Vice President.
Address: "**THE BEEF INDUSTRY - LOOKING TOWARD THE FUTURE**" - Ken Monfort, Monfort of Colorado, Inc., Greeley, CO

9:00-11:30 a.m.-**COMMITTEE MEETINGS**
-**REPRODUCTION** - Roy Wallace, Chairman -Renaissance West Room
-**GROWTH** - Henry Gardner, Chairman -Camillia-Wisteria Room
-**UTILIZATION** - Earl Peterson, Chairman -Laurel-Mimosa Room
-**EMBRYO TRANSFER & RELATED TECH** - Craig Ludwig, Chairman - Peach Room

10:30 a.m.-COFFEE BREAK - Compliments of AI Organizations.

11:30 a.m.-**FINAL ASSEMBLY** - Renaissance East
-DATA BANKS STUDY SUMMARY - Dr. Frank Baker
-CHANGING OF THE GUARD & LOOKING AHEAD -Bill Borror
-LUNCH & TOUR PLANS - M. K. Cook

12:30 p.m.-**LUNCH** (Georgia Style Beef) - Fulton County 4-H Fairground (½ mi. from Hotel-transportation provided). Sponsored by Georgia Beef Breeds Council.

1:30 p.m.-**GEORGIA CATTLE TOUR** - Transportation furnished by NOBA, Inc. (see back program panel)

6:00 p.m.-**STEAK SUPPER** - Compliments of Auction Way, Gerald Bowie & Mike Jones.

8:00 p.m.-Return to Atlanta.

PROCEEDINGS OF BEEF IMPROVEMENT FEDERATION 1984 ANNUAL CONVENTION

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"MATERNAL BREEDING VALUE - IMPROVING METHODS FOR ACCURACY"
Roy A. Wallace - Select Sires, Inc.

When a cowboy evaluates maternal values, he always ask why didn't they milk. However, I think we need to back up and look first at the components of what we currently call Maternal Breeding Value. There are two parts to what we are currently terming Maternal Breeding Value. The first is the amount of growth that the female transmits to her resulting offspring. The second is the environment that that cow supplies for that particular calf to express himself. And of course that environment is nothing more than the milk production that she currently poses for the calves. However, some of the problems that I think we have in the evaluation of females in all maternal programs, is that we only look at what she does as a milk cow to evaluate her from what she can transmit. We must realize there are some problems with females that grow exceptionally fast on their mothers, there is defintely a generation skip, the particular female might have more milk production genetically than they express from an environmental standpoint. It is advantageous for us not to just evaluate the female on her own individual performance as far as her milk production but also take a look at her both paternal and maternal half sibs.

Let's preview what has happened in maternal selection over the last number of years, certainly before 1960 there was very little selection in the purebred herds for maternal performance. Most of the selection was basically on type at that particular point in time, many of the seedstock herds were using nurse cows, so therefore we probably made no progress and probably did not loose anything because we were not selecting for or against that particular trait. However, I think over time that commercial cattle industry has always tried to sell the cows that had the lightest calves. However, I am sure that before the 1970's there was very little done and the only selection happened to be on the dam herself, and there was no pressure put on the paternal half sibs or the maternal half sibs.

During the 1970's we had the establishment of the different breed associations programs for Estimated Breeding Values. Maternal Breeding Value was implemented in the 1970's and many breeders became aware of it and implemented programs using it. If a bull has no daughters in production it uses the data available from his paternal half sibs, his maternal half sibs, and his maternal grandsire's half sibs. This of course was much better than we have had in the past and has become an industry standard in many particular breeds of cattle. The Maternal Breeding Value had a tremendous impact on the number of breeds of cattle and has been used for selection procedures in many of those particular breeds. At the same time in the early 70's with the American Simmental Association and the North American Limousin Foundation, they established their maternal data by using the sire summaries and evaluating those females the same way they did from a growth standpoint not using collateral relatives in the calculation, and adjusting for herdmates genetic merit.

We have not approached the problems that we are currently having with Estimated Breeding Values for maternal evaluation. As we work with EBV's we realize that we have some certain problems with these particular programs that are causing us to pull our hair out in some respects and also I think to do injustice to some cattle breeding programs. We are using a procedure that was designed for within herd use for across the breed use. Certainly when we do this we know we can expect problems. Secondly we are not currently adjusting for genetic trend in Maternal Breeding Values as they are calculated currently today in Angus, Hereford and Polled Hereford. This certainly has a disadvantage to the young bulls within the population. There have been estimates that we might be penalizing these bulls as much as 25% because of the genetic trend that has been taking place within the populations of the different breeds in the last 10 years. Certainly as we look at the young population of bulls, we feel that ought to be better. However, if you look at them after they get their first round of daughters, they are usually 4 to 5 ratio points under their sires. We are also not adjusting for the mating sires, and we must realize when we are evaluating Maternal Breeding Value we are also evaluating the growth of the calf. One half of the genetics of the calf is made up from the mating sire. So we do need to have a look at adjusting for the mating sire. The fourth thing we currently are doing is combining both growth and milk and calling it maternal. However, in the future hopefully we will be able to separate out the contribution that a female has for growth, and also milk, so that we can make these females what we want to as far as milk production for which ever environment we are going to put them in.

The current accuracy figure that we are using rises too fast and we get a tremendous amount of movement on the bulls after they reach a .95 accuracy. I have had personal experiences of bulls after reaching a .95 accuracy of moving from 4 to 5 ratio points. People are losing confidence in Maternal Breeding Values because they use a bull one year that has a very acceptable Maternal Breeding Value, and then he falls out of bed the next year, then the next year he comes back up to where he was originally. This adds a tremendous amount of confusion in the field and people are totally confused in which particular bulls are going to increase milk production. We have confused the breeders to the extent they are going back to the old bulls that have extremely high accuracies and we realize that at some point in time there are certainly some sons of these particular bulls that are better. However, under our current system with the problems we have the young bulls will not have high enough accuracies until these bulls are 10 or 11 years old. So we are certainly loosing some generation turn over that we could defintely have if we had a better evaluation on the younger bulls within the population. The other problem that we have with the calculation is that we find some young bulls that do not have daughter data on them that are sired by the old high maternal bulls in the population, and these particular young bulls get an extremely high Maternal Breeding Value as young bulls. Many of them 108 and 109, and 110. When their first daughters come in to production and because we are not adjusting for genetic trend, these bulls on the average take a tremendous dive. Then if you have a set of bulls that average about 108 on Maternal Breeding Value as young bulls and you use those particular young bulls in the population, you would hope that if you sampled 100 of those young bulls the average of that particular group would be close to the estimate. However, if you use a set of young bulls in the population today that have 108 Maternal Breeding Value, you would probably end up with that 100 head of bulls averaging about 101 or 102. So we are over estimating many of the young bulls within the population and when these bulls are progeny tested the group is several points below the estimate.

A good summary of this particular information was recently done by Zollinger and Neilson in Nebraska, where they looked at the problems of bias due to genetic trend in evaluating Estimated Breeding Values of Angus cattle where they evaluated 53,989 records from the American Angus Association. They were able to establish that if there was no genetic progress within the herd there was very little loss in selection response when using Estimated Breeding Values. In herds where the trends for maternal improvement was from .75 to 1.1 units per year, the loss was from 6% to 8%. In 5 herds where the estimated trend was from 1.1 units per year or higher, the loss ranged from 10.8% to 25.5% We see in the Angus population that on the average the genetic trend within the population is over 1 pound per year for weaning weights so certainly I think it is well established that we are making some genetic advancements in weaning weights and that is confusing the data on Maternal Breeding Values. Also Zollinger and Neilson found that there was bias in the evaluation or in the cow Estimated Breeding Value caused by the non random mating of sire. Across herds the average estimated bias associated with positive assorted mating ranged from .05 to .08 ratio units. So I think there isn't any question as people are more precious in their mating schemes and are usually more A.I. in their particular programs, we are going to have to design programs that will better evaluate these bulls or these particular cattle taking into account the problems that we currently have. Certainly I feel as we go along today we will see that there already has been a number of things thought out by some of the people that are working with the different national sire summaries and we will have Dr. Larry Benyshek discussing some of their cross-herd analysis data that they have done with the Limousin breed?

PATERNAL EFFECTS - FERTILITY AND CALVING EASE[1]

J. S. Brinks
Colorado State University

I have interpreted the title to mean "how can we improve maternal traits such as fertility and calving ease through sire selection." In these days of discussing optimums for size, milk production, etc., I believe we still need something near maximum genetic potential for cow fertility and calf survival at or near birth.

We have somewhat of a selection criteria dilemma in that these traits are measured and recorded on the female but most of the genetic improvement must be obtained through sires which many times are selected on different criteria.

Sires are progeny tested for these traits in a sense in that data has been recorded and data banks exist on their female offspring reaching reproductive status. Several breed associations report EBV's for birth weight, calving ease and calving ease of daughters. EBV's have not been reported on fertility traits such as date of first calving, date of calving, calving interval, etc., to my knowledge. Progeny information on these fertility traits may be biased due to different proportions of female offspring per sire reaching reproductive ages and continuing in the herd. Information on collateral relatives could be used for younger bulls but often this information is limited, or non-existent for young bulls by young sires.

It would be highly useful if fertility and calving ease indicator traits could be measured on young prospective sires themselves.

FERTILITY

Age at Puberty - Females

Age at puberty in heifers can be important in determining reproductive efficiency. Most heifers probably have the potential to reach puberty and breed satisfactorily at yearling ages if provided adequate (or more than adequate?) nutrition and management. However, the cost of doing so may vary greatly among breeds and among heifers within a breed. In addition, age at puberty may indicate a higher potential for subsequent fertility measures.

Heritability estimates for age at puberty are relatively high (Table 1).

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[1] Presented at the Beef Improvement Federation Annual convention, May 3-4, 1984, Atlanta, Georgia.

TABLE 1. Heritability Estimates for Age at Puberty

Source	Estimate
Arije (1969)	.20
Laster _et al_ (1979)	.41
Werre (1980)	.67
King _et al_ (1983)	.48
Smith _et al_ (1976)	.64
Lunstra (1982)	.41

Age at puberty in heifers will probably not be recorded to any large degree by either purebred or commercial cattlemen, and thus, it will be used by researchers (hopefully) to elucidate relationships of this trait with other productivity traits.

There are some problems associated with this trait. From observations on the distribution of age at puberty by years (Colorado), it appears that there are large differences in genetic potential for AP which are manifested in years with little climatic stress but are not manifested in years with great stress; e.g., very few reach puberty during the climatic stress period and then a high proportion reach puberty following the stress period. Another problem deals with date of calving (season) versus age at puberty. Heifers born later in the season reach puberty at early ages which may reflect a photoperiod effect which would have to be taken into account in the statistical models.

Correlations of age at puberty with subsequent heat cycle of conception (1 = early, 3 = late) through four lactations are presented in Table 2 (Werre, 1980).

TABLE 2. Correlations of Age at Puberty with Subsequent Conception

	1st Lactation	2nd Lactation	3rd Lactation	4th Lactation
Age at Puberty	.54	.34	-.06	.47

These correlations were calculated from among line of sire means which may indicate a genetic relationship. They indicate that heifers from lines with early puberty also tend to conceive earlier each year through four lactations except for the third lactation.

Laster (1979) reported correlations among breed means of .75 between AP and percent calving the first 25 days and -.42 between AP with percent pregnant. Doornbos (1983) reported a residual correlation of -.40 between AP and percent pregnant. Hence, AP appears to be favorably and moderately related to subsequent fertility.

Age at Puberty - Males

Lunstra (1982) reported that scrotal circumference was a more accurate predictor of when a bull reached puberty than either age or weight regardless of breed or breed cross. Bulls reached puberty (50 x 10^6 sperm with a minimum of 10% motility) at an average of 27.9 cm in scrotal circumference. He reported a correlation of .98 among breed means (8 breeds) for scrotal circumference of bulls with age at puberty in heifers (Table 3).

TABLE 3. Breed Comparisons: Bull Testicular Size Versus Heifer Age at Puberty

Breed	Heifer age at puberty (days)[1]	Scrotal Circumference of yearling bulls[2]	
		Average (inches)[3]	Range (inches)
Gelbvieh	341 ± 9 (81)	13.7 ± 0.2 (22)	11.9-16.6
Brown Swiss	347 ± 8 (126)	13.5 ± .2 (19)	12.2-15.6
Red Poll	352 ± 8 (95)	13.2 ± .2 (20)	11.7-14.6
Angus	372 ± 12 (24)	12.9 ± .2 (79)	10.3-15.1
Simmental	372 ± 6 (157)	12.9 ± .3 (28)	10.3-15.4
Hereford	390 ± 13 (27)	12.1 ± .2 (55)	10.3-14.2
Charolais	398 ± 7 (132)	12.0 ± .3 (31)	10.0-14.8
Limousin	398 ± 6 (161)	11.9 ± .2 (20)	9.6-13.5
Average	368 ± 3 (723)	12.7 ± .1 (274)	

[1]Least-squares means ± standard error. Number of heifers measured is given in parentheses. Data from Germ Plasm Evaluation Project (Cycle I, II, and III).

[2]Data from Germ Plasm Utilization Project and adjusted to 365 days of age.

[3]Least-squares means ± standard error. Number of bulls measured is given in parentheses.

Genetic correlations between SC in bulls and AP in half sib heifers of -.71 and -1.07 have been reported by Brinks et al. (1978) and King et al. (1983). These estimates combined with that of Lunstra (1982) indicate that SC is highly related (same trait?) to AP in bulls and related females both among and within breeds.

Scrotal circumference in yearling bulls appears to be highly heritable (Table 4).

TABLE 4. Heritability Estimates for SC in Beef Bulls

Estimate	Age	Source	
.26	yearling	King *et al*.	1983
.38	yearling	Latimer *et al*.	1982
.60	weaning	Latimer *et al*.	1982
.52	yearling	Lunstra	1982
.69	yrl - adj for wt.	Lunstra	1982
.68	yearling	Coulter	1979

Thus relatively high heritability coupled with large within breed variation indicates that selection would be effective in improving SC as well as changing traits that are genetically correlated.

If one selects bulls with larger SC, what changes in SC and age at puberty are expected in the offspring?

Assume the following values:

Heritability of SC	=	.5
Genetic correlation of SC with AP	=	- .9
Genetic standard deviation of SC	=	1.4 cm
Genetic standard deviation of AP	=	24 days
Selection differential for sires	=	1 cm

Then:

Response in male offspring = heritability X selection differential

$$R = .5 \quad \frac{(1.0 \text{ cm} + 0 \text{ cm})}{.2}$$

$$= .25$$

Correlated response in AP of female offspring = R X genetic regression

$$CR = .25 \text{ X } -.9 \quad \frac{(24\ )}{1.4}$$

$$= 3.86 \text{ days}$$

Thus, for each centimeter superiority of sires above the population mean, one would expect .25 cm increase in SC of male offspring and 3.86 days earlier in puberty of female offspring.

In addition, both quantity and quality of sperm production should be improved in yearling bulls because of favorable correlations with SC.

Other Fertility Traits

Data on fertility traits such as age at first calving, date of calving and calving interval are all available from many sources including Breed Associations data banks. Progeny information of sires is thus available. However, data could be biased substantially due to different percentages of female offspring per sire reaching reproductive ages and continuing in the herd. Possibly percent remaining in the herd at given ages could be used as a progeny test for overall fitness.

All three traits suffer from lack of potential to exhibit true genetic differences due to constraints of time and length of breeding season practiced in varying degrees in most herds. Heritability estimates for these traits have generally been low; .05 to .20.

It seems to me that these traits may aid in finding cows poorer in fertility (those that are self eliminating anyway) but will do little in sorting out cows truly superior in genetic potential for reproduction.

We are presently combining date of calving (60 = conception in first 20 days, 40 = 2nd 20 days, 20 = 3rd 20 days) with calving interval (change in consecutive date in days) to ascertain if this will aid in getting at the underlying genetic potentials. Using this procedure one has to approximate both ends of the normal curve in the scoring system.

We are also beginning to collect data in our cows herds of known ancestry on post partum interval. This will be combined with ovarian (size) and reproductive tract scores (tone, size, etc.). We are interested in the relationship of AP as heifers with these scores as older cows. If this genetic relationship is highly favorable, then more selection emphasis can be placed on AP.

It seems obvious that we need more detailed research on the genetic relationships among reproductive traits and between reproductive and other production traits before useful and simple applications can be recommended.

CALVING EASE

Calf birth weights have probably increased from 70 to 85 lbs (15 lb or 20%) in commercial herds in the past 15 years. Even though heifer and cow weights have also increased, there has been an increased incidence of calving difficulty. Besides body weight, frame, and condition, factors that may influence calving ease include pelvic height, width and area of the cow along with gestation length and calf birth weight. Calving ease scores are available in many data banks and they should represent more of an unselected population (as opposed to cow fertility traits) since breeders report most scores.

Bellows et al. (1971) reported correlation of calving difficulty with pelvic height, width and area of -.07, -.25 and -.22; with gestation length, .10; and with birth weight, .48. Others have reported significant effects of pelvic measures, gestation length and birth weight on calving ease (Laster, 1974; Zink et al., 1978).

Heritability estimates of calving ease have generally been low (<.20) although Burfening et al. (1978) reported an estimate of .34 in Simmental data. However, heritability estimates of some factors associated with calving ease are relatively high (Table 5).

TABLE 5. Heritability Estimates of Factors Affecting Calving Ease

Trait	Source		Estimate
Gestation length			
	Lasley et al., 1961		.54
	Burfening et al., 1978		.48
	Bourdon and Brinks, 1982		.36, .37
Pelvic area			
	Benyshek, 19		.53
	Nelville et al., 1978		.24
	Green and Brinks, 1984	(age)	.61
		(wt)	.44
Birth weight	Summary		.40

This spring we measured pelvic area on all our yearling bulls as well as their half-sib heifers. Correlation among sire means between bull and heifer measures were: pelvic area, .80; pelvic height, .76 and pelvic width, .61. We will obtain the genetic correlations in the near future.

SUMMARY

Heritability estimates of fertility traits and of calving ease are relatively low. Heritability estimates of some of the component traits of fertility and calving ease are relatively high.

More research is needed on the genetic relationships among reproductive traits and between reproduction and production traits, especially between the two sexes.

It would be simple to select young bulls on scrotal circumference (BSE exam) and pelvic measures, along with EBV's for calving ease, birth weight and milk. How effective will these selection criteria be in improving genetic potential for superior reproduction and for calving ease in the nations cow herds?

MATERNAL EVALUATION -- GENETIC IMPLICATIONS OF EMBRYO TRANSFER

Dale Van Vleck
Cornell University, Ithaca, NY

Embryo transfer must become more than a way to exchange money among investors if it is to become a valuable tool for the improvement of beef cattle. Sales of calves of highly regarded cows and of exotic, popular breeds generally have provided the stimulus for the spread of embryo transfer. In the long run, however, the potential for overall genetic improvement will determine how widely embryo transfer will be used.

Because relatively few of the top cows are needed to produce replacements, embryo transfer obviously can increase the rate of genetic improvement as compared to the usual situation where nearly all cows are needed to produce replacement heifers. Thus, the question to be answered is not whether embryo transfer can produce better cows. The real question is whether embryo transfer can be profitable. The purpose of this presentation is to answer this question for two situations. For the dairy example, with which I am more comfortable, the goal is to increase milk production per lactation. For the beef example, the goal is to increase maternal ability as measured by weaning weight of the cow's calves.

Only increased production will be considered in both examples. Sales of breeding stock due to scarcity, glamour or promotion will not be considered.

The answer to the question is that unless costs are drastically reduced, then embryo transfer will not be profitable for either dairy or beef producers. The remainder of this presentation will show why.

The dairy situation is different in two major ways from the beef situation. First, production of milk is by far the most important trait of a dairy cow. Second, there is no apparent optimum production other than "the sky is the limit". Beef selection is more complicated as we all know. Many traits are important. Their relative importance seems to depend on which part of the industry one talks to. In addition, most traits have some intermediate optimum -- there is usually a limit to "bigger is better". A dairyman would like to have a 35,000 lb producer (nearly three times the national average). A rancher might have problems if 205-day weaning weights were suddenly to become 1,500 lb.

Nevertheless for purposes of illustrating the potential of embryo transfer I will assume that beef selection is for one trait -- maternal ability as measured by weaning weight -- and that there is no limit as to how big calves can be.

Two basic facts of genetic selection will become apparent. Gains from selection:

1) are usually frustratingly small on a year-to-year basis, but
2) are cumulative so that the gain for one year is added to the gain from previous years; thus, over a period of time total gain can be substantial.

Selection Paths

The genetic principles of selection can be summarized into two simple equations. Gain per year depends on the success of selection from the four natural paths illustrated in Figure 1. How good bulls are depends on how good their sires were (sires of bulls) and how good their mothers were (dams of bulls). These two paths ordinarily determine most of genetic progress because only a few sires of bulls and dams of bulls are needed. In other words, selection can be very strong for the best bull dams and for the best sires of bulls. If AI is used, selection can be considerably more intense for both these paths than if bulls are used naturally.

The path for sires of cows also is important because selection can be substantial. Selection for dams of cows is ordinarily of relatively little value because nearly all of the herd is necessary to produce replacements (70 to 90% on the average).

This last path (dams of cows), however, is the path that embryo transfer can greatly affect since up to 10, or even more, fertilized eggs per year can be obtained from the best cows. The genetic principle is that the top 10% of cows can produce all replacements rather than the top 70 to 90% as is the situation without embryo transfer. The contribution of the dam of bull path can also be increased with embryo transfer because fewer cows would be needed to produce sons.

The formula for genetic gain per year from the four selection paths is quite logical. The contribution of each path depends on:

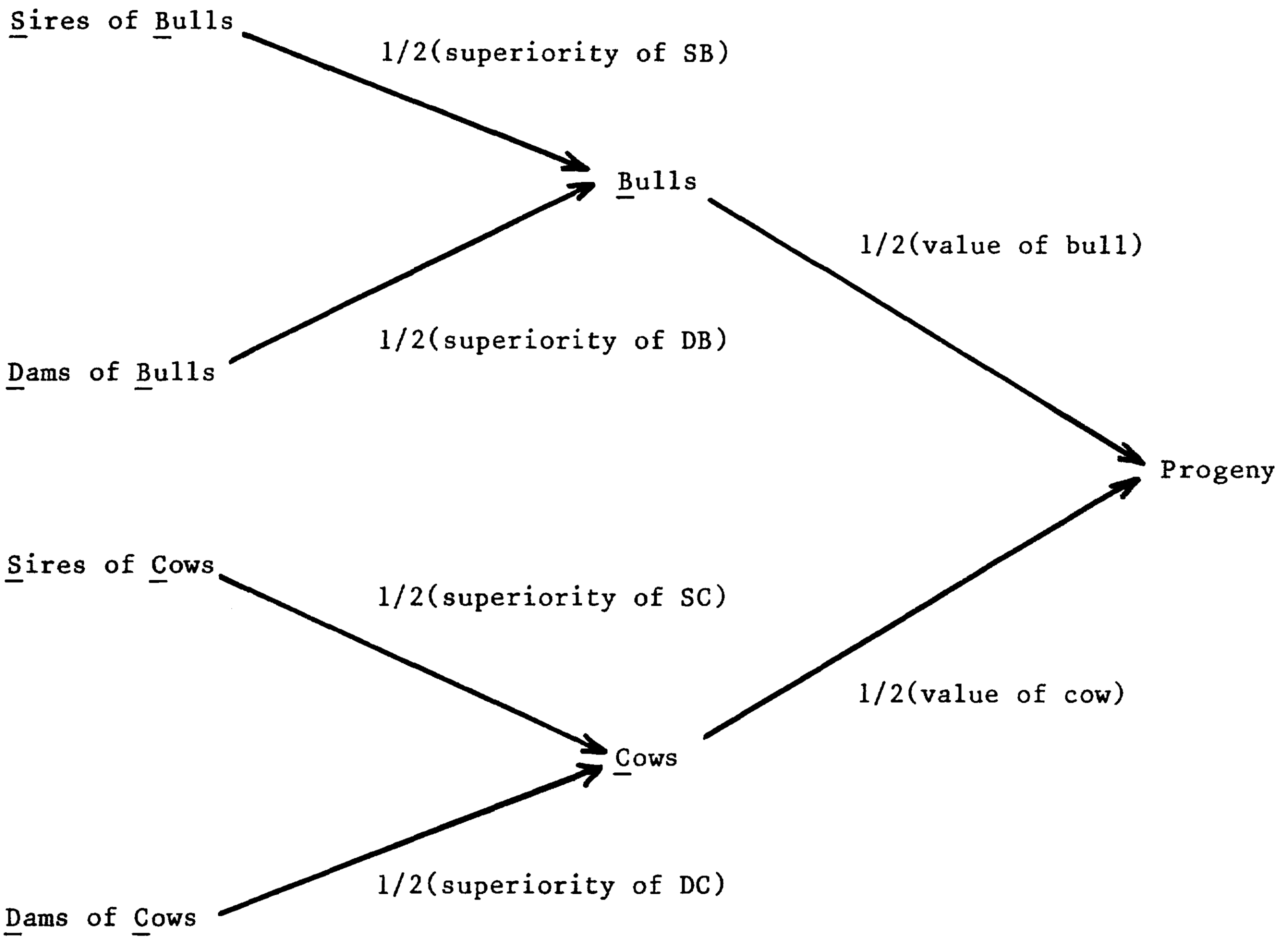
1) accuracy of identifying the best cows or best bulls (accuracy of evaluation),
2) intensity of selection (what fraction is selected), and
3) the measure of genetic differences (the genetic standard deviation) which is about 1,250 lb of milk for a lactation for dairy cows and about 30 lb for maternal ability for weaning weight of calves.

Genetic superiority for any selected group (for example, sires of bulls) can be estimated as:

$$\Delta SB = \text{Accuracy} * \text{intensity factor} * \text{genetic standard deviation.}$$

Accuracy of evaluation depends on heritability of the trait as well as numbers of records and kinds of relatives used for the evaluation. Examples are given in Guidelines for Uniform Beef Improvement Programs. For our examples the accuracy values will be between .65 and .90.

Figure 1. Four paths for genetic gain.



The intensity factor depends on the fraction of animals selected out of those available for selection. Some examples are:

Fraction selected	Intensity factor
Top 1 of 100	2.660
Top 4 of 100	2.153
Top 5 of 100	2.064
Top 6 of 100	1.985
Top 10 of 100	1.755
Top 20 of 100	1.400
Top 50 of 100	.798
Top 60 of 100	.644
Top 90 of 100	.195

Total expected gain calculated as shown in Figure 2 is the sum of the selection superiorities for the four paths divided by the sum of the generation intervals for the four paths. The sum of generation intervals for dairy cattle will be assumed to be 24 years and for beef cattle will be assumed to be 20 years to allow for evaluations for maternal ability.

Milk example -- Genetic gain from embryo transfer

The first example applies these principles to a comparison of artificial insemination (AI) and AI with embryo transfer (ET) for improving milk yield of dairy cows. Table 1 gives a reasonable set of assumptions in terms of accuracies of evaluation and fractions selected for the two breeding programs. The basis is a reasonably good AI program. With embryo transfer the same AI bulls should be used as with AI alone. Embryo transfer influences only the two dam paths--dams of bulls and dams of cows--by increasing the selection intensity. Embryo transfer is not very useful in increasing accuracy of evaluation of cows although the reasoning would take several paragraphs to explain.

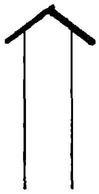
Table 2 shows the contributions of the four paths to yearly genetic gain for AI and for AI with embryo transfer from top 10% of dams of cows. Most of the gain for each plan depends on the success of AI studs in finding successively better AI bulls. Embryo transfer adds considerably to the dam paths, especially the dam of heifer replacement path, 53 lb per year. The total gain per year over AI is substantial--76 lb more for ET. This extra gain is cumulative, which means that each year the average cow in the herd would produce 76 lb more than the average cow in the herd the previous year. Thus, after 5 years, the average cow in the herd would produce 5 x 76 = 380 lb more than the average cow in the herd 5 years earlier.

Milk example -- Comparing gain from ET with costs of ET

Gain in production from embryo transfer must be compared to the costs of embryo transfer on a whole herd basis. If embryo transfer is

Figure 2.Genetic gain per year depends on selection superiority for the four selection paths and their generation intervals.

Genetic gain per year



$$\frac{\text{Genetic superiorities:}\quad SB + DB + SC + DC}{\text{Generation intervals:}\quad SB + DB + SC + DC}$$

Table 1. Assumptions for calculating genetic gain per year -- milk yield of dairy cows.

	Sires of bulls	Sires of cows	Dams of bulls	Dams of cows
	Accuracy of evaluation			
	.85	.85	.65	.65
	Number selected out of 100			
AI alone	Top 4	Top 20	Top 6	Top 90
AI and ET	Top 4	Top 20	Top 1	Top 10

Genetic standard deviation = 1250 lb.
Sum of generation intervals = 24 yr.

Table 2. Dairy cattle: Contribution of selection paths to genetic gain per year (pounds per year).

	Sires of bulls	+	Sires of cows	+	Dams of bulls	+	Dams of cows	=	Total gain per year	Difference
AI alone	95		62		67		7		231	
AI and ET	95		62		90		60		307	+76 lb

to be used regularly, then all cows in the herd will be involved. The best will be donors of embryos to the rest which will be the recipients. Outside recipients would be an additional cost and would be unavailable if all dairymen were using embryo transfer.

Therefore, the extra genetic gain from ET over that from AI alone is what should be compared to costs of ET.

An easy way to compare costs of embryo transfer and returns from extra milk due to greater genetic improvement from ET is to set up a typical herd of 100 milking cows. At least 100 successful embryo transfers would be required each year. After the selection system reaches equilibrium, the average cow in the herd would produce 76 lb more milk than the average cow the year before. One of the lowest estimates of the cost of ET is $300 per live birth. At that rate the cost of 100 cows freshening per year would be $30,000 due to ET alone. Semen costs will be considered the same as if ET were not done and thus will be ignored.

The value of each extra pound of milk above feed costs is assumed to be $0.07 per pound.

A simple table can be set up to compare the value of ET above that for AI for milk production with the cost of ET for a number of years. Table 3 shows that the expected extra genetic gain from ET accumulates slowly but eventually becomes very large as would the dollar value of the increase. (The calculations do not attempt to consider inflation although milk prices, feed costs and embryo transfer costs are likely to remain proportionally constant.)

Only in the 60th year would the added income from accumulated genetic gain pay for the embryo transfer cost for that year. The herd at year 60 would have a debt of over $800,000 due to previous income not meeting ET costs. If interest were charged at, for example, 10% per year, the economic picture would be much more dismal. With a zero interest rate, by year 100 the added yearly income would exceed yearly costs by $23,000 and the debt would have been reduced to $313,000. By year 120, profits would have accumulated (again without considering interest) to a quarter of a million dollars. Obviously none of us have a very good idea what the economic conditions will be for dairy farms even 5 or 20 years from now and certainly not what they will be a century from now. Thus, the calculations are not very realistic for the long run but should give an idea of the value of ET for a reasonable length of time.

A similar table can be assembled for lower or higher costs per successful ET. ET costs may become lower than what is now predicted.

Table 3 can be used as a guide to determine what added value of breeding stock sales would be required for ET to be economical. For the first ten years ET would need to contribute added sales of $25,000 to

Table 3. Dairy cattle: Economic value of added genetic gain due to embryo transfer (ET) of 76 lb/year with income over feed cost of 7 cents per pound for 100 milking cows requiring 100 transfers per year (assumes program in operation).

Year	Yearly value of increased herd production ($)	Yearly ET cost at $300 ($)	Yearly loss or gain ($)	Herd cumulative loss (no interest charge) ($)
1	532	30,000	- 29,468	- 29,468
2	1,064	30,000	- 28,936	- 58,404
10	5,320	30,000	- 24,680	- 270,740
20	10,640	30,000	- 19,360	- 488,280
50	26,600	30,000	- 3,400	- 821,700
60	31,920	30,000	+ 1,920	- 826,440
100	53,200	30,000	23,200	- 313,400
120	63,840	30,000	33,840	+ 261,320

$30,000 per year to pay for itself on a herd basis. These sales might, however, reduce genetic gain because buyers would not want offspring of the poorer cows.

Maternal ability for weaning weight -- Gain and cost

Would ET be more profitable for the beef producer than for the dairy producer? The answer, for maternal ability, is ..., no!! We will go through a set of calculations similar to those for the dairy example. An AI situation will be assumed although the added value of ET through the dam of cow path does not depend much on AI, and the dam of bull path is also not affected much by AI. The difference in genetic gain between AI and AI with ET is essentially the same as the difference between natural service (NS) and NS with ET.

The economic assumptions will favor ET much more than ET deserves although the conclusions will be obvious. The genetic standard deviation for maternal ability of 30 lb is on the high side. The value of each added pound of weaning weight will be $0.60. In fact, net rather than gross value should be used. The accuracy values and intensity factors will also be optimistic for an ET program. In addition the weaning weight of all calves is assumed sold when about 50% of each heifer crop would have to be saved as replacements, which would reduce the value per pound of the calf crop to .75 x $0.60 = $0.45.

Table 4 lists the assumptions for accuracy of evaluation and fractions of bulls and cows selected for the four paths. The accuracy values are slightly larger for maternal ability (see BIF guidelines) than for lactation yield of dairy cows. The assumption that the normal situation is to select replacements from the top 90% of the herd is very conservative. In fact, selection could very likely be from the top 60%. The intensity factors are .195 for 90% and .644 for 60%, which would account for much of the expected gain attributed to ET of selecting from the top 10% with an intensity factor of 1.755.

Table 5 describes the expected contributions of the four selection paths to genetic gain for weaning weight from selection for maternal ability. The less than optimum AI program for maternal ability would be expected to increase weaning weight by a little over 7 lb per year. Embryos transferred from highly selected dams of cows would be expected to increase the gain by 2.35 lb to 9.43 lb per year. These are impressive potential gains from a genetic point of view. But, what is the economic outlook?

The story is discouraging as shown in Table 6 -- even more so than for the dairy example. The herd value of weaning weight (at $0.60/lb) increases by $141 per year requiring 213 years before the total added weaning weight (500 lb per calf???) would equal the yearly $30,000 embryo transfer costs.

Table 4. Assumptions for calculating genetic gain per year for maternal ability for weaning weight.

	Sires of bulls	Sires of cows	Dams of bulls	Dams of cows
		Accuracy of evaluation		
	.90	.90	.70	.70
		Number selected out of 100		
AI alone	Top 4	Top 20	Top 6	Top 90
AI and ET	Top 4	Top 20	Top 1	Top 10

Genetic standard deviation = 30 lb. Average generation interval = 5 years.

Table 5. Contribution of selection paths to genetic gain for maternal ability for weaning weight (lb).

	Sires of bulls	+ Sires of cows	+ Dams of bulls	+ Dams of cows	= Total gain per year	
AI alone	2.91	1.89	2.08	.20	7.08	
AI and ET	2.91	1.89	2.79	1.84	9.43	+ 2.35 lb

Table 6. Economic value of genetic gain per year of 2.35 lb per calf weaned for a 100 cow herd. Value of weaning weight at $0.60/lb and 100 ET's required at $300.

Year	Increase in lb of weaning wt.	Value at $0.60/lb ($)	ET cost at $300 ($)	Yearly loss ($)	Cumulative loss ($)
1	2.35 x 100	141	30,000	29,859	29,859
2	4.70 x 100	282	30,000	29,718	59,577
⋮					
5	11.75 x 100	705	30,000	29,295	147,885
⋮					
10	23.50 x 100	1,410	30,000	28,590	292,245
⋮					
20	47.00 x 100	2,820	30,000	27,180	570,390
⋮					
50	117.50 x 100	7,050	30,000	22,950	1,323,609
⋮					
100	235.00 x 100	14,100	30,000	15,900	2,287,950
⋮					
200	470.00 x 100	28,200	30,000	1,800	3,165,900
⋮					
213	500.55 x 100	30,033	30,000	(Profit 33)	3,176,469

What is even more unrealistic than having gained an extra 500 lb of weaning weight due to ET is that AI, if used, would have been projected to increase weaning weight by three times as much, 1,508 lb/calf. Projecting an increase in weaning weight of 2,000 lb must make you wonder about me and other animal breeders. The point, though, is that 500 lb of gain due to ET is needed for a break-even year -- 213 years away if somehow gain continued at that rate for that length of time. Obviously, widespread use of ET based on expected gain due to improved maternal ability primarily through the dam of cow path will not be economical. Perhaps the dam of bull path would be more economical?

Gain and costs through the dam of bull path

European animal breeders nearly 10 years ago pointed out that although the cost of ET for the dam of cow path far outweighs the genetic gain, the gain from ET for the dam of bull path may be greater than the cost. The important points are that few ET's will be needed and that the genetic superiority will be distributed to the whole population if AI is used. Does this conclusion depend on use of AI? Apparently so.

Suppose that in a natural service situation a breeder with 100 cows needs three bulls per year. Assume that on the average these bulls are produced by the top 6 cows in the herd. The intensity factor is 1.98. With ET, only the top cow would be needed each year to produce three bull calves (intensity factor of 2.66).

The added gain per year for this path would be about .7 lb per calf. Each year ET would add 70 lb of weaning weight to the total calf weight of the herd. At $0.60/lb, each year the herd would gross $42 more than the year before if all calves were sold. The yearly cost to obtain 3 bull calves from ET would be the cost of about 9 successful transfers (half would be heifers, others would be lost before breeding). If ET cost was $300 per successful transfer, the yearly cost would be $2,700. Over 60 years of gain would be needed before the income from the gain would equal the yearly ET cost.

The AI situation is much more promising for the use of ET with the dam of bull path. For example, assume the following situation:

500,000	cows are to be bred artificially,
50	proved bulls are needed,
100	bulls are to be sampled each year,
300	dams of bulls are required to produce the sampling bulls.

Assume that the 300 dams of bulls are from a random sample of the top 6% of cows.

Assume that with ET only 50 dams of bulls are required and are from a random sample of the top 1% of cows with a total of 300 transfers required.

The added gain per year from ET will be .70 lb of maternal ability for weaning weight.

Now describing the true value of an added pound of weaning weight becomes more critical for an economic analysis. For the example, assume the extra costs of the added weaning weight are one-third of the selling price of the weaning weight--thus the net value per lb would be [$0.60 - 1/3(.60)] = $0.40. The proportion of the calf crop sold also becomes important. For this example assume 50% of the heifers are saved to be replacements so that about 75% of the total herd weaning weight is sold. For ease of computation we will combine the 75% and the net of $0.40 per lb to arrive at a selling price per lb for the whole calf crop of .75 ($0.40) = $0.30 per lb.

Table 7 illustrates the value of ET for the dam of bull path with AI.

These calculations show for a reasonable range of ET costs that increased selection of dams of bulls equivalent to .70 lb/yr would soon pay for ET costs.

There, however, are some cautions. A reasonable argument is that selection of bull dams should be for the top 300 of 500,000 rather than from a random 300 of the top 6%. If selection of bull dams could be this intense then the advantage of ET would be greatly reduced. More importantly the expected gains have been based on maternal ability being normally distributed. In general, the normal distribution may seem to fit quite well, but whether the tails of the normal distribution -- top 1%, top .5% etc. -- can be used to predict genetic gain is more doubtful. A third reason for caution is that with dairy data evaluations of bull dams have not predicted their sons' successes or failures nearly as well as theory would suggest.

Nevertheless, these crude calculations suggest that ET for the dam of bull path may be worthwhile as part of an AI program to improve maternal ability. More intense selection of bull dams may, however, accomplish the same result. Whether genetic superiority with intense selection will match the normal expectation will need to be determined.

Summary

Selection of AI bulls with increasingly high proofs is a more economically effective way than ET to increase genetic potential of cows for milk production or maternal ability if only milk and weaning weight sales are considered. An AI program to improve weaning weight directly ignoring maternal ability is likely to be much more effective than one to improve weaning weight by improving maternal ability. Such an analysis was outside the responsibility of this presentation.

Table 7. Comparison of gain in weaning weight and cost of ET for the dam of bull path.

Yr.	Added ww/calf (lb)	Value at .30/lb for 500,000 calves ($)	ET cost at $300 ($)	ET cost at $1000 ($)	Cumulative balance at $300 ($1000)	Cumulative balance at $1000 ($1000)
1	.7	105,000	90,000	300,000	15	-195
2	1.4	210,000	90,000	300,000	135	-285
3	2.1	315,000	90,000	300,000	360	-270
4	2.8	420,000	90,000	300,000	690	-150
5	3.5	525,000	90,000	300,000	1,125	75
⋮						
Totals at 20 yr.	14.0	22,500,000	1,800,000	6,000,000	20,050	16,050

GENETIC - ENVIRONMENTAL INTERACTION CONCERNS

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Genetic x environmental (GxE) interaction is a topic that has interested beef cattle researchers for several years. The statistical aspects of interaction have been simply illustrated by Steele and Torrie (1960) but are much more difficult to biologically measure and relate to practical breeding plans (Figure 1). Simply stated an interaction exists if the differences between genotypes are not consistent when measured in different environments. The interaction may be relatively unimportant if rankings of genotypes remain the same but of major importance if the ranking of genotypes change in specific environments. The purpose of this paper is to review the evidence and concepts of GxE interactions in beef cattle relative to selection aspects with emphasis on maternal influenced traits. A dam's direct environmental effect on her calf is partly due to her own genotype and partly due to her environment. Therefore, evaluating weaning weight relative to maternal breeding value is important and could understandably be affected by GxE interaction effects. Ignoring G x E interaction effects result in this source of variation being considered as environmental.

Falconer (1972) presented the concepts of evaluating GxE interaction using a defined factorial experiment to directly measure the interaction and an alternate approach of evaluating the genetic correlation of the same genotype measured in different environments. In the absence of a GxE interaction, the correlation is unity. If the GxE interaction is present, the correlation is lowered. Eisen and Saxton (1983) have identified some statistical bias due to heterogeneity of genetic variances that must be considered in interpreting the genetic correlation or adjustments to consider in obtaining the estimate. From an applied standpoint, the main problem is to determine the type of interaction (degree of differences versus rank change) or the actual value related to the interaction component in a linear model. This is important because it must be known to insure the accurate selection of breeding cattle relative to a defined environment. Hammond (1947), as cited by Warwick and Legates (1979), expressed the opinion that genetic improvement was best made in an environment allowing maximum genetic expression. This ignores the effect of interactions involving rank change and would not be effective genetic change when such interactions were present. Warwick and Legates (1979) in reviewing selection relative to the possible existence of genetic x environmental interaction suggested:

1. Adaptation tends to be fairly general for most traits and only in exceptional circumstances would selection in one environmental be totally ineffective for performance in another.
2. Genetic differences tend to be more fully expressed under more favorable environments.
3. Evidence indicates the desirability of selection under conditions reasonably like those of commercial animals in the area.

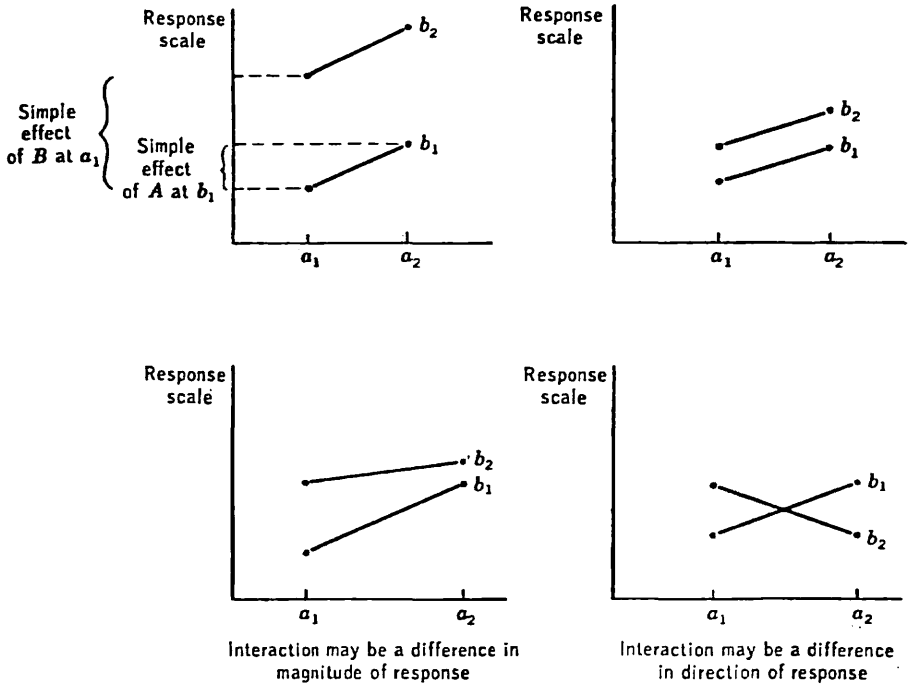

FIG. 11.1 Illustration of interaction

Figure 1. Illustration of interaction (Steele and Torrie, 1960)

Experimental Evidence of GxE Interactions

The existence of various GxE interactions have been reported and reviewed by several workers (Dickerson, 1962; Butts et al., 1971; Warwick, 1972; Kress et al., 1971a, b, c; Benyshek, 1979; Massey and Benyshek, 1981a, b; Barlow, 1981) Because the measurement of GxE interaction is often difficult and involves various effects defined as genetic and environment, it is best to review the types of GxE interactions identified and the significance implied to future breeding plans.

Butts et al. (1971) presented a very well documented study of herd x location interaction existing between genetic herds of Hereford cattle tested in Florida and Montana. Evidence was presented clearly recommending that the GxE interaction could not be ignored and that the selection of cattle in one location would not be effective to genetic value in another location. Buck et al. (1982) presented some interesting growth data with a breed x management interaction in Botswana that shows a change in breed ranking. They observed that Simmental crossbred cattle were superior to Brahman crossbred cattle under improved ranch management but Brahman crossbred cattle were superior under extensive or communal management. Warwick (1972) was careful to identify the rather large breed x environmental interaction effects known to exist with Zebu or Brahman type cattle and the extreme environments they are normally associated with in commercial production. It is safe to indicate that GxE interaction involving breeds and extreme environments are large and must be considered.

Breed x diet interaction effects have been observed by Moore et al. (1975) and Hansen et al. (1982). Kress et al. (1971a, b, c) observed essentially no set x diet interaction with Hereford and Hereford crossbred twins used in GxE interaction studies for growth, feed efficiency, reproductive performance, conformation score, fat thickness, weight change, feed consumption and production traits during lactation. Their collective conclusion was that GxE interactions of rank change are seldom important sources of variation unless large differences exist between environments and genotypes.

Interactions of sires with other "environmental" factors, such as, location and herd, have been reported. Ahlschwede et al. (1969) studied growth of Hereford steer progeny at three locations in North Carolina and over two rations. The sire x environment interactions were not observed to be real and little error would result from sire comparisons across the location and ration effects. Benyshek (1979) did find sire x breed of dam interactions of rank change when considering weaning weight. When breed of dam is considered as a measure of maternal environment, the sire x breed of dam interaction is an important GxE interaction and could possibly influence postweaning growth as a result of compensatory growth. Wide differences in types or breeds of dam (maternal environment) would apparently result in sire evaluation errors due to specific GxE interaction effects. Subsequent research utilizing North American Limousin Foundation performance data yielded somewhat different results. Massey and Benyshek (1981a) found nonsignificant sire x breed of dam interactions for pre- and postweaning performance of 75% Limousin calves. In a study of Limousin-sired calves from Hereford and Angus dams (Massey and Benyshek, 1981b) observed large sire x breed of dam interaction effects in preweaning and postweaning traits. Only postweaning average daily gain was observed not to be affected by a sire x breed of dam interaction. The possibility of selection error in the sire evaluation programs was an evident conclusion drawn.

Based upon the lack of evidence of sire x herd interactions from dairy production research (Warwick, 1972), there is, as yet, no well defined body of evidence relating to the true importance of GxE interactions. In dairy production, apparently there is little need to be concerned with sire x environment interaction effects due to the controlled dairy production environment. However, with beef cattle where wider genetic differences and environmental differences are real, there is evidence of GxE interaction that must be considered. Barlow (1981) identified that a heterosis x environment interaction was the expectation rather than exception.

Conclusions

In considering performance testing and maternal traits with beef cattle, there is no questioning the wide range of environmental factors that can dictate performance. This fact plus evidence that GxE interaction effects are most pronounced in extremes would indicate that there are GxE interactions that will require selection of germ plasm that is different for specific environments. It is evident the design of future GxE research studies must clearly relate levels of effects, genetic and environment, that are carefully selected. The development of embryo transfer with microsurgery may allow for more effective research and greater power of statistical tests. Beyond a doubt, the specific GxE effect must be evaluated. It would appear to be an error to ignore the possibility of GxE interactions not affecting performance testing programs.

Dickerson (1962) capably reviewed and documented GxE interactions in egg production in poultry. A recommendation to sample 5 to 10 field environments and select for an average adaptability to the range of environments in California was made. This concept could easily be applied to performance testing of beef cattle, if the environmental factors could be properly identified. Willham (1984) has considered the regional classification of progeny and performance data by zip code classification as a possible means of establishing data subsets for regional analyses. While subset analyses would not utilize all available data, it would restrict genetic evaluation to selected test herds and by experimental design (controlled observation) obtain a more powerful test for breeding value estimation. This approach, of course, would limit the number of sires that could be evaluated in specific regions and lead to multiple evaluations for sires used over several regions. It is probably not fully acceptable but would be accurate in regions where GxE interaction effects are important. It is possible to consider an average merit over regional evaluations for general adaptability as suggested by Dickerson (1962).

More research must be done to accurately evaluate GxE interactions in performance traits of beef cattle. It is safe to recommend that genetic evaluation continue across a sample of environments where genetic and environmental differences are small. However, care must be taken to avoid nonrandom matings and common environmental effects that are advantageous to progeny groups. There is no defined measure of how much difference is small or large for classification relative to possible GxE interaction effects. Individual breeders must still rely heavily upon within-herd selection and keep an "environment" that relates to the commercial utility of the germ plasm generated from their herd.

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ACROSS HERD ANALYSIS - CONCERNS AND POSSIBILITIES

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The advent of performance testing marked a milestone in the production of beef cattle. The records generated from such testing programs have provided a means for making selection decisions based on sound genetic principles for characteristics of paramount importance to a successful cattle industry. A successful cattle industry is one that provides food for a consuming public and a profit to the producer. Performance testing programs have played a large role in increasing the production efficiency of the U.S. cattle industry through genetic improvement. As time passed, the food production industry became more competitive; thus, cattlemen demanded more efficiency and more sophisticated systems to provide information on which to base selection decisions for enhanced genetic improvement. This demand has led us to the present day national sire evaluation (NSE) programs maintained by many beef cattle breed associations. Beef cattle national sire evaluation programs have been a reality for ten years. These programs are a result of competition among the many breeds of cattle to produce the best and a most competitive system of food production in the United States.

The incorporation of national sire evaluation programs into the U.S. cattle industry provided the first sound method on which selection decisions could be made for animals from different herds and/or generations. The impact on the cattle industry has been significant and could be even greater as more sires are brought into the various programs. National sire evaluation programs could provide a vehicle for making further genetic change in the cattle industry particularily as the analysis procedures are refined and the programs are expanded to include other classes of traits such as reproductive efficiency. For example, much effort has gone into developing the procedure to account for genetic trend, relationships among sires and now for non-random mating of sires and dams.

The problem with national sire evaluation is that it sacrifices individual performance information in favor of the progeny test. Classically, the progeny test has always been known to increase the generation interval, but the increased accuracy of selection has been a good tradeoff. This is particularily true since the records used in the NSE programs are collected as part of the ongoing within herd performance testing programs. National sire evaluation has simply extended the use of those records to more accurately evaluate herd bulls. Today's cattle industry is demanding the next step in genetic improvement programs and that is the merging of within herd performance testing and national sire evaluation programs. The ultimate goal of such a merger is the development of genetic values on each animal in the population (breed) which can then be used to compare them fairly on traits of economic importance. This simply means that all available information, including an individual's own record and those of his/her relatives, would enter into the computational procedure. Thus all animals, those with and those without progeny, could be compared fairly. The procedure will identify animals with superior genetic merit at a much earlier age thus reducing the generation interval. The procedure will identify more of those potentially superior young animals (males and females) at an early enough age to ensure that they are used in a breeding program.

[1] Invited paper presented at Beef Improvement Federation Annual Meeting, Atlanta, Georgia on May 3, 1984.

Willham (1976) discussed the merger of beef cattle NSE and within herd performance testing programs through the use of estimated herd means adjusted for genetic differences among herds. These estimated herd means could then be used to develop performance ratios on individuals which are also partially adjusted for genetic differences between herds.

Mixed model methodology resulting in best linear unbiased prediction (BLUP), described so eloquently by Henderson (1973), is used by almost all breed associations in their NSE programs. Henderson and Quaas (1976) described the use of best linear unbiased prediction procedures to provide breeding values utilizing large numbers of relatives as well as the individual's own records. The methodology is discussed with respect to multiple trait evaluation and is similar to the methodology for sire evaluation however computationally much more complex. It is not within the scope of this paper to fully describe and explain the computational procedures used in this type of analysis. The procedures are carefully discussed by Quaas and Pollak (1980). For those not comfortable with matrix algebra and its notation a discussion given by Pollak and Quaas (1983) will provide an understanding of the procedures. Willham and Leighton (1978) discussed similar procedures for a within herd selection model. The model is referred to by Quaas and Pollak (1980) as the "animal model" in contrast to a sire model. The following is taken from Pollak and Quaas (1983) and should serve a brief introduction to the method of analysis.

$$Y_{ij} = b_i + u_j + e_{ij} \qquad [1]$$

represents the record of an animal where y_{ij} is the record, b_i is the i^{th} fixed effect (contemporary group) associated with the record, u_j is the additive merit (breeding value) of the individual making the record, and e_{ij} is the random residual associated with the ij^{th} observation. It should be noticed that this model is different from sire evaluation models which include a fixed contemporary group effect, a random sire effect (which becomes the expected progeny difference) and a random residual. In sire evaluation models an equation is developed for each sire whereas in the animal model an equation is developed for each animal.

In matrix notation the animal model [1] can be represented as

$$y = Xb + Zu + e \qquad [2]$$

with the incidence matrices **X** and **Z** relating the fixed and random effects, respectively to the **y** vector of records. The vector **b** contains the fixed effects and the **u** vector represents the breeding values of all animals.

In beef cattle performance testing each individual in a contemporary group has one record. If each animal has a single record, **Z** is the identity matrix. The mixed model equations given by Pollak and Quaas (1983) are:

$$\begin{vmatrix} \mathbf{X'X} & \mathbf{X'} \\ \mathbf{X} & \mathbf{I} + \mathbf{A}^{-1}\alpha \end{vmatrix} \begin{vmatrix} \hat{b} \\ \hat{u} \end{vmatrix} = \begin{vmatrix} \mathbf{X'y} \\ \mathbf{y} \end{vmatrix} \qquad [3]$$

$\mathbf{A}^{-1}$ is the inverse of Wright's numerator relationship matrix for all animals represented in **u**. All relationships among the animals in the analysis are used in the computational procedure. The ratio of the residual variance to the additive variance (σ_e^2/σ_a^2) is the value of α. $\mathbf{A}^{-1}$ and α are presently used in most sire evaluation programs; however, in sire evaluation, only the relationships among the sires are used. The above system of equations [3] includes an equation for each animal in the population which will be considerably more equations than generated from sire evaluation models. Pollak and Quaas (1983) decompose the system of equations [3] and show that the equation for the i^{th} animal is:

$$(1 + a^{ii}\alpha)\,\hat{u}_i + \sum_{j \neq i} a^{ij}\alpha\hat{u}_j = \mathbf{y} - \mathbf{X}\hat{\mathbf{b}} \qquad [4]$$

where a^{ij} is the i,j^{th} element from $\mathbf{A}^{-1}$. Therefore, the animal's evaluation is:

$$\hat{u}_i = 1/(1 + a^{ij}\alpha)(\mathbf{y} - \mathbf{X}\hat{\mathbf{b}}) - 1/(1 + a^{ij}\alpha)\sum_{j \neq i} a^{ij}\alpha\hat{u}_j \qquad [5]$$

This is the regressed deviation of the animal's record $(\mathbf{y} - \mathbf{X}\hat{\mathbf{b}})$ minus the regressed weighted function of his/her relatives's evaluation. The evaluation of animal i, through the use of A^{-1}, utilizes information on its sire, dam (if known), and progeny (if available) and includes adjustments for the merit of mates of the individual. Thus the procedure utilizes all available information including the pedigree of the individual, the individual's own performance, the performance of the individual's progeny and adjusts for any non-random mating of sires and dams.

The model [2] is flexible in that individuals without performance records can be included provided they have relatives with records. In general the model will allow the development of an individual's evaluation based on all possible information or any part of the information available. This means that almost every individual in the population can be evaluated, even those individuals several generations back that may not actually be in the current breeding population. By starting with the oldest or first individuals in the base population and developing the analysis forward, through $\mathbf{A}^{-1}$, genetic trend is accounted for by the procedure. The procedure provides a fair comparison of all individuals in the population regardless of the amount of information available. For example, bulls without progeny can be compared with those that have progeny. The accuracy of evaluation would obviously be in favor of those animals with greater amounts of information, ie. progeny and individual performance. Each evaluation is adjusted for the amount of information available; therefore, the comparisons are unbiased for individuals with differing amounts of information (individual records, progeny records and ancestors). The emphasis placed on any one piece of information in the evaluation procedure is dependent on the total amount of information available. For example, as the number of progeny increase for an individual the evaluation emphasizes his progeny average more than his own performance record.

The procedure will allow the comparison of individuals across herds or tests provided the data are connected which is usually accomplished through the use of common sires. Breeds which use artificial insemination extensively will meet this requirement. There will be some herds that are totally disconnected from the main data set because they use only natural service. The use of $\mathbf{A}^{-1}$, which provides some loose ties between those herds and the main body of data, may provide a kind of solution to this problem.

The model can be expanded to adequately provide evaluations for traits which are maternally influenced such as weaning weight. The solution to the system of equations developed for these traits provide evaluations for direct performance (innate genetic potential for growth) and maternal ability of all animals in the analysis. The evaluations for direct performance are adjusted as indicated previously and in addition for maternal influences. The procedure provides a genetic evaluation of maternal ability early in the animal's life which would be superior to present maternal breeding values. Most probable producing ability values can be computed from the analysis which would be superior to present beef cattle MPPAs.

This methodology has been developed for multiple trait evaluation (Henderson and Quaas, 1976; Quaas and Pollak, 1980 and Pollak and Quaas, 1983). The use of multiple traits can enhance the precision of the evaluation, particularily for those inidviduals with missing information. Of great importance is that multiple trait evaluation can eliminate the bias due to selection at an early age. In beef cattle the number of yearling weight records is almost always less than the number of weaning weight records indicating that some individuals have been culled from the population on the basis of their weaning performance. The single trait analysis of yearling weight in this situation represents an evaluation of a select group of individuals. Pollak and Quaas (1981b), using simulated yearling weight records selected on the basis of weaning weight, were able to show that the bias introduced into the yearling weight evaluation by the selection at weaning was eliminated by the multiple trait methodology. It is important to note that yearling evaluations could be made at weaning using the multiple trait approach.

It is obvious that the application of the "animal model" will increase the accuracy of genetic evaluation in beef cattle and particularily if the model encompasses the multiple trait approach. However, the application will also provide greater flexibility to the breeders of purebred cattle. For example, specific matings can be arranged according to the results of such evaluations without an effect on the next year's analysis because of the adjustments for non-random mating. It will provide information at an early age which should be advantageous in a creative breeding program. The generation interval would certainly be decreased. The multiple trait methodology may provide information early enough in the animal's life, say at weaning, such that fewer animals would have to be tested to a later age. Evaluations for yearling weight and maternal ability provided at weaning may be accurate enough to eliminate substantial numbers of animals from further testing. This could result in significant savings to the purebred industry.

The commercial industry will benefit from the procedures since it will remove much of the guesswork presently involved in selecting young bulls for natural service. If commercial breeders were to buy bulls on the basis of these evaluations the genetic change in the commercial industry would be directly proportional to the change in the purebred industry. This might eliminate the need for laborious performance testing in the commercial industry since most of the genetic change in a commercial operation comes through the selection of bulls.

The need to merge within herd performance testing and national sire evaluation programs is obvious. The technology is developing to accomplish this goal; however, the implementation and application is not without problems. It is not a small task to solve the number of equations generated by the "animal model" particularily if multiple trait methodology is used. These large systems of equations may be ill-behaved and convergence may be slow using the iterative procedures presently being employed in sire evaluation programs. There has been substantial progress toward solving this problem through the use of equivalent models (Quaas and Pollak, 1980; Pollak and Quaas, 1983). These researchers describe the use of a reduced animal model which results in fewer equations to be solved than the full animal model [3]. The reduced animal model provides a system of equations involving only those animals that are parents in the population, and this will usually be a much smaller number of animals than actually exists in the population. The solution to this set of equations provides breeding values for the parents and then a backsolution provides breeding values for the rest of the population which have not become parents. The breeding values from this approach are essentially the same as those obtained from the full animal model; however, the problem of number of equations to solve is significantly reduced (Pollak and Quaas, 1981a). Subsequently, the cost of applying the reduced animal model is less than the full animal model.

This methodology requires many more genetic parameters than are used in the present sire evaluation programs. The procedure assumes that the appropriate variances and covariances are known or at least well estimated. If inappropriate variances and covariances are used the accuracy of prediction could be seriously diminished.

Computers are available today that can handle the animal model. However, it is of major concern to breed associations, who have the responsibility of administering genetic improvement programs, to determine whether the evaluations can be done in their present shops. Breed associations may find it advantageous to use their present computers in the dissemination of the large amount of information generated from an across the breed evaluation program. Of course the associations are already involved in the collection of records to be used in any genetic improvement program. It may be a full-time job for breed associations to collect the data and update their members, perhaps electronically, on the status of individual herd improvement programs. The dissemination of information will eventually become the most important part of such a bold improvement program. Obviously, the breed associations are the organizations best suited for that task and should retain that responsibility. This means that the evaluations would need to be generated at some location, other than the breed association, where computer hardware could be maintained to accomplish the task. A central computing facility may be the most economical method of providing these genetic evaluations.

The effect of preferential treatment of animals on genetic evaluations has been discussed many times. This new methodology will not solve this problem. Sound within herd performance testing procedures will still need to be followed. Those procedures are reduced to essentially the proper identification of contemporary groups.

There has been considerable interest in developing procedures for the evaluation of embryo transfer calves. This problem is not easily solved even though the animal model does incorporate considerably more information into the computational procedures. It may be possible, with the proper identification of contemporary groups and some knowledge of the surrogate dams, to include embryo transfer animals in an across breed evaluation. It seems that there are physiological phenomenon such as in utero effects on postnatal characteristics which are not clearly understood. A better understanding of the biology of embryo transfer may be necessary to develop a model for genetic evaluations. At least, the evaluations provided by the animal model would identify those females which could become candidates for embryo transfer with much greater accuracy than present day techniques.

Breed association personnel and the extension service will have a monumental task in educating both purebred and commercial producers as to how all of this information can best be used. There are some bright spots here. For example, the genetic values will be represented the same for animals with progeny as those without progeny. The enhanced accuracy of prediction will result in fewer "dissatisfiers" than the present programs. Differences, significant or not, between the present within herd or central test evaluation of animals and national sire evaluation have been no small problem for all who work in the area of beef cattle genetic improvement. The application of this new methodology will not completely eliminate the problem but it will reduce it substantially. Another positive note is that purebred breeders are now accustomed to national sire evaluation and in fact believe it to be a sound program for genetic improvement. Many understand the concept and the terminology being used. The application of the animal model will put within herd evaluation on a similar level of acceptance. When a program works breeders are the first to know and they become eager to know more about such programs and to participate in them. One final point that will make the educational process easier is that the genetic evaluations will be very acceptable to commercial producers. The response to such programs by the commercial industry may be astounding. Commercial producers will be able to buy breeding value with a level of confidence never afforded them in the past.

There will be problems to solve with respect to how often the evaluation procedure has to be run. The need to make the evaluations a part of breeder merchandising programs is obvious. There may be a conflict between what is needed for genetic improvement and what is needed for merchandising. Each orgainzation responsible for such a program will have to evaluate its needs and perhaps make some difficult decisions. The timing of the evaluations is important; however, the frequency with which the evaluations are made will be a compromise of what is needed for genetic improvement and merchandising. This will be directly related to the cost of analysis and dissemination of the information.

Cost of a new genetic improvement program is of major concern to sponsoring organizations. Costs of present day programs are basically absorbed by the sponsoring organizations who have taken the responsibility for their development. Commercial producers will pay more for genetically superior bulls. Whether the commercial industry will pay enough to offset the cost of genetic improvement programs is directly related to the financial return they achieve from the use of superior bulls. The problem has been that the commercial industry does not receive a premium for a superior product because the industry is segmented; thus, there is a limit to what can be paid for bulls. If the new programs are of sufficient scope to enhance efficiency through both growth and fertility the commercial industry would provide support for such programs. It seems doubtful that the present marketing system used in the commercial industry would generate enough income to totally offset the cost of new genetic improvement programs. It seems inevitable that some changes in the commerical marketing system will occur if the industry is to become prosperous and some of the increased income would certainly go into genetic improvement. In addition, the new programs will tend to spot-light the superior individuals in the population making them worth more but probably reducing the value of average to below average individuals. This may reduce purebred cattle registrations which is the main source of income for most organizations sponsoring genetic improvement programs. There may be some way to direct the outside money which finds its way into the purebred cattle industry toward genetic improvement. The competition between breeds may dictate implementation of the new programs to insure survival regardless of cost. This may not be fair but certainly is a part of the free enterprise system under which the cattle industry operates.

There is one final possibility for financing genetic improvement which may need to be explored and that is government support. The cattle industry is important to the nation's food supply, and government has taken a role in ensuring the production of many other commodities. The livestock industry has been fortunate not to require much government intervention. The industry has always been able to solve its own problems and it may do so again. However, if government was to become involved in the cattle industry it would seem that financial support of genetic improvement programs would be far better than subsidies which would require quotas and other regulations.

In conclusion, it is safe to say that the technology for genetic improvement of beef cattle is increasing at an extremely fast rate. This new technology is certainly more complicated than what has been used; however, it will be implemented because the industry demands that it be implemented. It is the responsibility of all who work with the cattle industry to develop the format for a fast, efficient and profitable transition.

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WHERE WE ARE & WHERE BIF MUST LEAD

Bill Borror
BIF President

I enjoy dreaming about how this dynamic beef industry could function if we participants could somehow, someway get our act together. It has been stated that "dreams are cheap". Dreams are cheap but also vitally necessary if we leaders (and by leaders I mean each and everyone of you in this room tonight) are going to identify and quantify the crucial decisions facing us as beef cattle breeders in the years to come. Well, never in my dreams did I visualize myself appearing before such a distinguished group, leaders of the academic and research sector, leaders in the breed associations, the AI industry, and perhaps most important leaders in the beef cattle breeding business. I am not one to back away from a challenge; certainly it is a challenge to prepare remarks which might stimulate the thinking of such a distinguished group as is present here this evening. Dedicated people are the backbone of any organization united for a common purpose. BIF is indeed fortunate to have so many dedicated people working on its behalf.

Performance testing (quantifying my success or failure as a cattle breeder) began early in life for me. As a nine year old my father gave me the opportunity to purchase an Angus cow to supplement my interest in a 4-H steer project. At the same time the family partnership purchased some registered Angus cows to begin a new venture. We had a Holstein herd of some national fame because we had been quantifying the results of that endeavor since its inception. My Uncle Mark had learned the principles of dairy testing as a Kansas State student in 1916. I mention this family history not as any self-serving purpose, but as an illustration of how <u>education</u> and <u>direction</u> are the driving forces behind our progress or lack of same in our life's endeavors. When some 40 years ago, the county extension agent came by to suggest that this Angus enterprise be enrolled in a new pilot program being offered by the University of California, the family was truly excited - because of their education, direction, and past experiences. The work of Gilbert and Hart at UC Davis in developing a beef performance program was being field tested in a few California herds in the early 1940's. I can well remember the visit by Horace Strong and Vard Shepherd, the State livestock specialists, to weigh and grade our first group of calves. No one had figured out what a ratio was in that era, so weaning reports were expressed as pounds + or - the average of the contemporary group. All calculations were done by hand in the county extension office. Turn around time was not too swift. As time went on - late 40's early 50's - more herds became enrolled until it became necessary to form a Beef Improvement Association to handle the data processing chores and administration duties being previously supplied by University Extension. Computer programs were written to facilitate the recordkeeping and I believe California was the first BCIA to publish a computerized dam progeny report. This was a milestone in the recordkeeping process.

Bull Test stations were becoming popular in other areas of the country, so in the late 60's the California B.C.I.A. began a series of bull tests. We did all of the standard things <u>supposed</u> to be done in a bull test. We even had an innovative county agent who began measuring testicles, attempting to correlate testicle size with growth rate. Unfortunately, his <u>direction</u> was a little askew as there was no attempt at correlating testicle size with fertility - which you all know has become a common practice. The test period was followed by an auction sale. Our biggest problem was agreeing on a sale order. We were grading the bulls (another form of visual appraisal); we had A.D.G. and W.D.A. figures. Many fruitless hours were spent agonizing over which trait should have the highest priority. Dr. Willham has defined a "3D" breeding system as having Direction, Decisions, Differences. Well this group working on those sale orders lacked direction - that's for sure, we had decisions to make but were overwhelmed by our differences. At this point in time the breed associations began to see the need for performance records on a national scale. Most state BCIA's, some 25 of them, were processing information in a variety of ways. The need for a Federation of these groups became evident, so in 1968 BIF was born. Committees of various disciplines were formed to write Guidelines for standard recordkeeping procedures. The concept of making selections based on "Breeding Values" for various traits has been implemented. The structure for National Sire Summaries was laid out and these are now being published by many breed associations.

So, we have come along way since that extension agent visit I experienced some 40 years ago. Where do we go from here? What does the future hold? All of the excercises we go through, collecting data, processing that data, and utilizing the results are of little value unless those efforts have some positive influence in the breeding of improved cattle. Dr. Willham has defined the breeding problem as the methodology to select and combine germ plasm that results in superior stock to that previously produced. You notice he doesn't define "superior". Going back to his "3D" breeding program - Direction, Decisions, Differences - certainly we can agree there are differences in our cattle population. Differences in growth rate, milking ability, color, calving ease, etc. In the past 15 years we have seen an increase in the magnitude of these differences, witness the importation of the continental breeds to the U.S. and increased popularity of the Brahman influence. These differences are the raw material of the selection process.

Do we, and I am referring to BIF and its member organizations, have in place the necessary tools to evaluate properly the differences we use in our selection process? The BIF Guidelines have defined the measurable traits and setup procedures for their evaluation. These are continually being revised by BIF committees and the Board of directors. There is more work to be done. The organizational structure is in place to make changes in the procedure as the need arises. The speakers this morning referred to some of the changes being considered.

We can make the proper decisions using the differences available to us if we have the proper direction. Defining proper direction - that is the task before us as breeders and as leaders of a National Beef Improvement Federation. A breeders breeding program direction is his own business; no one needs to interfere with that. However, my feeling is that breeders are asking for more information in order to make those decisions about their direction.

Perhaps one example might illustrate my point. Back to the bull test stations I described earlier. It is only human nature (at least the American version) to attempt to win contests when entered. Bull tests are contests and to win a test station gain record, one must shoot for the max. This entails using more than just one generation of the highest growth sires available. That is o.k. if maximum growth is always going to be the most important trait to my customer who is going to buy these tested bulls. Fortunately my customers are cowmen (otherwise they wouldn't be needing bulls). They need bulls that sire heifers that develop into high producing cows with a high degree of reproductive efficiency. Unfortunately, at least in the breed of cattle I have been working with for 40 years, when I shoot for the max on growth, I do it at the detriment of these other highly important traits.

Do I really need to breed cattle to win test stations or is this just an influence from outside my breeding plan I should ignore.

Another obvious outside influence bearing down on our direction is that of the show ring. The people (judges and sale managers) that are telling us what cattle are best are only looking at extremes. I will not bore you with an extensive critique on the folly of using show-ring evaluation to make breeding decisions, because you all know the consequences.

Bull test centers and the showring, two of the outside influences that are using extremes to maximize selection pressure for single traits; I'm sure there are others. Can BIF develop a system for multiple trait selection? BIF explored the concept of a systems approach to beef cattle breeding in depth at our convention two years ago in Rapid City. Jim Gibb is heading a committee working on this concept. The two previous BIF presidents have expressed a strong concern that a systems philosophy be incorporated in future beef cattle breeding. My analysis is that the development of a workable plan to initiate a systems philosophy will be slow, and educating the breeders to use it may be even slower. The most critical item to influence the direction of breeding programs should be, "what do our customers need and what will they be willing to pay for at a price that we can live with?" The challenge to the researchers and academe is to develop guidelines to give breeders, both seedstock and commercial, sound information to formulate the direction of their breeding programs. What is the job description of that commercial cow given varying environmental constraints? How big should she be? What are the trade offs from increasing frame vs. calving ease vs. milk production. Quantifying the input variables into a breeding system and their interaction with each other is the challenge. Without that quantification we just play a guessing game and are wasting those generations that come so slowly.

Another area of great importance to our efforts in BIF involves education and utilization. I am privledged to host five different meat production classes from local colleges and Universities at our ranch each year. These students for the most part have never been exposed to the philosophy of breeding cattle according to the principles of BIF. They have come up through 4-H and FFA programs and some have been on collegiate judging teams. Visual appraisal has been their guiding light. When I tell them that my customers really need maternal value in the bulls they purchase from me, and that it is impossible to visually appraise a bull for maternal value, they look at me in disbelief. They are caught up in the "perfect bull syndrome" always looking for the best which really means looking for the prettiest. We in BIF must design educational programs for these future cattle persons and their instructors. Your Board of directors through its Utilization committee head by Earl Peterson has taken the bull by the horns in this endeavor. Four items being covered in their meeting in the morning include:

1) Education fact sheets covering several disciplines explaining the basics of performance programs and how to implement them.

2) Slide sets with dialogue for use by youth groups and breed associations.

3) Computer software programs for commercial producers.

4) Incorporating performance evaluation in collegiate, 4-H, and FFA judging contests.

The BIF update column that Ike Eller puts out for the press each month is proving to be a very efficient means of disseminating information. Educational programs are a new direction for BIF. We are excited about the possibilities in this realm of activity.

I began these remarks with dreams. In the not too distant future we will have available to us shirt pocket computers that will have memories capable of storing all the information necessary to make the breeding and management decisions for our cowherds. We will no doubt have direct access to the databanks of our breed associations. Much of the information stored in these computers will be similar to what is now recorded, some will be different. Thus BIF, through its deliberations will make the decisions on what that information will be. Turn around time in recordkeeping will be eliminated as on-farm computers become commonplace. Already we can have sire summaries printed within the hour after calves are weighed. Improved programming will facilitate computation of EPD's - Breeding Values in the same time frame. Even feedlot buyers could have the expected predictability of the cattle they are buying at their fingertips. Bull customers can purchase their bulls with a high degree of reliability for the traits important to them. The list could go on and on. Dreams are cheap but as time moves on some of them will be fulfilled!

BIF will lead the way by defining what is a "superior" beef critter. BIF will lead the way by seeing that the proper information is available for breeders to make correct decisions about the direction of their breeding programs. BIF will lead the way in developing educational material and programs for member organizations to utilize that methodology and information. That is our challenge for the future.

SIRE EVALUATION COMMITTEE MEETING

R. L. Willham, Chairman   L. L. Benyshek, Secretary

The major concern of the meeting was a review and discussion of the guidelines for National Sire Evaluation Programs and Predicting Breeding Values. The committee was provided a draft containing updates to the guidelines for these programs including Appendix 9 (analysis procedures).

There was a suggestion to include a brief discussion on "connectedness" to the guidelines for National Sire Evaluation. This is in light of the fact that most breed associations are now using field data rather than designed progeny tests. Designed tests used designated reference sires to ensure connectedness whereas the field data programs use the natural data structure to include all sires which are connected to the main body of data.

A motion was made by Bill Slanger and seconded by Bob Scarth to use

$$1 - \sqrt{\frac{\text{Prediction Error Variance}}{\text{Sire Variance}}} \quad \text{rather than}$$

$$1 - \frac{\text{Prediction Error Variance}}{\text{Sire Variance}} \quad \text{as the definition of}$$

Expected Progeny Difference accuracy. The first expression provides a more conservative accuracy value. The motion passed.

A motion was made by Pete Burfening and seconded by Dick Quaas to remove Appendix 9 from the Guidelines and to include appropriate references in the Guidelines text. The motion passed.

Jeff Berger moved to submit the amended Guidelines for National Sire Evaluation to the BIF board of directors. Bill Slanger seconded and the motion passed.

A suggestion was made to replace the Estimated Breeding Value section of the Guidelines with a discussion (draft included with these minutes) of Predicting Breeding Values. References should be included in the Predicting Breeding Values text.

Bob Koch moved to include the draft on Predicting Breeding Values in the Guidelines. Bob Scarth seconded and the motion passed.

Meeting adjourned.

National Sire Evaluation Program

(DRAFT)

BASIC CONSIDERATIONS

National sire evaluation has as its goal the increase in the number of sires that can be fairly compared on breeding value differences obtained from all sources of information. As more is learned about the beef population through sire evaluation analyses and as more complex models are used in the analyses, all sources of information on breeding value will become more useful.

Because of the economic potential of crossbreeding, each breed association should be encouraged to develop a breed-wide sire evaluation program for its members. Use of these programs will strengthen breed association efforts to help their breeders supply the genetic material for commercial cattle production.

A national sire evaluation program for a breed is an objective program designed and conducted by an organization having no direct interest in the test bulls. The purpose of such a program is to increase the effectiveness of sire selection in breeding programs.

The basic problem in sire evaluation is one of comparison. The BIF Guidelines for National Sire Evaluation Program have incorporated experience in dairy sire evaluation and the realities of the beef industry into a system that uses sires having large numbers of progeny in many herds as a basis for comparison.

PROGRAM TYPES

Several types of National Sire Evaluation Programs are being conducted. Program types range from the use of existing field records, to designed programs conducted completely by the breed organization. The element common to all program types is the use of sires having large numbers of progeny as a basis for comparing sires.

Field data sire evaluation uses the records available from performance testing programs to estimate the expected progeny differences of sires.

Designed sire evaluation is conducted by breed organizations. They specify the progeny testing procedures and the use of designated reference sires. Programs vary in the amount of control exercised over progeny tests and in the use of sires for comparison.

THE PROGENY TEST

The basics of a sound progeny test are:

1. Comparable cows. All bulls to be evaluated must be mated to comparable cows, to eliminate differences in cows from the differences between averages for sire progeny. To assure that the cows are as comparable as possible, they should be assigned at random to the sires within known groupings. See (2) of test procedures.

2. Equal treatment of progey. Progeny from all bulls must be given equal treatment, to eliminate environmental differences from the differences between averages for sire progeny.

Any deviation from these basics leads to comparisons among bulls that do not reflect their breeding value differences accurately.

These criteria can be used to develop procedures and checks:

1. Credibility. The degree of control over the progeny tests must be such that the results of the program will have credibility with the industry.

2. Participation. The procedures and checks imposed must be easy to follow so there will be maximum participation in the program by breeders.

It is not easy to design and conduct a nationwide program incorporating significant germ plasm of a breed while maintaining high credibility. Suggested test procedures and checks for designed programs follow:

1. Planning. All progeny tests need to be planned carefully in advance. The number of progeny from reference sires is 20 when only one test

bull with 20 progeny is being compared. The number of progeny from reference sires increases by five with each additional test bull being compared, up to seven test bulls and 40 progeny. For over seven test bulls, no progeny beyond 40 are needed. Multiherd tests are thus encouraged.

2. Cow assignment. Progeny tests may be conducted using any type of cows, since comparisons among test bulls and reference sires are all within equal opportunity groups. The available test cows are grouped according to all known differences, such as age, breed or cross, and management group. Each test bull and the reference sires need to be bred to a proportion of each cow group.

3. Cow randomization. The bulls must be mated at random to cows within each cow group. Depending on the circumstances, two randomization procedures recommended are:

   Assignment of cows to bulls within cow groups at random before the breeding season; a procedure recommended for breeders testing bulls in their own herd to increase credibility.

   Random assignment of bulls to a breeding chute rotation, thus listing the order of bulls to be used as cows come into estrus; a procedure recommended for breeders testing bulls in contract herds where those doing the breeding have no direct interest in the test bulls. This chute randomization procedure, which helps to spread the calves by each sire over the season, is the method preferred by BIF.

4. Progeny treatment. The progeny tests must be conducted so that the resulting progeny are managed as uniformly as possible within cow groups. Or the progeny must be stratified so that all sire progeny groups are represented in each sex-management group. Bull, steer, or heifer progeny may be used in the test.

5. Data control. The organization needs assurance that the cows were bred as planned. Birth dates need to be reported promptly and accurately. The tests and resulting measurements required by the organization for the particular breed need to be taken and recorded as

prescribed by BIF. The organization should be able to inspect the performance records for accuracy.

REFERENCE SIRE SYSTEMS

The organization conducting the breed sire evaluation is responsible for the reference sire system. In the designed test, where the reference sires are stipulated by the organization, part of the program includes cooperative handling and distribution of frozen semen for the progeny tests. Also, a procedure must be established by the organization for assigning usage of sires so that all reference sires are compared adequately with each other. In breeds with sires used extensively by AI, designation of reference sires is not really necessary. However, to assure that bulls can be fairly compared, use of sires appearing in a previous report is recommended.

The criteria for a reference sire in those programs using field records is that he have a large number (100 to 500) of progeny evaluated in a large number (10 to 50) of herd-groups in comparison with many (5 to 10) other reference sires. A sire is used as a reference sire for at least 2 years with approximately one-half replaced in any 1 year. The number of designated reference sires should be the minimum needed to facilitate accurate comparisons while still retaining enough sires to service an expanding number of cows.

Programs using the natural data structure (sires used extensively in AI) of the breed, should ensure that sires listed belong to the group of sires that are tied together. In this way, fair comparisons among sires is assured.

EXPECTED PROGENY DIFFERENCE (EPD)

The expected progeny difference is an estimate based on existing progeny data of half the breeding value of a sire or what he is expected to transmit to his offspring. It is an estimate of how future progeny of the sire are expected to perform relative to the progeny performance of the reference sires, when both are mated to comparable cows and the resulting progeny are treated alike.

The important aspect in progeny difference is to predict future progeny performance from the sample of progeny performance currently available.

Therefore, the sire progeny differences are regressed toward the average expected progeny difference, which is zero, depending on the number and distribution of progeny involved in the difference and on the heritability of the particular trait. The expected progeny difference should be reported in the units of measure of the trait. It can be either a plus difference or a minus difference.

With each expected progeny difference, there will be an accuracy or reliability value. The accuracy of an expected progeny difference is based on the number and distribution of available progeny and the kind and amount of relative data available when relationships are used in the analysis. As the number of progeny and/or relative information increases, the expected progeny difference becomes a more accurate or reliable predictor of the future mean progeny difference of a sire.

The following definition of sire expected progeny difference accuracy is appropriate for evaluations using best linear unbiased prediction:

$$\text{Accuracy} = 1 - \sqrt{\frac{\text{Prediction Error Variance}}{\text{Sire Variance}}}$$

Accuracy computed in this manner will range between 0 and 1, with 1 being perfect accuracy. The prediction error variance of a sire is obtained from the inverse element on the lead diagonal of the coefficient matrix of the mixed model equations. In evaluations where the inverse cannot be computed because of matrix size, prediction error variance can be sufficiently approximated for the accuracy calculation (see appendix).

In sire evaluations that compute sire expected progeny differences by adding the sire group effect and the sire prediction within group effect, it may be appropriate to replace "Prediction Error Variance" with "Evaluation Error Variance" (see appendix) in the accuracy equation. When the number of sires in a sire group is of the same order of magnitude as the diagonal elements of the mixed model sire equations, "Evaluation Error Variance" is more appropriate than "Prediction Error Variance". When the number of sires within each group exceeds the magnitude of the sire equation diagonal elements, "Prediction Error Variance" is sufficient to determine expected progeny difference accuracy values.

Sire expected progeny differences computed within the same mixed model sire evaluation are directly comparable without regard to any accuracy value. This is because the expected progeny differences are regressed toward the average for each respective sire, depending on the number and distribution of progeny and the relatives used. The accuracy value only provides the breeder with an assessment of the extent of the regression and the likelihood of possible change in a sire's expected progeny difference when determined in a future sire evaluation.

ANALYSIS PROCEDURES

The calculated expected progeny differences and their possible change values from all sire evaluation programs need to be interpreted the same way by the beef industry. A common analysis procedure will help. Currently, most sire evaluation programs are using a mixed-model analysis developed by Henderson and others. The model is:

$$y_{ijk} = \mu + h_i + s_j + e_{ijk}$$

where y_{ijk} is the record on the k^{th} progeny of the j^{th} sire in the i^{th} contemporary group, μ is the population mean, h_i is the fixed effect of the i^{th} contemporary group, s_j is the random effect of the j^{th} sire or the expected progeny difference and e_{ijk} is the unexplained random effect of the k^{th} progeny. Appendix 9 provides a procedure for the estimation of expected progeny differences and their accuracy.

As the various sire evaluation programs mature and there is a listing of a large number of sires, the current model will need modifying to account for any existing genetic trend. There are three ways to accomplish this. The first is a modification of the model to include a group effect. The model is:

$$y_{ijk\ell} = \mu + h_i + g_j + s_{jk} + e_{ijk\ell}$$

where $y_{ijk\ell}$ is the record on the ℓ^{th} progeny of the k^{th} sire in the j^{th} group of sires in the i^{th} contemporary group. The new effect in the model is "group of sire effect." Sires can be grouped in a number of ways, but the most useful way is to group them into birth year or age groups.

The group equations are easily formed by summing the sire equations of the sires belonging to each group. The sum of the group effects is set equal to zero, and the sire equations are augmented on the lead diagonal and the equations solved with an iteration procedure or the inverse. This gives a floating base sire evaluation. Setting the earliest group effect to zero gives a fixed base where all values are expressed relative to that group. Most current values are on a floating base. The resulting estimates of the group effects, or $\hat{g}_j$ values are the differences in average performance of the sire groups. When sires are grouped by birth year, the $\hat{g}_j$ values represent the genetic trend. If substantial differences are found in the average performance of sires in the different groups, grouping is necessary because the individual sire effects, or $\hat{s}_{jk}$, are regressed for numbers and imcomplete heritability back toward the group effect to which the sire belongs. If grouping is not done, all sires are regressed to a common mean. The expected progeny difference for a sire when grouping is used is:

$$\text{EPD} = \hat{g}_j + \hat{s}_{ik}$$

The group effect plus the sire-within-group effect constitutes the expected progeny difference. When considering whether there is a need to group, organizations can average expected progeny differences by sire age. If differences are small, it will not be necessary to group.

The second way to account for genetic trend is to utilize the inverse of the numerator relationship matrix in the solution of the absorbed-sire equations. See appendix 9 for the equations. This procedure also will account for genetic trend by involving the pedigree relationships of the sires. Methods are available to calculate the inverse of the numerator relationship matrix, which is the size of the sire equations, by using the registration number of each sire and his sire's and dam's registration numbers. This matrix is then added to the left-hand-side of the sire equations, and they are solved for expected progeny differences in the usual manner.

The resulting expected progeny differences, besides being adjusted for genetic trend, can have smaller accuracy values when the information on relatives (sire values used in son's values, and others) is included. Choice of either method of considering genetic trend will depend on study of both procedures using particular sire evaluation data.

The third way to account for genetic trend is to include sire groups and use a partial relationship matrix that includes sires and maternal grandsires only. This procedure is in use in breeds where the numbers of dams is very large. The sire groups then account for the remainder of selection practiced on the dams. To obtain the genetic trend the EPD values consisting of the group plus sire within effect must be averaged by birth years or the sire groups.

A method is available to account for sire by contemporary group interaction. An analysis of some sets of sire evaluation data suggests that sires do not rank exactly the same in all regions of the United States. Provided the ratio of the error variance to the interaction variance is available, the interaction equations can easily be absorbed into the sire equations and these solved using standard procedures. The resulting expected progeny differences rank the sires over area or region. If the interaction is large between areas or regions, the sires can then be ranked within area or region by a mixed-model analysis within each area or region.

Rather than accounting for a possible sire by contemporary group interaction it is possible to account for the performance of the dams of the progeny being used to evaluate the sires. The model is:

$$y_{ijk\ell mn} = \mu + h_{ij} + g_k + s_{k\ell} + d_{im} + e_{ijk\ell mn}$$

where $y_{ijk\ell mn}$ is the record on the n^{th} progeny from the m^{th} dam of the i^{th} herd and the ℓ^{th} sire of the k^{th} group of sires in the j^{th} contemporary group of the i^{th} herd. This model would relax the first BASIC of progeny testing that the sires must be mated to a comparable group of cows.

The analysis requires reading the records in dam progeny order within a herd and absorbing dams as the contemporary group and sire equations are made. At the end of each herd the contemporary group equations are absorbed into the sire equations and these from each herd are stored until all herds are processed. This second absorption requires an inverse to be calculated for each herd. Since dams have only one progeny per contemporary group, the contemporary groups within a herd are not only tied together by sire groups but also by progeny from the same cow. The result is that more sires can be fairly compared. After the absorptions, the sire equations are solved as with the other models for sire EPD values. This model although more difficult to use can help eliminate problems resulting from the use of selected females to produce progeny from popular sires. As more breeders use the results of national sire evaluation, models that better describe the data must be employed to continue the usefulness of the evaluations.

Rather than fitting dams in the model, maternal grandsires could be fit. This can be done more easily than the dam absorption, but results in more equations for sires to solve.

Mixed model methodology is available for a multiple trait analysis. By the use of the variances and covariances, both genetic and environmental, it is possible to develop sire equations, one for each trait, which are solved simultaneously to give EPD values on each sire for each trait. Because the traits, especially birth, weaning, and yearling weight, are correlated this method is the best solution to handle sequential selection where only selected animals have the latter traits measured on them. Further, it uses correlations among traits to better predict the EPD values for traits. Standard use involves the solution of a system of equations numbering the number of sires times the number of traits. However, procedures are available to utilize the information on the other traits by appropriate transformation such that an equation for each sire only needs to be simultaneously solved thus reducing the magnitude of the problem. These values would be the same as if all equations had been solved.

A publication titled "Analysis of sire evaluation data by mixed model procedures" is available on request. This publication could be used to develop programs for data analysis when simple models are used.

PUBLICATION OF A SIRE SUMMARY

Periodically, the organization conducting the program should publish a sire summary that includes information on all sires evaluated regardless of their merit. The purpose of such a sire summary is to describe the germ plasm available for traits considered of major economic importance to the breed. Selection of sires from among those described is the prerogative of the breeder.

A sire summary should include all descriptive data that are necessary and available, so the breeders have a basis for rational decisions. Suggested inclusions are as follows:

1. Identification. Complete sire information, including the parentage.

2. Sire evaluation. For the traits considered of prime importance to the breed, at least the following two items should be included on each sire:
   a. The expected progeny differences reported in the units of measure of the trait.
   b. The accuracy of the EPD.

The exact format for such a sire summary is left to the organization conducting the breed program. Genetic trends of the breed should be included in graphic form for the benefit of the user in selecting sires.

TRAITS

Performance

Selection of the particular traits that should be evaluated in a National Sire Evaluation Program is the prerogative of the organization conducting the program for the breed. Traits suggested for consideration by breed programs are as follows:

1. Reproduction. Expected progeny differences for calving ease and/or birth weight are essential for some breeds. Scrotal circumference EPD values may be useful when enough data becomes available. Inclusion of EPD values for mature size of daughters and their overall maternal performance, both fertility and milk production, is badly needed.

2. Production. BIF recommends several measures of growth during the relevant commercial period, such as weaning weight and several measures of yearling weight (365-day, 452-day, or 550-day). Again, provisions to include the milk production EPD values based on daughters is desirable.

3. Product. The amount (yield grade) and quality (quality grade) of the product produced is not measurable directly for sires. Information on carcass evaluation adds new information in a sequential selection scheme. Such carcass progeny tests can be used effectively as sib tests on the sons from tested sires.

Genes With Major Effects

Breeders need to be on the lookout for animals that may have a major gene that contributes to performance. Such desirable genes could prove to be useful in cattle breeding. Ways exist to evaluate such genes in the hands of a geneticist.

The problem of undesirable genes is always present in the beef industry. Bulls may be progeny tested for undesirable recessive genes by two methods. Both methods test for all recessives. The first method is breeding to a large cross-section of cows. The probability of detection is a function of the existing gene frequency:

$$\text{Probability of detection} = 1 - (1 - 1/2q)^n$$

where (q) is the gene frequency in the cow, and (n) is the number of progeny. This procedure allows a short generation interval, yet keeps undesirable, recessive genes at a low frequency.

The second method is to breed a sire to his daughters under strict supervision by the organizations sponsoring the test. The probability of detection uses the same formula, with (q) equal to 1/4. The production of normal offspring from 22 daughters gives a probability of 19 in 20 that the sire does not contain a specific recessive gene. From 35 daughters, the probability is 99 in 100.

THE FUTURE OF SIRE EVALUATION

BIF's philosophy in the development of guidelines for National Sire Evaluation Programs relates to the overall spirit and rationale of sound programs, rather than specific details. This generality is intentional. Several sound programs of different types are now in operation in the beef industry. Much can be learned from this variety of approaches to the problem of sire evaluation. With the spirit of cooperation now prevailing in the Beef

Improvement Federation among the organizations conducting sire evaluation programs, shared experiences should lead to marked improvement in design and conduct of these programs and to the improvement of the entire beef industry.

Mixed model methodology is just as useful for within herd analyses. It can account for competition within contemporary groups and for the genetic trend in a particular herd. The procedure would eliminate the use of ratios and breeding values or EPD values would be reported in the units of measure for the traits. Use of the inverse of the numerator relationship matrix allows all relative information to be used in the calculation of the EPD values for all animals in the herd that would be available for selection.

Such within herd analyses might be used to develop the sire equations for a national sire evaluation. The national sire evaluation might be used as the starting point from which to back solve for the dam and contemporary group effects in a particular herd and complete a within herd evaluation as new data are introduced from a herd and selections need to be made. Then the values from all herds would be directly comparable over the breed since each herd is expressed relative to the breed average from the national sire evaluation.

Using such approaches it is possible to use all available information to produce EPD values on yearling bulls and heifers. This greatly expands the numbers of sires that can be fairly compared on their breeding value which was the goal of national sire evaluation from the beginning.

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ANALYSIS OF SIRE EVALUATION DATA BY MIXED MODEL PROCEDURES

(DRAFT)

This presentation should be available on request to interested parties.

The intent of this appendix is to demonstrate the procedures to follow for a mixed model analysis of sire evaluation data.[1] The information should provide the necessary background for getting the programming ready for data inputs and carrying out solutions to yield expected progeny differences (EPD) values and accuracy values.

BASIC MIXED MODEL

The mathematical model for the analysis is $y_{ijk} = \mu + h_i + s_j + e_{ijk}$, where y_{ijk} is the record on the k^{th} progeny by the j^{th} sire in the i^{th} herd or group, μ is the population mean, h_i is the effect of the i^{th} herd or contemporary group, s_j is the effect of the j^{th} sire, and e_{ijk} is the unexplainable random portion of y_{ijk}. Equations are set up to solve for the sire effects (EPD's) with $\mu + h_i$ effects absorbed. Absorption, merely a mathematical manipulative technique, allows the herd effects to be considered in the analysis without actually estimating them, thus, minimizing the number of equations to be solved.

The model for the analysis can be written in matrix notation as follows:

$$\underline{y} = X\underline{h} + Z\underline{s} + \underline{e}$$

where $\underline{y}$ is a vector of all the records, X is a known incidence matrix associating each record with a specific herd or contemporary group, $\underline{h}$ is an unknown vector of herd or contemporary group fixed effects, Z is a known incidence matrix associating each record with a specific sire, $\underline{s}$ is an unknown vector of random sire EPDs, and $\underline{e}$ is a vector of residual random errors. The mixed model equations are formed by writing the least squares equations for

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[1]The procedures described and the theory on which they are based were developed by C. R. Henderson. For detailed account, see:

Henderson, C. R., 1973, "Sire Evaluation and Genetic Trends," proc. of the Animal Breeding and Genetics Symposium in Honor of Dr. Jay L Lush, American Society of Animal Science and American Dairy Science Assoc., Champaign, Ill., p. 10, and

Henderson, C. R., 1974, "General Flexibility of Linear Model Techniques for Sire Evaluation," *Journal of Dairy Science* 57:963

the model and augmenting the sire effects with the appropriate covariance structure follows:

$$\begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z + G^{-1} \end{bmatrix} \begin{bmatrix} \tilde{\underline{h}} \\ \tilde{\underline{s}} \end{bmatrix} \begin{bmatrix} X'\underline{y} \\ Z'\underline{y} \end{bmatrix}$$

where G^{-1} is equal to σ_e^2 times $[Var(s)]^{-1}$. If sire effects are uncorrelated then Var(s) is equal to $\sigma_s^2 \cdot I$. If sire relationships exist and are known then Var(s) is equal to $\sigma_s^2 \cdot A$, where A is the numerator relationship matrix. After absorption of the herd or contemporary groups, the mixed model equations are of the form

$$[Z'SZ + G^{-1}]\ [\tilde{\underline{s}}] = [Z'S\underline{y}]$$

where $S = I - X(X'X)^{-}X'$

NUMERICAL PROCEDURES FOR SOLVING THE MIXED MODEL EQUATIONS

The absorbed set of mixed model equations, $[Z'SZ + G^{-1}]\ [\tilde{\underline{s}}] = [Z'S\underline{y}]$ can be represented as As = B where A is a pxp matrix (p = number of sires to be evaluated) and is called the coefficient matrix, s is a px1 vector of the sire effects, and B is a px1 vector and is called the right-hand side vector. The following shows the equations in more detail:

$$\begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1p} \\ A_{21} & A_{22} & & \\ \vdots & & \ddots & \\ A_{p1} & & & A_{pp} \end{bmatrix} \begin{bmatrix} s_1 \\ s_2 \\ \vdots \\ s_p \end{bmatrix} = \begin{bmatrix} B_1 \\ B_2 \\ \vdots \\ B_p \end{bmatrix} \qquad (1)$$

or in linear form:

$$\begin{aligned} A_{11}s_1 + A_{12}s_2 + \ldots + A_{1p}s_p &= B_1 \\ A_{21}s_1 + A_{22}s_2 + \ldots + A_{2p}s_p &= B_2 \\ &\vdots \\ A_{p1}s_1 + A_{p2}s_2 + \ldots + A_{pp}s_p &= B_p. \end{aligned} \quad (2)$$

Thus, there are p equations with p unknowns (s values). The values in A and B are as follows:

$$A_{11} = \sum_i n_{i1.} \left(1 - \frac{n_{i1.}}{n_{i..}}\right) + \alpha$$

$$A_{22} = \sum_i n_{i2.} \left(1 - \frac{n_{i2.}}{n_{i..}}\right) + \alpha$$

Thus, the r[th] diagonal element of A is $\sum_i n_{ir.} \left(1 - \frac{n_{ir.}}{n_{i..}}\right) + \alpha$ where $\alpha = 4/h^2 - 1$, h^2 = heritability of the trait.

$$A_{12} = -\sum_i \frac{n_{i1.}\, n_{i2.}}{n_{i..}}$$

$$A_{13} = -\sum_i \frac{n_{i1.}\, n_{i3.}}{n_{i..}}$$

$$A_{1p} = -\sum_i \frac{n_{i1.}\, n_{ip.}}{n_{i..}}$$

$$A_{21} = -\sum_i \frac{n_{i2.}\, n_{i1.}}{n_{i..}}$$

Note that $A_{12} = A_{21}$, the two halves of the A matrix, are mirror images; that is, any $A_{ij} = A_{ji}$. The uv[th] off-diagonal element of A is $-\sum_i \frac{n_{iu.}\, n_{iv.}}{n_{i..}}$

$$B_1 = \sum_i n_{i1.} (\bar{y}_{i1.} - \bar{y}_{i..})$$

$$B_2 = \sum_i n_{i2.} (\bar{y}_{i2.} - \bar{y}_{i..})$$

Thus, the r[th] element of B is $\sum_i n_{ir.} (\bar{y}_{ir.} - \bar{y}_{i..})$.

An explanation of the notation may be necessary here.

$n_{i1.}$ = number of progeny by sire No. 1 in the i[th] herd
$n_{i..}$ = number of total progeny in the i[th] herd
$n_{i2.}$ = number of progeny by sire No. 2 in the i[th] herd
i = summation over subscript i (over all herds)
$\bar{y}_{i1.}$ = mean of progeny records by sire No. 1 in the i[th] herd
$\bar{y}_{i..}$ = mean of all progeny records in the i[th] herd

Consider the following example where the only progeny are those by sires 1, 2, and 3 in herds 1, 2, and 3.

	sire 1	sire 2	sire 3	herd summary
herd 1	10 progeny 1,000-lb. avg.	10 progeny 1,050-lb. avg.	no progeny	20 progeny 1,025-lb. avg.
herd 2	20 progeny 1,050-lb. avg.	no progeny	10 progeny 900-lb. avg.	30 progeny 1,000-lb. avg.
herd 3	no progeny	30 progeny 925-lb. avg.	10 progeny 825-lb. avg.	40 progeny 900-lb. avg.

$n_{11.} = 10, n_{12.} = 10, n_{13.} = 0, n_{1..} = 20, \bar{y}_{11.} = 1{,}000, \bar{y}_{12.} = 1{,}050, \bar{y}_{13.} = 0, \bar{y}_{1..} = 1{,}025$

$n_{21.} = 20, n_{22.} = 0, n_{23.} = 10, n_{2..} = 30, \bar{y}_{21.} = 1{,}050, \bar{y}_{22.} = 0, \bar{y}_{23.} = 900, \bar{y}_{2..} = 1{,}000$

$n_{31.} = 0, n_{32.} = 30, n_{33.} = 10, n_{3..} = 40, \bar{y}_{31.} = 0, \bar{y}_{32.} = 925, \bar{y}_{33.} = 825, \bar{y}_{3..} = 900$

The elements of A and B can be found in the following ($h^2 = 0.40, \alpha = 9$):

(3)

$$A_{11} = 10(1 - 10/20) + 20(1 - 20/30) + 0(1 - 0/40) + 9 = 20.667$$
$$A_{22} = 10(1 - 10/20) + 0(1 - 0/30) + 30(1 - 30/40) + 9 = 21.500$$
$$A_{33} = 0(1 - 0/20) + 10(1 - 10/30) + 10(1 - 10/40) + 9 = 23.167$$

$$A_{12} = A_{21} = -[(10 \times 10)/20 + (20 \times 0)/30 + (0 \times 30)/40] = -5.000$$
$$A_{13} = A_{31} = -[(10 \times 0)/20 + (20 \times 10)/30 + (0 \times 10)/40] = -6.667$$
$$A_{23} = A_{32} = [(10 \times 0)/20 + (0 \times 10)/30 + (30 \times 10)/40] = -7.500$$

$$B_1 = 10(1{,}000 - 1{,}025) + 20(1{,}050 - 1{,}000) + 0(0 - 900) = 750$$
$$B_2 = 10(1{,}050 - 1{,}025) + 0(0 - 1{,}000) + 30(925 - 900) = 1{,}000$$
$$B_3 = 0(0 - 1{,}025) + 10(900 - 1{,}000) + 10(825 - 900) = -1{,}750$$

Note here that the sum of the elements in B is zero. The equations to be solved are:

(4)

$$\begin{aligned} 20.667\, s_1 - 5.000\, s_2 - 6.667\, s_3 &= 750 \\ -5.000\, s_1 + 21.500\, s_2 - 7.500\, s_3 &= 1{,}000 \\ -6.667\, s_1 - 7.500\, s_2 + 23.167\, s_3 &= -1{,}750 \end{aligned}$$

Solutions to the equations As = B can be obtained by iteration. Iteration is a repetitive process of re-estimating the values of s using previous estimates of s. Iteration is completed when successive estimates of all s_j value meet a prescribed degree of agreement. The equations in (2) can be written as follows:

$$s_1 = \frac{1}{A_{11}} (B_1 - A_{12}s_2 - A_{13}s_3 - \ldots - A_{1p}s_p)$$
$$s_2 = \frac{1}{A_{22}} (B_2 - A_{21}s_1 - A_{23}s_3 - \ldots - A_{2p}s_p)$$
$$\vdots$$
$$s_p = \frac{1}{A_{pp}} (B_p - A_{p1}s_1 - A_{p2}s_2 - \ldots - A_{p(p-1)}s_{p-1})$$

Initially, no estimates for the s vector are available, and so, they are assumed to be zero. Thus, the first estimates, ^1s, are the following:

$$^1s_1 = B_1/A_{11}$$
$$\vdots$$
$$^1s_p = B_p/A_{pp}$$

From here on, the most recent estimates of the s values are used. Observe the following (the notation $^2s_1$ refers to the second estimate for sire #1):

$$^2s_1 = \frac{1}{A_{11}} (B_1 - A_{12}{}^1s_2 - A_{13}{}^1s_3 - \ldots - A_{1p}{}^1s_p)$$
$$^2s_2 = \frac{1}{A_{22}} (B_2 - A_{21}{}^2s_1 - A_{23}{}^1s_3 - \ldots - A_{2p}{}^1s_p)$$
$$^2s_3 = \frac{1}{A_{33}} (B_3 - A_{31}{}^2s_1 - A_{32}{}^2s_2 - A_{34}{}^1s_4 - \ldots - A_{3p}{}^1s_p)$$

For $^2s_1$ above, only the first estimates on the other sires were available. For $^2s_2$, the second estimate of s_1 plus the first estimates on the other sires were available. In general notation, these are represented by the following:

$$^{K+1}s_j = \frac{1}{A_{jj}} \left(B_j - \sum_{m=1}^{j-1} A_{jm}\, {}^{K+1}s_m - \sum_{m=j+1}^{p} A_{jm}\, {}^{K}s_m\right)$$

The process continues or repeats through the sires until $|^{K+1}s_j - {}^Ks_j|$ is less than some prescribed value for *all* sires. From the example in equations (4), solutions via iteration would proceed as follows:

$$\begin{aligned} s_1 &= 750/20.667 = 36.2897 \\ ^1s_2 &= 1000/21.500 = 46.5116 \\ ^1s_3 &= -1750/23.167 = -75.5385 \end{aligned}$$

$$^2s_1 = \frac{1}{20.667} [750 - (-5.000)(46.5116) - (-6.667)(-75.5385)] = 23.1743$$

$$^2s_2 = \frac{1}{21.500} [1000 - (-5.000)(23.1743) - (-7.500)(-75.5385)] = 25.5503$$

$$^2s_3 = \frac{1}{23.167} [-1750 - (-6.667)(23.1743) - (-7.500)(25.5503)] = -60.5978$$

and so forth. When finished, the final s values are the EPD values.

The value of σ^2 requires some extra calculations on the data, but these are relatively simple. The following describes what is necessary for these calculations:

$$\sigma^2 = (T - H - S)/(n_T - n_h - n_s + 1)$$

where $T = \sum_{ijk} y_{ijk}^2$ = sum of the squared progeny records

$H = \sum_i y_{i..}^2/n_i$ = sum of the herd totals squared and divided by the number in them

$S = \sum_j s_j B_j$, s_j is the final EPS value

n_T = total number of progeny in the data

n_h = number of herds in the data

and n_s = number of sires in the data.

EXPECTED PROGENY DIFFERENCE ACCURACY

For sire evaluations in which the mixed model coefficient matrix is not inverted to obtain the solutions, an approximation of prediction error variance (PEV) is required if accuracy for a sire's expected progeny difference (EPD) is to be computed as:

$$EPD_{accuracy} = 1 - \frac{\text{Prediction Error Variance}}{\text{Sire Variance}}$$

$$= 1 - \frac{Var(\hat{s}-s)}{Var(s)} .$$

One approximation of PEV for the i^{th} sire is given as follows:

$$PEV_i \cong \frac{\sigma_e^2}{EPN_i + (\sigma_e^2/\sigma_s^2) \cdot a_{ii}}$$

where σ_e^2 is the evaluation model residual error variance, σ_s^2 is the sire variance, EPN_i is the effective progeny number for the i^{th} sire, and a_{ii} is the diagonal element of the inverse of the numerator relationship matrix (A^{-1}) for the i^{th} sire.

This approximation of PEV is just one over the diagonal element of the mixed model sire evaluation coefficient matrix for the i^{th} sire times the model residual error variance. The influence of off-diagonals are somewhat accounted for because EPN_i reflects the distribution of the i^{th} sire's progeny across contemporary groups and a_{ii} accounts for his relationship ties with other sires.

It should be noted that the approximation for PEV given above will in most cases have more error variance than desired and will be biased downwards. The PEV approximation error variance can be reduced by adjusting $(\sigma_e^2/\sigma_s^2) \cdot a_{ii}$ to account the amount of prongey test data from sons of the i^{th} sire and his own sire. The adjustment, k_i, is given as follows:

$$k_i = (.06667\alpha)^2 [\sum_{j=1}^{n_s} (\frac{1}{EPN_j + \alpha \cdot a_{jj} - k_j}) + \frac{1}{EPN_k + \alpha \cdot a_{kk} - k_k}]$$

where

n_s = the number of sons of the i^{th} sire also having progeny records in the evaluation,

EPN_j = the effective progeny number for the j^{th} sire (son of the i^{th} sire),

EPN_k = the effective progeny number for the k^{th} sire (sire of the i^{th} sire), and

α = σ_e^2/σ_s^2.

The approximation for PEV for the i^{th} sire is then given by:

$$PEV_i \cong \frac{\sigma_e^2}{EPN_i + \alpha \cdot a_{ii} - k_i}$$

The following regression equation has been found appropriate for one beef breed to remóve bias in the PEV approximation:

$$PEV_i \cong .0052 + .94976 \left(\frac{1}{EPN_i + \alpha \cdot a_{ii} - k_i}\right)$$

It is interesting to note the similarity between this regression equation and those found by Ufford[2] et al. (1979) for two of the colored dairy breeds. The similarities would suggest that the regression is somewhat robust in its application.

Evaluation error variance, $Var(\hat{g} + \hat{s} - s)$ where $\hat{g}$ is a group estimate, may be more appropriate than prediction error variance, $Var(\hat{s} - s)$, in the EPD accuracy formula when EPD is calculated as $\hat{g}_j + \hat{s}_{ij}$. For evaluations involving several thousand sires, the relative difference between $Var(\hat{g}_j + \hat{s}_{ij} - s_{ij})$ and $Var(\hat{s}_{ij} - s_{ij})$ will be of immeasurable importance. For evaluations with relatively few sires, the difference could be quite significant. A rough estimate of the change in accuracy when using $Var(\hat{g}_j + \hat{s}_{ij} - s_{ij})$ versus $Var(\hat{s}_{ij} - s_{ij})$ is α times 3/(sum total of effective progeny records in the j^{th} group).

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[2]Ufford, G. R., C. R. Henderson, and L. D. Van Vleck. 1979. An approximation procedure for determining prediction error variances for sire evaluations. J. Dairy Sci. 62:621.

AMENDING THE ANALYSIS TO INCLUDE SIRE GROUP EFFECTS

It may be necessary in some evaluations to include group fixed effects in the sire evaluation model to account for known genetic differences that exist. For example, if a breed is experiencing a significant genetic trend, then genetic differences between the subpopulations of sires must be accounted for. One method of accounting for genetic trend is to group sires by their birth year in the evaluation model. The mathematical model for this case would be:

$$y_{ijk\ell} = \mu + c_i + g_j + s_{jk} + e_{ijk\ell}$$

where g_j is a fixed genetic effect common to every sire born in the j^{th} year, and s_{jk} is the genetic effect for the k^{th} sire born in the j^{th} year.

The mixed model equations with contemporary group effects absorbed for this evaluation model would be as follows:

$$\begin{bmatrix} T'ST & T'SZ & \underline{r} \\ Z'ST & Z'SZ + G^{-1} & \phi \\ \underline{r}' & \phi & 0 \end{bmatrix} \begin{bmatrix} \underline{\tilde{g}} \\ \underline{\tilde{s}} \\ LM \end{bmatrix} = \begin{bmatrix} T'S\underline{y} \\ Z'S\underline{y} \\ c \end{bmatrix}$$

where T is an incidence matrix defining the birth year group to which a sire belongs. The group equations will be linearly dependent with the contemporary group equations requiring that a restriction be added to the mixed model equations before they can be solved. One way of adding the restriction is to augment the equations with a Lagrangian Multiplier (LM). Chosing the vector $\underline{r}$ to be a vector of 1's and c = 0 results in $\sum_j g_j = 0$. This restriction yields what is typically referred to as a "floating base" sire evaluation. This means that sire expected progeny differences will not be comparable across evaluations. Alternatively, a "fixed base" sire evaluation can be obtained by defining $\underline{r} = [0, 0_2 \ldots 1_j \ldots 0_n]$ and setting the constant c to some fixed value for the j^{th} group. Using the same $\underline{r}$ and c in subsequent evaluations results in sire expected progeny differences that are comparable across evaluations.

One computational procedure to form sire group equations (T'ST, T'SZ, Z'ST, and T'S$\underline{y}$) directly from sire equations (Z'SZ and Z'S$\underline{y}$) is presented here. First, develop a sire list that includes the equation number, k, of each sire and his group number, j. Second, process each k^{th} sire equation, where the equation coefficients are given by

$$Z'SZ(k,1), Z'SZ(k,2) \ldots . Z'SZ(k,n_s) \text{ and } Z'S\underline{y}(k)$$

where n_s is equal to the total number of sires, such that

$$Z'SZ(k,k') \text{ is added to } T'SZ(j',k),$$
$$Z'ST(k,j'), \text{ and } T'ST(j,j'),$$

where j' is the group number for the k'^{th} sire, for $k' = 1$ to n_s. Third, add Z'Sy(k) to T'S$\underline{y}$(j) as each k^{th} sire equation is processed.

AMENDING THE ANALYSIS TO INCLUDE COMPLETE RELATIONSHIPS

Best linear unbiased prediction of expected progeny differences can be enhanced by accounting for relationships between the bulls with progeny records in the evaluation. The procedure for accomplishing this is to augment the sire equations with ancestor sire (those without progeny records) and dam equations and a relationship covariance structure between each bull and his sire and dam if known. The potential advantages of accounting for sire and dam relationships are: 1) accuracy of prediction can be increased, 2) fewer groups (if any) are required to account for genetic trend and for genetic differences among subpopulations, and 3) bulls can be evaluated earlier through the records on close relatives.

The mixed model equations including sire and dam relationships are as follows:

$$\begin{bmatrix} X'X & X'Z & \phi \\ Z'X & \multicolumn{2}{c}{\begin{pmatrix} Z'Z & \phi \\ \phi & \phi \end{pmatrix} + G^{-1}} \\ \phi & & \end{bmatrix} \begin{bmatrix} \tilde{\underline{h}} \\ \tilde{\underline{s}} \\ \tilde{\underline{t}} \end{bmatrix} = \begin{bmatrix} X'\underline{y} \\ Z'\underline{y} \\ \phi \end{bmatrix}$$

where G^{-1} is equal to σ_e^2/σ_s^2 times A^{-1}, the inverse of the numerator relationship between bulls and their sires and dams, and $\underset{\sim}{t}$ is an unknown vector of effects for the ancestor sires and dams without progeny records. The inverse relationship matrix is given as follows:

$$A^{-1} = \begin{bmatrix} A_{11} & A_{12} \\ A_{12}' & A_{22} \end{bmatrix}^{-1}$$

where the A_{11} partition refers to sires with progeny records and A_{22} refers to the ancestor sires and dams without progeny records.

Henderson[3] (1976) presents a simple method for computing the elements of the inverse of a numerator relationship matrix without computing the relationship matrix itself. The A^{-1} can be found directly from a list of sires and dams and the diagonal elements of L, where L is a lower triangular matrix such that $LL' = A$. Quass[4] (1976) modified Henderson's procedure for finding the diagonal elements of L such that L does not have to be stored in memory. Both of these papers should be used as the basis from which to program computer algorithms for computing a complete inverse relationship matrix, A^{-1}.

AMENDING THE ANALYSIS TO INCLUDE GROUPS AND SIRE AND MATERNAL GRANDSIRE RELATIONSHIPS

For large breed structures, adding the complete relationship (sires and dams of bulls in the evaluation) would require more computing capability than may be possible or economically warranted. An alternative to including the dam relationships is to account for the bull's maternal grandsire instead. This would significantly reduce the number of equations to solve because a majority of the maternal grandsires will already be in the evaluation. When using the sire and maternal grandsire relationships, it may be necessary to include sire genetic group equations to account for genetic trend in the female side of a sire's pedigree not being accounted for by the maternal grandsires. The mixed model equations to include groups and sire and maternal grandsire relationships are as follows:

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[3] Henderson, C. R. 1976. A simple method for computing the inverse of a numerator relationship matrix used in prediction of breeding values. Biometrics 32:69.

[4] Quass, R. L. 1976. Computing the diagonal elements and inverse of a large numerator relationship matrix. Biometrics 32:949.

$$\begin{bmatrix} T'ST & T'SZ & 1 \\ Z'ST & Z'SZ + G^{-1} & \phi \\ 1 & \phi & 0 \end{bmatrix} \begin{bmatrix} \tilde{\underline{g}} \\ \tilde{\underline{s}} \\ LM \end{bmatrix} = \begin{bmatrix} T'S\underline{y} \\ Z'S\underline{y} \\ 0 \end{bmatrix}$$

where G^{-1} is equal to σ_e^2/σ_s^2 times A^{-1}. A^{-1} is the inverse of the numerator relationship matrix among the sires in the evaluation. If contemporary group or herd effects are absorbed into the sire equations, then $\sigma_e^2/\sigma_s^2 \cdot A^{-1}$ is added to Z'SZ, the set of sire equations after absorption.

Henderson[5] (1975) developed a procedure whereby elements of A^{-1} can be determined from known sire and maternal grandsire pedigree relationships. The method is valid for noninbred populations. This procedure includes the ability to increase the number of sire ties by adding ancestors of bulls to be evaluated even though the ancestors have no tested progeny in the evaluation.

The first step is to make a list of all the bulls with progeny records and determine the sire and maternal grandsire of each. To this list, add any ancestor that is either a sire or maternal grandsire, but has no progeny data themselves in the evaluation. Delete from the add on list any ancestor "bull" that does not have at least two sons, or one son and one maternal grandson, or two maternal grandsons in the evaluation. Identify the bulls in the final list by 1,2,...n in any sequence desired. Identify the sires and maternal grandsires of these bulls by the same numbers, 1,2,...n, that apply, except that an unknown sire or maternal grandsire is identified by a zero. Let the trio of identifications, (bull, sire, maternal grandsire), be denoted in general by (i,j,k) where i = 1, 2...n. Proceed through the list of bulls for i = 1, 2...n, adding the following contributions to specific elements of A^{-1}.

a. If $j \neq 0$ and $k \neq 0$, add:
   1/11 to (k,k) element;
   2/11 to (k,j) and (j,k);
   -4/11 to (k,i) and (i,k);
   4/11 to (j,j);

[5]Henderson, C. R. 1975. Inverse of a matrix of relationships due to sires and maternal grandsires. J. Dairy Sci. 58:1917.

-8/11 to (j,i) and (i,j);
16/11 to (i,i).

b. If $j \neq 0$ and $k = 0$, add:
1/3 to (j,j);
-2/3 to (j,i) and (i,j);
4/3 to (i,i).

c. If $j = 0$ and $k \neq 0$, add:
1/15 to (k,k);
-4/15 to (k,i) and (i,k);
16/15 to (i,i).

d. If $j = 0$ and $k = 0$, add:
1 to (i,i).

AMENDING THE ANALYSIS TO INCLUDE AN INTERACTION BETWEEN SIRE AND HERD (GROUP)

This process provides a method of considering the extra correlation between progeny from the same sire in the same contemporary group. The modifications necessary in the equation As = B are:

(1) replace each $n_{ij.}$ with $\dfrac{n_{ij.}\beta}{n_{ij.} + \beta}$

and (2) replace each $\bar{y}_{ij.}$ with $\dfrac{\bar{y}_{ij.}\beta}{n_{ij.} + \beta}$

The β represents the ratio of the within sire-group component of variance to the sire by group component of variance. With these modifications, the interaction is absorbed into the sire equations and, thus, is accounted for in the analysis.

AMENDING THE ANALYSIS TO INCLUDE DAM EFFECTS

Adding dam effects to the sire evaluation model can be used to remove bias due to preferential mating of sires to dams. The mathematical model which includes dam effects is as follows:

$$y_{ijk\ell m} = \mu + c_{ij} + s_k + d_{i\ell} + e_{ijk\ell m}$$

where

$y_{ijk\ell m}$ = the record on the m^{th} progeny of the k^{th} sire and the ℓ^{th} dam of the i^{th} herd and reared in the j^{th} contemporary group of the i^{th} herd,

μ = the population mean,

c_{ij} = a fixed effect common to each record in the j^{th} contemporary group of the i^{th} herd,

s_k = a random genetic effect associated with the k^{th} sire, NID (0, σ_s^2),

$d_{i\ell}$ = a random composite effect of transmitited additive genetic effects and maternal influence effects associated with the ℓ^{th} dam of the i^{th} herd, NID (0, σ_d^2),

$e_{ijk\ell m}$ = a residual random effect, NID (0, σ_e^2).

The mathematical model can be expressed in matrix notation as:

$$\underline{y} = X\underline{c} + Z_1\underline{d} + Z_2\underline{s} + \underline{e}$$

where $\underline{y}$, $\underline{c}$, $\underline{d}$, $\underline{s}$, and $\underline{e}$ are vectors of the records and model effects. The matrices X, Z_1 and Z_2 are design matrices. The mixed model equations to obtain sire expected progeny differences are:

$$\begin{bmatrix} X'X & X'Z_1 & X'Z_2 \\ Z_1'X & \multicolumn{2}{c}{\begin{pmatrix} Z_1'Z_1 & Z_1'Z_2 \\ Z_2'Z_1 & Z_2'Z_2 \end{pmatrix} + G^{-1}} \\ Z_2'X & & \end{bmatrix} \begin{bmatrix} \tilde{\underline{c}} \\ \tilde{\underline{d}} \\ \tilde{\underline{s}} \end{bmatrix} = \begin{bmatrix} X'\underline{y} \\ Z_1'\underline{y} \\ Z_2'\underline{y} \end{bmatrix}$$

where

$$G^{-1} = \sigma_e^2 \cdot [\text{Var}\begin{pmatrix}\underline{d} \\ \underline{s}\end{pmatrix}]^{-1}.$$

The order of the mixed model coefficient matrix will, in most cases, necessitate absorbing the contemporary group and dam effects into the sire equations. Under the assumption of no relationships between dams, one method of forming the sire equations is as follows:

Step 1: Sort all performance records by herd, dams within herd, and contemporary groups within dam.

Step 2: Absorb dam effects into contemporary group and sire equations within the i^{th} herd to form directly the following matrices:

$$\begin{bmatrix} X_i'S_iX_i & X_i'S_iZ_{i2} \\ Z_{i2}'S_iX_i & Z_{i2}'S_iZ_{i2} \end{bmatrix}, \text{ and } \begin{bmatrix} X_i'S_i\underline{y}_i \\ Z_{i2}'S_i\underline{y}_i \end{bmatrix}$$

where $S_i = I_i - Z_{i1}(Z_{i1}'Z_{i1} + \sigma_e^2/\sigma_d^2 \cdot I_i)Z_{i1}'$.

Step 3: Compute $[X_i'S_iX_i]^{-1}$ and absorb contemporary group effects into the sire equations for the i^{th} herd to form:

$$[Z_{i2}'S_i^*Z_{i2}], \text{ and } [Z_{i2}'S_i^*\underline{y}_i]$$

where $S_i^* = S_i - S_iX_i[X_i'S_iX_i]^{-1}X_i'S_i$. Elements of the sire equations are stored by sire identification.

Step 4: Repeat steps 1-3 for each herd.

Step 5: Sort and sum the coefficient elements by sire identification from each $[Z_{i2}'S_i^*Z_{i2}]_i$ and $[Z_{i2}'S_i^*\underline{y}_i]$ to form the final set of equations to use in the evaluation.

Step 6: Augment the sire equations with the appropriate sire covariance structure as follows:

$$[Z_2'SZ_2 + G_s^{-1}][\tilde{\underline{s}}] = [Z_2'S\underline{y}]$$

where $G_S^{-1} = \sigma_e^2/\sigma_s^2 \cdot I$ or $\sigma_e^2/\sigma_s^2 \cdot A^{-1}$ if relationships among sires are known.

Step 7: The vector of sire expected progeny differences ($\hat{\underline{s}}$) can be obtained by solving the equations iteratively or directly by solving:

$$[\hat{\underline{s}}] = [Z_2'SZ_2 + G_S^{-1}]^{-1}\ [Z_2'S\underline{y}].$$

PREDICTING BREEDING VALUES
(DRAFT)

A breeding value is the value of an individual as a parent. Breeding value is precisely what breeding stock herds sell. The value of the progeny from their breeding stock in the herd of the buyer is the issue. As specification of product becomes more important in the beef industry, breeders can be merchandising breeding value. Beef breeders are selling a product that must transmit a sample half of its germ plasm to progeny before the result is realized. Commercial producers sell pounds not breeding value, but they need to buy breeding value as well as make logical combinations of breeds to obtain the crossbred advantages, especially for the reproductive complex. Thus, both commercial and seedstock producers can benefit from understanding breeding value.

Beef performance records are relatively expensive in money and in time required to obtain them. Cattle have a long generation interval and low reproductive rate, and they are expensive. The latter two problems result in a low intensity of selection, especially in cows. If the existing records can be utilized to increase the accuracy of selection even a bit, without increasing the generation interval or reducing the intensity, this advantage should be used in performance programs serving the beef industry.

The breeding value concept was defined and developed to relate selection theory with the genetic reality that genes have their effects in pairs. One member of each pair comes from the sire and the other, from the dam. Thus, the genes are transmitted singly from parent to offspring. One gene or the other of each pair possessed by a parent is transmitted to an offspring.

The basis of selection is the resemblance between parent and offspring. Because each parent transmits a sample half of its genes to an offspring, the degree of resemblance is a measure of the importance of gene effects (not gene pair effects) on the variation of a trait. The heritability of a trait is evaluated using a measure of the degree of resemblance between relatives. The sum of the gene effects, produced by the sample half of the genes transmitted from a parent, as expressed in its progeny, is a definition of one-half of the breeding value of the parent. Thus, using measurable quantities obtained from performance data, one can predict selection response.

Heritability is the fraction of the variation in a trait that is produced by gene effects. Heritability times the superiority of the selected parents over the average is the average breeding value of the parents and the response to selection expected. Therefore, the concepts tie together into a usable theory on which to build and conduct breeding programs that maximize genetic change. Selection, or the choice of parents, is the only tool available to the breeder to bring about genetic change. There is no other.

Breeding value can be defined as twice the difference between the average performance of a large number of progeny and the population average. This is the working definition of breeding value. The difference is doubled because only a sample half of the genes of an individual is transmitted to its progeny.

The first estimated breeding values (EBV) using relative information for weaning and yearling growth came in 1971 and the first (EBV) using the calves of the daughters of the sires in the pedigree for maternal performance came in 1974. Today, computers are faster and the methodology is available to better predict breeding values. However, during the transition from EBV calculated by collecting ratio information and the new procedures, guidelines for the calculation of EBV need to be maintained and guidelines for new methods of prediction need to be outlined.

ESTIMATED BREEDING VALUE FOR GROWTH

The information needed for each individual animal (as ratio deviations) is (1) their own performance; (2) the average performance of their paternal half-sibs excluding their record and the number of sibs; (3) same as 2 for maternal half-sibs; and (4) the average performance of their progeny. The following must be solved for the B values for each individual.

$$1/H \cdot B_1 + 1/4 \cdot B_2 + 1/4 \cdot B_3 + 1/2 \cdot B_4 = 1$$
$$1/4 \cdot B_1 + X_1 \cdot B_2 + 0 \cdot B_3 + 1/8 \cdot B_4 = 1/4$$
$$1/4 \cdot B_1 + 0 \cdot B_2 + X_2 \cdot B_3 + 1/8 \cdot B_4 = 1/4$$
$$1/2 \cdot B_1 + 1/8 \cdot B_2 + 1/8 \cdot B_3 + X_3 \cdot B_4 = 1/2$$

where:

$$X_i = \frac{4 + (N_i - 1)H}{4N_iH}$$

and N_i = the number of paternal sibs, maternal sibs, or progeny, respectively, and H = heritability. Only the X_i values change. If an individual has only part of the information, that row and column is deleted. Matrix inversion or iteration yields B values or weights. Then, the weight breeding value is:

$$WBV = B_1 \cdot V_1 + B_2 \cdot V_2 + B_3 \cdot V_3 + B_4 \cdot V_4$$

where the V_i are the respective performance deviations. The accuracy of the estimated breeding value is:

$$ACC = \sqrt{B_1 \cdot 1 + B_2 \cdot 1/4 + B_3 \cdot 1/4 + B_4 \cdot 1/2.}$$

The accuracy indicates the confidence to be placed in the estimate, but the breeding values have already been regressed for numbers so they are directly comparable.

ESTIMATED BREEDING VALUE FOR MATERNAL PERFORMANCE

Three values are being calculated. The third equation differs when a CALF, SIRE, or DAM breeding value is being calculated. The purpose is to evaluate the individual's ability to produce daughters that have maternal performance as measured by the weaning weight of calves of the daughters. The information needed for each individual, if available, is as follows:

1. The number of calves and the number of daughters and the average weaning weight ratio deviation of all calves from the daughters for the PATERNAL and MATERNAL GRANDSIRE, the SIRE, and the individual if a sire with daughters.

2. The number of calves and the average weaning weight ratio deviation of all calves from the DAM and the individual if a dam with calves.

After collection of the necessary information for a calf, sire, or dam, the following set of linear equations must be solved for the B values for each individual:

$$\begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{bmatrix} = \begin{bmatrix} r_{11} \\ r_{21} \\ r_{31} \\ r_{41} \end{bmatrix}$$

Letting 1 = sire, 2 = PGS, 3 = dam if a calf or individual if a sire or dam, and 4 = MGS; the correlation matrices and right-hand sides are as follows:

CALF

$$\begin{bmatrix} X_1 & 1/8 & 0 & 0 \\ 1/8 & X_2 & 0 & 0 \\ 0 & 0 & X_3 & 1/4 \\ 0 & 0 & 1/4 & X_4 \end{bmatrix} \quad \begin{bmatrix} 1/4 \\ 1/8 \\ 1/2 \\ 1/8 \end{bmatrix}$$

SIRE

$$\begin{bmatrix} X_1 & 1/8 & 1/8 & 0 \\ 1/8 & X_2 & 1/16 & 0 \\ 1/8 & 1/16 & X_5 & 1/16 \\ 0 & 0 & 1/16 & X_4 \end{bmatrix} \quad \begin{bmatrix} 1/4 \\ 1/8 \\ 1/2 \\ 1/8 \end{bmatrix}$$

DAM

$$\begin{bmatrix} X_1 & 1/8 & 1/8 & 0 \\ 1/8 & X_2 & 1/8 & 0 \\ 1/4 & 1/8 & X_3 & 1/8 \\ 0 & 0 & 1/8 & X_4 \end{bmatrix} \quad \begin{bmatrix} 1/4 \\ 1/8 \\ 1 \\ 1/8 \end{bmatrix}$$

The off diagonals and right-hand sides are relationships only. The general value of X_1, X_2, X_3, and X_4 is as follows:

$$X_{1,2,3,\text{ or } 4} = \left[\frac{1 + (M - 1)R}{NMH} + \frac{(N - 1)}{4N} \right]$$

where M = average number of calves per daughter, N = number of daughters, R = repeatability, and H = heritability. The general value of X_3 when dam records are used is as follows:

$$X_3 = \left[\frac{1 + (M - 1)R}{MH} \right]$$

where M = number of calves of the dam of a calf or the number of calves of the individual if a dam. After solution, the B values are multiplied by the deviations as:

$$MBV = B_1 \cdot V_1 + B_2 \cdot V_2 + B_3 \cdot V_3 + B_4 \cdot V_4$$

where the V values are the average ratio deviations of the weaning weights of calves of daughters of the males in the pedigree or the average ratio deviations of the calves of a dam. The deviations can either be difference or ratio deviations from the contemporary group means. To accumulate enough data, the maternal EBV uses ratios from all herds where the relatives are. The accuracy is calculated as the square root of the sum of products of the weights (B) times the right-hand sides of the equations.

NEW PREDICTION METHODS

The technological advances in high capacity and low cost microcomputers will allow for sophisticated genetic evaluations for all animals within a breeding herd in the not too distant future. Best linear unbiased prediction methodology for within herd evaluations are derived from what has been termed the animal model. Variations to the basic animal model are being researched and experimented with to arrive at computationally feasible evaluation methodology that retains the desirable prediction properties.

WITHIN HERD ANIMAL MODEL

The within herd animal model has the advantages of: 1) including all information available on all relatives to predict the individual animal's breeding value, 2) accounting for the effects of inbreeding, and 3) accounting for contemporary group fixed effects and genetic trend. The model is used to estimate the breeding value of each current animal in a herd using all the available information on all relatives that are or have been in the herd in addition to the animal's own performance. The procedure is to fit a model for every animal in the herd of the form

$$y_{ij} = \mu + c_i + b_{ij} + e_{ij}$$

where

y_{ij} is the measured record for a particular trait on the j^{th} animal in the i^{th} contemporary group,

μ is the population mean,

c_i is the i^{th} contemporary group effect,

b_{ij} is the breeding value of the j^{th} animal reared in the i^{th} contemporary group, and

e_{ij} is the residual error associated with y_{ij}.

Written in matrix notation, the model is $\underline{y} = X\underline{c} + Z\underline{b} + \underline{e}$ where $\underline{y}$, $\underline{c}$, $\underline{b}$, and $\underline{e}$ are vectors of the records, unknown contemporary group effects, breeding values and residual errors, respectively. The matrices X and Z are known incidence matrices relating each record to the appropriate contemporary group and animal. The mixed model equations are given by:

$$\begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z + G^{-1} \end{bmatrix} \begin{bmatrix} \tilde{\underline{c}} \\ \tilde{\underline{b}} \end{bmatrix} = \begin{bmatrix} X'\underline{y} \\ Z'\underline{y} \end{bmatrix}$$

where G^{-1} is equal to σ_e^2/σ_s^2 times A^{-1}, the inverse of the relationship matrix associated with all animals in the herd.

The animal model in the above form is not characterized by desirable computational features. There are a large number of equations which must be solved, one for every animal that has ever existed in the herd, and the equations do not lend themselves to iterative solution procedures because of small diagonal elements relative to off-diagonal elements. Computational difficulties can be reduced by partitioning Zb into Z_1b_1 and Z_2b_2, where b_1 is a vector of unknown effects for animals in the herd that are no longer available for selection and b_2 is a vector of unknown effects for the animals still in the herd. That is, the vector b_2 would contain one element for each calf in the current calf crop plus one for each sire and dam that produced the current calf crop. The contemporary group equations and b_1 would be absorbed, leaving only the number of animals in b_2 to be solved for. The mixed model equations or this arrangement of the animal model can be written as follows:

$$\begin{bmatrix} X'X & X'Z_1 & X'Z_2 \\ Z_1'X & \multicolumn{2}{c}{\begin{pmatrix} Z_1'Z_1 & Z_1'Z_2 \\ Z_2'Z_1 & Z_2'Z_2 \end{pmatrix} + G^{-1}} \\ Z_2'X & & \end{bmatrix} \begin{bmatrix} \underline{c} \\ \underline{b}_1 \\ \underline{b}_2 \end{bmatrix} = \begin{bmatrix} X'\underline{y} \\ Z_1'\underline{y} \\ Z_2'\underline{y} \end{bmatrix}$$

where

$$G^{-1} = \sigma_e^2/\sigma_s^2 \left[\begin{array}{c|c} A_{11} & A_{12} \\ \hline A_{12}' & A_{22} \end{array}\right]^{-1}$$

where A_{11} is the partition of the numerator relationship matrix for animals no longer available for selection, A_{22} is the partition for animals that are still in the herd.

Alternatively, the within herd animal model can be reduced to an equivalent model that contains equations equal to the number of fixed effects and parent animals. After determining the parent animal breeding values, one can back solve for the breeding values of other nonparent animals of interest. This reduced animal model retains all of the desirable prediction properties of the basic animal model while greatly enhancing the computational task. The development of the reduced animal model is being done by researchers Quass and Pollak at Cornell University.

WITHIN HERD SIRE AND DAM MODEL

Another method of within herd evaluations is to fit a model for every record of the form

$$y_{ijk\ell m} = \mu + c_i + s_j + d_\ell + \gamma_m + e_{ijk\ell m}$$

where the breeding value of the animal (b_{ij}) has been replaced with ($s_j + d_\ell + \gamma_m$). The term s_j is one-half the breeding value of the sire of the animal, d_ℓ is one-half the breeding value of the dam of the animal, and γ_m is a random effect common to the m^{th} animal that is due to the Mendelian gene sampling effect. The model written in matrix notation is $\underline{y} = X\underline{c} + Z_1\underline{s} + Z_2\underline{d} + \underline{e}^*$, where the Mendelian sampling effect is combined with the residual error term into $\underline{e}^*$. The mixed model equations are as follows:

$$\begin{bmatrix} X'X & X'Z_1 & X'Z_2 \\ Z_1'X & \begin{pmatrix} Z_1'Z_1 & Z_1'Z_2 \\ Z_2'Z_1 & Z_2'Z_2 \end{pmatrix} + G^{-1} \\ Z_2'X & & \end{bmatrix} \begin{bmatrix} \tilde{\underline{c}} \\ \tilde{\underline{s}} \\ \tilde{\underline{d}} \end{bmatrix} = \begin{bmatrix} X'\underline{y} \\ Z_1'\underline{y} \\ Z_2'\underline{y} \end{bmatrix}$$

where

$$G^{-1} = \sigma_e^2 \cdot [\mathrm{Var}(\tilde{\underline{s}}\ \tilde{\underline{d}})']^{-1}.$$

In evaluations where the trait being measured is influenced maternally, the dam effect, $\underline{d}_\ell$, will be a composite effect that includes both a direct genetic effect and a maternal effect. This composite effect can be partitioned into the separate effects given their variance and covariance. Expected progeny differences for yearling bulls and heifers are computed as follows:

$$EPD_{\text{yearling animal}} = 1/2\ EPD_{\text{sire}} + EPD_{\text{dam}} + \gamma_m$$

where γ_m is an estimate of the animal's Mendelian sampling effect.

The within herd evaluation results can be referenced to the breed's national sire evaluation if the herd is using bulls that are used nationally and have high accuracy published expected progeny differences. One method of accomplishing this is to substitute the national sire summary expected progeny differences into the vector of unknown sire effects, $\tilde{\underline{s}}$, before solving the model equations. Several progeny by the nationally used sires from matings to random females in the herd are required to insure the herd is adequately tied to the national sire evaluation base of reference.

BIF LIVE ANIMAL EVALUATION COMMITTEE REPORT

A frame score chart is being prepared now, it will be presented and formally recommended to BIF for inserting into the guidelines at the next meeting.

John Massey and Bob Schalles presented their data in regards to both hip and shoulder height measurements. It appears that most data concerning height is similar and measurements are rather repeatable when the same person(s) are taking measurements. Agreement is strong that hip height, shoulder height, body length and weight (205 or 365) are highly correlated.

Comments were made that height measurements are used for the following: provide a description of the package the weight is in, to provide a basis for selection, is correlated with the commercial industry (large, medium, small frames), has sale appeal and can provide a short cut in breeding programs.

There are concerns with how frame or height measurements might be used and how it should be presented in the guidelines. Questions were raised as to the relationship between frame, backfat, marbling, carcass yield and grade.

We do know that frame size or height is important within the industry. It will be used as a selection criteria and marketing tool. Frame is now and will continue to be of more or less importance within certain breeds and used more or less within certain breeding schemes. However, major emphasis must continue to be placed upon percent calf crop weaned, average daily gain, or in effect, the pounds of beef marketed per cow exposed.

Again, a frame score chart is being prepared.

Henry W. Webster
Secretary

MINUTES OF THE CENTRAL TEST STATION COMMITTEE

Beef Improvement Federation
May 3, 1984

Chairman Roger McCraw called the meeting to order. He distributed copies of the revised 1984 Bull Testing Survey compiled by Dixon Hubbard to those in attendance and reviewed the items on the agenda. He indicated that the committee had been charged to make recommendations for revisions in the section of the BIF Guidelines dealing with central test stations.

Recommendations for changes to be made in the Guidelines were:

1.) Include a section on recommendations for conducting bull tests using forages. A committee consisting of Larry Olson, Chairman, Richard Deese, and Mike Crider was appointed to develop recommended guidelines for these tests.
2.) Appendix Table 3 should list the standard birth weights and the age-of-dam adjustment factors for birth and weaning weight used by the various breed associations. This table should be revised as needed.
3.) The table for age range of dams (page 7 of Guidelines) should be corrected and extended to cover all ages used by various breed associations.
4.) A note should be included in the section, "Postweaning Phase - On the Farm and Ranch," (page 8) that ". . . the formula listed for Adjusted 365-day Weight is to be used for on-farm tests. Please refer to the section on Central Test Stations for the formula appropriate for central tests."
5.) The statement on page 49 dealing with warm-up periods for central tests should be revised to read, "There should be an adjustment, or pre-test, period of approximately 21 days at the test station immediately prior to the test period."
6.) Add a recommendation that EBV's, and accuracies, for calving ease, birth weight, weaning weight and yearling weight and MBV be included in sale catalogs.
7.) Calves resulting from embryo transfer should be identified as such on test station reports and catalogs.
8.) Scrotal circumference (Table 9, Page 51) should be made a recommended measure for test station reports rather than being optional.
9.) The statement describing scrotal circumference (Table 9, Page 51) should be expanded to include a reference to the Reproduction section in the Guidelines for more information.

A motion carried to recommend that the Embryo Transfer Committee develop a more appropriate method of dealing with records for ET calves. There was a consensus that using a ratio of 100 and one contemporary was not appropriate. Perhaps "ET" could be listed in place of all ratios for such calves on all reports.

There was much discussion about having a recommended index to be used by all stations for determining sale order of bulls in central test station sales. A motion that determination of sale order be the responsibility of each local test station committee carried.

Submitted,

Bill Swoope, Secretary

SYSTEMS COMMITTEE REPORT

The Systems Committee meeting was called to order by Chairman Jim Gibb, on May 3, 1984, with approximately 60 people in attendance. Items covered during the meeting were: (1) The results of a survey to ascertain the perception of the systems concept among selected BIF representatives. (2) A discussion by Hank Fitzhugh in which he outlined the importance of the systems concept and the perceived role of the Systems Committee in BIF. (3) A presentation by Rick Bourden illustrating the systems concept by applying sire evaluation data in a model simulating two production environments. (4) A presentation by Rich Benson involving a method for using currently available performance information, plus additional quantitative data to facilitate selection decisions for net merit.

Active audience participation demonstrated (1) an appreciation for the systems concept, (2) frustration in marketing the concept, and (3) a strong interest in overcoming the problems that inhibit acceptance and application of the systems concept. The difficulty of merchandising cattle with optimum, rather than maximum performance, led to the appointment of an ad hoc committee to provide guidance to have optimum performance perceived in a positive manner. Subsequent discussion among Hank Fitzhugh, Jim Gibb, Rich Benson and Frank Baker, suggested looking into a mid-year meeting of the Systems Committee and appropriate advisers.

Secretary,
C. Richard Benson

SYSTEMS APPROACH TO BEEF IMPROVEMENT
THE ROLE OF BIF

H. A. Fitzhugh
Winrock International
Morrilton, Arkansas

A systems approach to beef improvement will benefit both producers and consumers of beef. BIF can play an important role in the application of the systems approach to beef improvement.

SYSTEMS APPROACH

The systems approach is a process for making decisions about a system with due consideration to the full set of factors affecting the system. This approach is essential when dealing with highly complicated systems involving many different interacting factors and long-term trends.

Beef systems are among the most complex agricultural systems. Many factors -- ecological, climatic, economic, and political -- determine the beef production and marketing environment. BIF is primarily concerned with the genotypic factor of beef systems; however, cattlemen increasingly recognize that the "best" genotype varies for different environments.

Beef breeders must cope with an additional complexity. Many different traits combine to produce the "best" genotype. Important beef traits include growth and maturing rates, mature size, reproductive efficiency, carcass composition and quality, and adaptation to environmental stresses, among others. Genetic improvement is most appropriately sought not for a single trait but for Net Merit.

In theory, Net Merit includes all traits which affect beef production. Each trait is weighted according to its genetic and economic importance. In practice, an index of direct and indirect measures of traits in Net Merit is used. Care must be taken to ensure that the index is practical for cattlemen to use. Traits which cost more to measure than the value gained from their improvement are not in a practical index. And being realistic, cattlemen have many calls on their time and resources in addition to their efforts toward genetic improvement. A systems approach implies that genetic improvement programs must be practical and cost effective.

In summary, a systems approach to genetic improvement involves giving full consideration to the multifactoral beef production and market environment before deciding which traits to change in which direction. The systems approach also includes consideration of the practical realities and costs of implementing the genetic improvement program.

GENETIC IMPROVEMENT DECISIONS

Two groups are involved in these decisions -- the decision-makers and the decision-influencers. Both groups will benefit from following a systems approach.

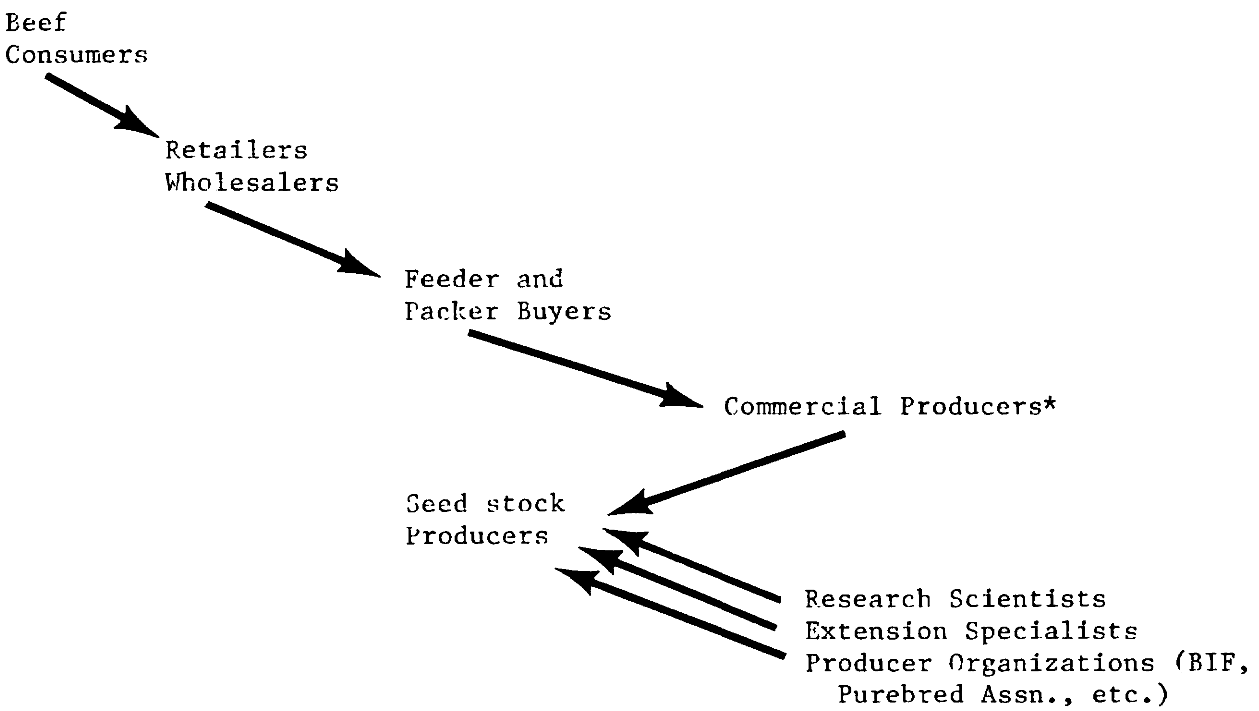
Decision-makers. These are the cattlemen who decide which bull to breed to which cow. There are two general types of cattlemen making these decisions:

1. Commercial Producers -- their mating decisions focus on producing cattle which are profitable at slaughter. They will know if they made the correct decisions within 2 to 3 years. Commercial producers have to remain flexible, able to adjust quickly to short-term trends in supply and demand and to changes in consumer preference.

2. Seed Stock Producers -- their mating decisions focus on producing cattle which will be profitable breeders. The profitability of the breeding cow is based on her lifetime productivity; the profitability of the sire is based on the performance of his progeny. Seed stock producers must make mating decisions today based on their expectations for the production and market situation one or more cow generations away.

The commercial cattlemen makes decisions on a time scale of years, the seed stock cattlemen make decisions on a time scale of cattle generations.

<u>Decision-influencers.</u> Decisions made by cattlemen are influenced from many different sources:



* Decision-makers

It is worth noting that cattlemen -- the decision-makers -- have a better record of using the systems approach to beef improvement than do the decision-influencers. The reason is simple. Cattlemen are trying to make a profit so they attempt to take into account all factors which affect profitability. The "decision-influencers," on the other hand, often focus only on a small portion of the overall system. Most of us involved with influencing decisions do not have to suffer the ultimate consequences of short-sighted and narrow-focused recommendations; e.g., some have made recommendations to increase weight gain with little or no thought to the costs of dystocia or cow maintenance.

ROLE OF SYSTEMS COMMITTEE

BIF appears ready to utilize the systems approach in formulating guidelines for beef improvement. The role of the Systems Committee might include:

1. Develop definitions of Net Merit appropriate to cattle in different production and market environments. The guidelines of BIF should not imply that there is a single set of standards against which all cattle everywhere should be measured.

2. Interact with other committees to formulate and revise guidelines so that they effectively address different definitions of Net Merit. BIF must take responsibility for sending appropriate signals to decision-makers -- especially seed stock producers (including commercial cattlemen producing their own replacement stock). These signals should accurately indicate the traits and directions which will be important when the impact of breeding decisions will be felt. For cattle this will be 5 to 10 years in the future.

The future well-being of individual cattlemen and the industry will be affected by the appropriateness of genetic improvement decisions made now. BIF has an awesome responsibility to influence these decisions in the right directions. Only a systems approach is adequate to the task. The Systems Committee should take the lead in ensuring that the systems approach is central to BIF deliberations.

RESULTS OF SYSTEMS SURVEY

SITUATION: For most people involved with performance, the philosophy guiding genetic improvement has been direction of change rather than goals and production output without direct accounting for input costs. In large part, input costs have been ignored because early research indicated a favorable genetic relationship between increased rate of gain and feed efficiency. Additionally, it was agreed that many costs were fixed per animal. Therefore, fixed costs would be spread over more pounds of production from larger animals.

Since the beginning of the performance movement, increased size and increased milk production have been major components of genetic improvement for the principle cattle breeds in the U.S. In some instances, the rate of change per size has been moderated by concern for calving difficulty.

Recently the efficiency issue has been reexamined. Results from studies evaluating feed efficiency of individual market animals, various measures of cow efficiency and a new area called "Systems" research have prompted some performance people to reexamine the meaning of genetic improvement.

1. Does the above statement capture the essence of the performance philosophy today, particularly that which is guiding genetic improvement for size and milk production in the U.S.?

   14 Yes   3 No   1 Undecided

Comments:

-- Increased cost of cereal grains, closer association of seed stock and commercial industries and dramatic increases in size and production through crossbreeding and selection have all contributed to this change of philosophy.

-- Yes, it is substantially correct that some performance people have not ignored input costs and have used a multi-trait approach. Some others are beginning to do so. Unfortunately, the total of both groups is still small percentagewise.

-- Basically, yes. Most breeders still think in terms of maximum weight, height, etc. However, credit is due those who have stressed adaptability, functional efficiency and convenience over the years. There is also a small, but growing population of breeders of "Systems Cattle." May they prosper.

-- No, too much emphasis is based on output alone without appropriate attention to tradeoffs resulting from antagonistic genetic relationships and input components.

-- Yes, it captures the stated philosophy, but in reality cattle breeders and bull studs generally are on an ego trip along with college professors and breed associations and could care less about the commercial cattle industry.

-- Yes, it also reflects a limited attention to the productivity obtained from pastures and the changes in stocking and supplementation rates that have accompanied genetic changes.

2. Is direction of change always a satisfactory determinate for genetic improvement of size and milk production?

   0 Yes   17 No   1 Undecided

Comments:

-- No, first optimum level of milk and growth is usually an intermediate production level. As economic factors change, so will production goals.

-- No, I think that size, in particular, must be constrained by the need to cross maternal and paternal types.

-- No, genetic improvement means fitting the animal to his overall environment. Obviously, many long-term economic, feed availability and stress conditions are determinate of optimal size and milk production condition.

-- No, each environment produces different goal determinates, as does the purpose of the breeder's particular breed in the market area crossbreeding programs.

-- No, direction of change should be dictated by environmental conditions, especially quantity and quality of feed stuffs.

-- No, if direction of change is the only statistic you are given it is meaningless.

-- No, I believe that production systems or situations exist in which maximum efficiency depends on optimum combinations of performance levels for several characters.

-- No, if change is being made, at some point we have enough change.

3. If you recommend an intermediate level of performance for size and milk production, briefly describe the quantatative method you would use to determine whether or not an individual animal or a group of animals has the desired genetic capability.

Comments:

-- I only recommend intermediate size or milk if the population averages near optimum for the intended breed role in beef production.

-- In our own ranch situation I like to breed and calve a high percent of a heifer crop and cull based on the performance of that first calf. I feel that those that perform under our own conditions are the right kind.

-- Until that time that we develop such factors as a total efficiency index, much of the efficiency selection will necessarily be based upon independent culling levels.

-- I understand the need to look at a systems approach but I am concerned about how I as a breeder can be successful in merchandizing mediocrity. I am wondering if the concept can be sold until the industry has a big wreck.

-- Average performance and average milk production do not guarantee adaptability. Nor do they ensure financial success.

-- Milk. Individual selection for intermediate optimum milk production levels in individuals is very difficult. However, in terms of type, our simulation results suggest that controlled experiments to determine the point at which increasing milk production begins to have a negative effect on reproduction should be identifiable and could perhaps be related (in the future) to breeding value estimates. Rigorous economic analysis for individual farms would go a long way toward determining ideal type.

Size. Start with an "ideal" size for the market animal. Add to this the maximum of divergence of size that can be tolerated between "sire" and "dam" breeds (perhaps 300-400 pounds in mature cow size). Be sure that dam breeds exist that do not overrun this divergence: when they threaten to, begin to increase emphasis on calving ease, fertility and other fitness traits. Then, convince producers that they should pay for these functional, moderate size types (this is the hard part). This approach would be much easier if the industry were more intergrated.

-- A possible solution (in my mind) is one in which researchers greatly expand their knowledge of the principles of efficiency using simulation models. This knowledge, when combined with data from live animal experiments and common sense, can then be distilled for use by nonacademics. Seed stock producers then make selection decisions based on the distilled information and the economic conditions and management programs of their customers.

-- I assume certain weight at weaning (205-day weight) and then place fertility (which includes calving ease, length of gestation, etc.) has a top priority. I select away from animals that suggest large, mature weight and are late maturing.

-- "Optimum" should replace "intermeditate" in this statement. Optimum performance is that which maximizes economic returns. At present, assessing optimum performance involves much educated, artistic guess work. Based, it is hoped, on what research and observation is available. Devine revelation is sorely needed in this area.

-- It seems to me that the Systems Committee should describe methodology for individual breeders to construct a "selection index" to fit individual situations.

-- I feel that the method of choice for estimating the optimum combination (or even several suitable combinations) may exist. It is the application of simulation modeling of production systems. However, I have less confidence in our ability to effectively select toward an optimum combination of trait levels in individuals or groups of animals.

4. When the genetic capability for size and milk production of a group of animals falls within your optimal range of performance, do you feel comfortable selecting as replacements the animals that are closest to the average?

   6 Yes   10 No   2 Undecided

-- Yes, I have found the extreme females--those indexing 115-120 at weaning--are later maturing and harder to get bred with the rest of the group.

-- Ideally, yes, however, because of the number of traits we usually select for and the general quality of my animals, I haven't as yet had that luxury.

-- No, I have not seen the perfect individual in all characteristics yet, but certainly, I see no problem in selecting for intermediate, optimal levels of performance.

-- Yes, if average refers only to size and milk production, obviously other traits must be "better than average" to improve overall system efficiency.

-- No, not unless you equate the group average with optimum.

-- No, if the population is such that heritability is moderate to high, the answer might be yes. If heritability for size and milk yield are low in the population, I would think "no." Selecting for optimums in multiple trait situations is never a situation in which to be comfortable. While sophisticated statistical methods may aid in this, we may not yet know a sufficient amount about the biological relationships.

-- Yes, otherwise you probably don't have complete faith in the optimality of your performance.

-- No, for example, after constraints on birth weights and mature size have been imposed, we can still select for maximum early growth using a selection index, independent culling or some other criterion.

-- No, genetically we must be challenging our management.

-- No, at that point you are saying no additional genetic progress is possible, which would, in fact, make us all multipliers instead of breeders.

-- No, probably weigh selection opportunity that would be better spent on selection for other functional traits like early maturity, fertility, calf viability and leanness using sire, family or progeny test information in pedigree selection.

USE OF COMPUTER SIMULATION MODELS AND SIRE EVALUATION DATA TO MAXIMIZE BEEF PRODUCTION EFFICIENCY

Rick Bourdon, Colorado State University

The systems concept incorporates an awareness that more is not always better in beef production. There are trade-offs between growth and calving ease, between productiveness and reproduction. Different natural environments, management systems, mating systems and economic scenarios favor different kinds of cattle. Choosing the right kind of cattle for any given situation is no easy task, however, and one might reasonably ask if computer models of beef production could help in this endeavor and in sire selection in particular.

The Texas A & M -- Colorado State University Beef Production Model was used to demonstrate the relative efficiencies of various genotypes in an ideal eastern Colorado range environment and in a sparser range environment under various economic conditions. The simulated genotypes were developed using combinations of EPD's from a typical sire evaluation listing (along with a little educated guesswork involving milk production and mature weight). Simulation results represent what could be expected if bulls of a particular genotype had been used over many years, so that the simulated genotype was that of an average cow in the herd.

Some important assumptions of the model:

1. Land area was fixed so that herd size varied with genotype and management.
2. Levels of winter supplement were not fixed, but were appropriate to the genotypes being simulated.
3. No terminal sires or heifer bulls were used.
4. All non-replacement calves entered the feedlot directly after weaning.
5. Calves were slaughtered at 30% empty body fat.
6. Efficiency was measured as $/100 kg fat free weight produced.

Under "standard" economic conditions, larger, heavier milking genotypes were favored in both environments. Cattle that combined moderate birth weight with very rapid early growth were the most efficient. Rankings of the genotypes changed little when feedlot costs were doubled. When the costs of winter supplement for the cow herd were doubled, however, lighter milking genotypes were favored, especially in the poorer environment.

In these comparisons, the larger cattle were uniformly more efficient. This is because they produced more income per head and more total income to offset the fixed costs of the operation. Remember, though, that all calves were fed out as weanlings. Recent results of the model have shown considerable improvement in the efficiency of smaller genotypes when calves were pastured through their second summer. When growth to yearling age was held constant, ultimate mature weight had relatively little effect on efficiency. The increased requirements of larger mature cows were offset by heavier slaughter weights of cull cows and fed animals.

Cattle with smaller birth weights relative to other measures of growth were always favored. Relatively small changes in weaned calf crop due to the reduced calving difficulty that accompanied smaller birth weights translated into significant improvements in overall efficiency.

Lower levels of milk production were indicated when the costs of winter supplement for the cow herd were high because heavy milking cows required more feed. This was especially true in the worse environment; the combination of poorer condition of the cows and sparser winter grass forced the feeding of greater amounts of supplement. When feedlot costs were high, more milk was indicated because heavier, fatter calves at weaning required less time and feed in the feedlot.

The results presented here demonstrate in a very limited way how computer models might be used as an aid in sire selection. In theory, once we have plugged in the environmental, management and economic variables, computer models can tell us the optimum genotype. They can even generate economic weights which can be used in conjunction with EPD's or breeding values from sire evaluations to form selection indexes.

While using computer models in this way would be ideal, there are a number of considerations which make such use unlikely. First, the models are far from perfect. They necessarily generalize, and it is not always possible to tell when the generalization has been harmful. The inputs to the models can be extensive and difficult to obtain. For a seedstock producer to make use of a model, he would have to simulate not his own herd, but a herd which represented the typical situation of his customers. That "typical" situation may be in reality a whole range of widely varying situations. Today's computer models are static in that they simulate a single set of circumstances without accounting for variable weather and prices. To be truly valid, the models should include some form of risk analysis that would prevent promotion of extreme genotypes which might be poor bets when the environment varies from the norm. Finally, producers have historically shown little interest in mathematical approaches to breeding. Beef cattle breeding has always been considered as much an art as a science.

The more likely use of computer models will be as research tools to study the many interactions among genotype, natural environment, management / mating system and economics. It will then be the responsibility of researchers and extension personnel to condense the results of modeling work into a set of principles and guidelines that can be of use to seedstock and commercial breeders.

BIF
REPRODUCTION COMMITTEE REPORT
May 4, 1984

Chairman Roy Wallace opened the meeting at 9:30 a.m. He called upon Jim Brinks of Colorado State University to discuss work done at Colorado State University in an effort to develop age adjustments for scrotal circumference in bulls.

Dr. Brinks indicated that his analyses of the data were preliminary and needed further evaluation. He indicated there were significant breed x age and location x age interactions in their data, which may indicate the need for each test station to develop its own age adjustment factors.

Dr. Brinks encouraged each breed association to look at its existing data and come to BIF with its own age adjustment factors next year.

Chairman Wallace then called upon Pete Burfening of Montana State University who discussed his work with Simmental data from a number of central test stations. A notable observation from his data was that test station was a significant source of variation. He also concluded that age adjustments for scrotal circumference are needed, and that adjustments may be needed on a "within test station", "within year" basis.

Dr. Burfening pointed out the need for care in using age adjustments for scrotal circumference. If scrotal circumference is used as an indicator of the "immediate" fertility of a bull, then the use of an age adjustment factor is not indicated; however, if scrotal circumference is to be used as a selection tool, then use of age adjustments would be proper.

A motion was made that the Reproduction Committee not recommend age adjustments for scrotal circumference at this time. The motion was seconded and passed by unanimous vote.

Chairman Wallace then called upon Dave Notter of Virginia. Dr. Notter discussed the question of what can we get out of field data regarding differences in fertility. He suggested that there is a need for breed associations to change their reporting schemes for reproduction data. He suggested that if heifers going into the breeding pastures were identified and reported, this data could be combined with calving data to generate valuable reproduction data.

Meeting adjourned.

Ron Parker
Secretary

GROWTH COMMITTEE MEETING

BEEF IMPROVEMENT FEDERATION

May 4, 1984

In his opening comments, Chairman Henry Gardiner challenged those in attendance to evaluate the information available on birth weights and calving ease and determining whether anything needed to be added to the BIF Guidelines in this regard. He noted that commercial bull buyers are evaluating birth weight information and are willing to pay for something other than the maximum of this trait.

Pete Burfening reviewed his work with the American Simmental Association. He noted that most calving difficulty is associated with first calf, two-year-old heifers. In two-year-olds, there is a linear increase in assistance as birth weight increases. Therefore, he recommended that calving difficulty information needed to come from two-year-old heifers. The Simmental data has shown very little environmental-genotype interaction in regard to birth weight and calving difficulty. He recommended the evaluation of sires' daughters for calving ease which would estimate the maternal contribution. It was also noted that the effect of gestation length on calving difficulty appears to be through its direct effect on birth weight.

Doyle Wilson reviewed some of the more recent research that is pertinent to sire evaluation for birth weight and calving ease. He noted that many studies have shown the heritability of birth weight to be in a range of from .35 to .45 although estimates derived from field data tend to be considerably lower (.12-.18). Birth weights are affected by breed, sex of calf, age of dam and gestation length, to name only a few. He noted that even though there appears to be a positive genetic correlation between birth weight and some of the major growth traits, national sire evaluations identify sires that have progeny with average birth weights and superior growth performance.

Jeff Berger reviewed his work with the Holstein Association. He noted that mortality occurs at all degrees of calving difficulty. He suggested that we can do a better job of predicting a sire's ability to produce live calves by evaluating him for dystocia rather than evaluating him for livability. He noted that all sires have some progeny born with difficulty. There is a need to present the calving difficulty information realistically. The Holstein Association presents this information as expected percent of difficult births in heifers and cows.

Additional discussion centered around the measurement and use of a bull's pelvic area to predict the pelvic area in his daughters. It was noted that this correlation is not known. There was concern about the repeatability of bull pelvic measurements due to the difficulty of making the measurements. External measurements which are used to estimate pelvic area appear to be of little use.

Although the committee felt the evaluation process should continue, no changes in the BIF Guidelines were recommended concerning the area of birth weight and calving difficulty at this time.

Respectfully submitted,

Doug L. Hixon

BIF UTILIZATION COMMITTEE MEETING

May 3, 1984
Chairman - Earl Peterson
Secretary - Ken Ellis

The main business of the committee is as follows:

1. Educational Materials - BIF educational materials in the form of fact sheets and slide sets are being put together.

   (a) Fact Sheets - Dr. Daryl Strohbehn, Central BIF Director at Iowa State University, is in charge of the editorial process and making of the camera-ready copy for the fact sheets. He reported that seven fact sheets are being put together as follows:

   - Understanding and Using Sire Summaries by Wayne Wagner at West Virginia University.
   - Understanding and Using Performance Pedigrees by Jim Gibb, American Polled Hereford Association.
   - Modern Beef Sire Selection by Roy Wallace, Select Sires, Inc.
   - Selecting and Culling the Cow Herd by John Crouch, American Angus Association.
   - Producing Profitable Commercial Bulls by Henry Gardiner, Angus breeder from Ashland, Kansas.
   - Commercial Herd Improvement by J. D. Mankin, University of Idaho.
   - Glossary of Performance Terms by Dave Notter, VPI&SU, Blacksburg, Va.

   These seven fact sheets are to be 4 to 6 page maximum length and will be produced on camera-ready copies which will be released separately as finished. The cost is approximately $2,300 and we will provide a camera-ready copy free of charge to BIF member organizations. All but one of the fact sheets are in the review process.

   (b) Slide Sets - Connie Pelton, a graduate student at Kansas State University, and Larry Corah, in the Animal Science Department at Kansas State University, are putting together two slide sets. The first one was reviewed by the committee. It is entitled, "Making Genetics and Animal Breeding Work for You". It is aimed primarily for 15 to 20 year olds involved in livestock projects. Approximately 12 to 15 minutes in length including script and tape to accompany. Will be produced from the original 28 slides and the cost will be in the reproduction plus the cost of the tape. Potential involvement of BIF in distribution of the slide sets will be detailed at the mid-year board meeting in November, 1984. The second slide set entitled, "Selection of a Project Heifer" has not been developed but an outline was reviewed with the committee by Ms. Pelton.

2. Computer Software for Commercial Producers - Roger McCraw from North Carolina State University, who is Eastern Regional Director of BIF, made the report. The BIF Board of Directors has agreed to support the development of the basic program to be reviewed at the mid-year board meeting in November, 1984. The program being developed may be utilized as a base and is expected to be distributed to each state extension service with source codes so that it can be modified to fit each state's individual needs. The current program is developed for Kay Pro with

CPM but can be converted for use on other computers. Mankin's Idaho commercial herd program provided the basic format for the program that McCraw's committee is putting together. The base information needed is cows individually identified - 4 letters or numbers; cow birth date; calf birth date, weight and identification; and breeding season start dates. The program, using Mankin's original program, has been modified by Dennis Lamm at Colorado State University, who will make the program available to BIF at a cost to cover his out-of-pocket expenses at CSU. CSU is charging 50¢ per calf weaning record. This buys all printouts. County agents receive a copy for herds in their county.

The BIF Board will review the program at the mid-year board meeting and reach a decision then on how the program can be duplicated and distributed.

3. Incorporating Performance Data into Judging Contests - Successful attempts have been made at formulating plans to incorporate performance data into intercollegiate and 4-H contests. Jim Gibb, as a member of the BIF Board of Directors, and others did considerable work. Doug Parrett, from the University of Illinois, current president of the National Collegiate Coaches Association, and Dave Seibert, University of Illinois Area Livestock Advisor, represent the two national contests. Doug Parrett reported that a committee of his association was formed at Denver in January, 1984, and resolved to include this year, one class at Eastern National, Wichita, and San Francisco contests with the hope of adding at least one class to the National contest in 1985. He encouraged BIF to develop fact sheets for reference guides. He suggested that a "Use" guidelines statement on how to interpret standards be developed. He stressed that classes should not present an unsolvable challenge; that students must be able to defend their placings. Dave Seibert began six years ago with production information on three species. He is concerned that performance data be actual rather than fictitious. He reported that in 1984 at the National 4-H Judging Contest, the contest will include one beef class with performance information and no reasons. He expects a "trickle-down" effect to state, regional, and local contests. He expressed a concern about the knowledge base in youth, 8 to 18 years of age. Can they understand? Information needs to be packaged for youth. Classes must be carefully selected, solvable, and placable. He indicated that educating coaches is a problem and that a good, simple fact sheet is needed.

4. Record Utilization in General - Darrell Wilkes, BIF board member representing the National Cattlemen's Association, indicated that cattle producers think performance testing is a good idea. Some may have made a conscious decision not to use performance testing however. He suggests that performance records and technology cannot be applied in insulation. Other management practices may make some producers more money. He suggested that producers want Extension to become problem solvers rather than information extenders. He broke producers into four groups including: innovators, early adapters, late adapters, and non-adapters. He says that Extension needs to concentrate on the innovators and early adapters.

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BIF EMBRYO TRANSFER AND RELATED TECHNOLOGY COMMITTEE MEETING

Craig Ludwig, Chairman L. L. Benyshek, Secretary

The meeting was attended by several members of the scientific community and nine breeders presently involved in embryo transfer. There appears to be little scientific evidence as to how embryo transfer calves should be genetically evaluated on the basis of their own performance. It seems that the progeny test and/or pedigree evaluation are the only acceptable methods at present. There is significant controversy among breeders concerning the genetic evaluation of embryo transfer calves.

A motion was made by Carla Nichols and seconded by Norman Wilson to appoint a subcommittee to review the literature on embryo transfer and develop a set of general guidelines for the evaluation of E.T. calves. The motion was passed.

The chairman appointed Carla Nichols, Chairperson for the subcommittee. Dick Spader, Craig Ludwig, James Bennett and Keith Vander Velde agreed to serve on the committee.

A motion was made by James Bennett to recommend to Carla Nichol's subcommittee that recipient cows be the same breed as donor cows. Seconded by Allen Ellicot. Considerable discussion. Motion passed (11 to 8).

It was suggested that a research project be designed to compare the evaluation of E.T. calves based on their own performance versus a later progeny test. Another research project suggested was to compare Holstein and Angus females as recipients using split embryos.

1984
BIF COMMITTEE ASSIGNMENTS

	Meet May 3				Meet May 4			
	SIRE EVALUATION	LIVE ANIMAL EVALUATION	SYSTEMS	CENTRAL TEST STATIONS	REPRODUCTION	GROWTH	UTILIZATION	EMBRYO TRANSFER
Ch.	Larry Cundiff	Greg Martin	Jim Gibb	Roger McCraw	Roy Wallace	Henry Gardiner	Earl Peterson	Craig Ludwig
Secy.	Richard Willham	Henry Webster	Rich Benson	Bill Swoope	Wayne Singleton	Dennis Lamm	Jim Gosey	Larry Corah
	F.D. Kirkpatrick	Carla Nichols	Dean Freschnecht	Larry Nelson	Ron Parker	Chuck Christians	J. D. Mankin	Larry Cundiff
	John Crouch	Earl Peterson	Keith Gregory	Don Franke	Peter Burfening	Doug Hixon	Ken Ellis	Bill Durfey
	Craig Ludwig	John Massey	David Notter	Bruce Howard	Robert Bellows	Richard Frahm	Richard Willham	Larry Benyshek
	Jim Gibb	Will Butts	Bill Borror	John Masters	Don Lunstra	Robert Koch	Bobby Rankin	Paul Miller
	Paul Miller	Les Holden	Frank Baker	Connie Greig	Merlyn Nielson	Don Kress	Mark Keffeler	Mike Davis
	Larry Benysbek	Bob Dickenson	Steve Hammack	Charles McPeake	Mary Garst	James Bennett	Don Hutzel	Dick Spader
	Jim Brinks	Harold Bennett	Chris Dinkel	Bill Rishel	Daryl Strohbehn	C. DuVall	James Nolan	Merlyn Nielson
	Greg Martin	Russ Danielson	Art Linton	Bill Zollinger	Chuck Shroeder	Tom Chrystal	Jim Leachman	Robert Godke
	Lyle Springer	Martin Jorgensen	Peter Marble	Bill Borror	Bill Durfey	Larry Foster	John Crouch	
	Darryl Loepke	Robert Schalles	John Brunner	Jim Glenn	Bob Sand	Joe Sagebiel	Glen Klippenstein	
	Roy Wallace	Ken Hartzell	Dave Breiner	Keith VanderVelde	Dave Nichols	Steve Wolfe	Darrell Wilkes	
	Robert Scarth		Curtis Absher	Wayne Wagner	Jim Brinks	Roy Beeby	Wayne Wagner	
	Jack Farmer		Robert McDaniel	Robert Stewart	Steve Radakovich	Glenn Butts	Bob deBaca	
	John Pollok				Mike McInerney	Gene Schroeder	Jim Gibb	
	Bill Slanger							
	Brett Middleton							
	Eldin Leighton							

Minutes
Beef Improvement Federation
Board of Directors Meeting
May 3 & 4
Ramada Renaissance Hotel
Atlanta, Georgia

The BIF Board of Directors held two directors meetings in conjunction with the 1984 Annual Convention at Atlanta, Georgia. The first meeting was held on Wednesday, May 2 at 5:00 p.m. with dinner being served at 7:00 p.m. Attending this meeting was Bill Borror, President; Gene Schroeder, Vice-President; A. L. Eller, Jr., Executive Director; Roger McGraw; Daryl Strohbehn; and Ken Ellis, Regional Directors; Jack Farmer; Greg Martin; Robert Scarth; Roy Wallace; Lyle Springer; Jim Gibb; Earl Peterson; Harvey Lemmon; Henry Gardiner; Craig Ludwig; Steve Radakovich; Bruce Howard; Glenn Butts; Michael McInernery; and Dixon Hubbard. The following items of business were transacted:

1. MINUTES - The Board voted to dispense with the reading of the minutes of the mid-year board meeting.

2. FINANCIAL REPORT - A complete financial report for the 1983 was distributed and is attached to these minutes. The report showed a beginning year balance of $39,270.18 and a ending year balance of $48,001.67. Income for 1983 amounted to $17,573.27 and total expenses amounted to $9,977.43. In addition to this report a financial status January 1, 1984 through April 20, 1984 was presented showing a April 20th balance of $51,859.31. Income to April 20th of $10,457.97 and expenses of $6,598.38. Eller explained the financial report indicating that the BIF Data Banks project was paid for March 1 in the amount of $4,000.00, his expenses to the Data Bank's meeting in Arkansas was $543.00. A copy of this financial status is also attached to the minutes.

3. EXECUTIVE DIRECTOR'S REPORT - A. L. Eller indicated that the year 1983 had been a good one and that he had enjoyed his work as Executive Director. He touched on the following points:

   a. BIF Membership - He passed out a sheet which listed the 32 State BCIA'S groups that have paid dues in 1984, the 16 Breed Associations that have paid dues for 1984, and the 11 other organizations that have paid dues in 1984 for a total paid up membership as of May 1 of 59 members. State groups that have not yet paid dues are Arkansas, Colorado, Louisiana, Nebraska, Ohio, Utah. Breed Associations that have not yet paid dues are American Gelbvieh Association, American Tarentaise Association, Canadian Hereford Association, Texas Longhorn Breeders Association. Other groups that have not paid dues are Central Alberta Livestock Ltd., Beef Booster Cattle Limited, Bovine Test Center, and Boeing Computer Services. A total of $8,658.00 dues have been received in 1984.

   b. BIF Update - He reported that the Update had gone to the livestock press, member organizations, and state extension beef specialist on a monthly basis and that this communication effort is definitely working.

   c. Office Management - He reported that Gale Stowers, the part-time secretary, is doing an outstanding job and that the cost of her salary and postage to mail the Update had been substantial increases in cost of operation since the first of the year 1983.

   d. Guidelines - Many BIF Guidelines have been mailed and a fairly good supply still remains.

e. Fact Sheets - He indicated that these were in the works and would be reported on later in the meeting by Daryl Strohbehn. Progress is good.

f. Slide Sets - He reported that these were also being put together and will be reported on later in the meeting.

g. Commercial Computer Program Software - He indicated that that committee has been quite active and that progress is being made.

Eller asked the directors to make suggestions at any time to him.

4. REPORT ON THE ATLANTA CONVENTION BY DR. CURLY COOK - Dr. Cook gave a quick report on the various activities that have been planned and would be coming up in the Atlanta Convention. Eller indicated that Ken Monfort is replaced on the program by Vice-President of Monfort of Colorado - Dr. Rod Bowling. Also that Gene Schroeder Vice-President would not be able to chair the breakfast meeting on Friday morning because of his voice. Steve Radakovich agreed to handle this chore and was thanked by the board.

5. PLANS FOR 1985 CONVENTION AT MADISON, WISCONSIN - Keith VanderVelde of ABS reported that the Wisconsin group have made preliminary plans for the convention to be held at the Concourse Motel in Madison, Wisconsin on May 2 and 3, 1985. He indicated that there had been some work done toward getting sponsors for the various portions of the convention and that possibilities for a tour had been tentatively made which would include a visit to the University of Wisconsin and Forage Research Center, to the Experiment Station where Ed Hauser's feed efficiency work with beef cows has been conducted and a stop at ABS and a hosted steak fry there. Steve Radakovich moved that May 2 and 3 be designated dates for the 1985 convention, seconded by Martin, carried.

6. PLANS FOR 1986 and 87 CONVENTION - Eller suggested that Kentucky was in line to host the 1986 Convention but that the matter of dates needed to be discussed because of the Kentucky Derby being in Lexington the first week of May. It was a concensus of the board that since there were no invitations for 1987 or later that an announcement be made at the Atlanta meeting calling for invitations for 1987 and that the board at the mid-year board meeting in November, 1984 would try to arrive at a solution in designating the place for the 1987 convention.

7. ELECTION OF DIRECTORS - Eller appraised the board of the fact that the four directors going off the board were ineligible for re-election and would all four need to be replaced at the caucus the afternoon of May 3. They are Jack Farmer, At- Large; Les Holden, Western BCIA; Greg Martin, North American Limousin Foundation; and Robert Scarth, American International Charolais Association.

8. PROGRESS REPORT ON BIF FACT SHEETS - Daryl Strohbehn of Iowa State and Central BIF Director reported that Iowa State University has been designated to print the camera-ready copy under his direction. He indicated that several of the 7 fact sheets had been written and/or are some stage of review. He indicated that the cost of producing 100 camera-ready copies, if all facts sheets are 4 page fact sheets, would be $1350. The estimated cost for all 7 facts, if they are 6 pages each, would be $1850. His estimate of the cost of producing the 100 camera-ready copy for the 7 fact sheets would range between $1600 and $2200. He passed around copies of the suggested logo and the material to be included in the glossary of Performance and Related Terms Fact Sheet so that the board would get an idea of what the fact sheets will look like. It was agreed that the logo as presented is quite adequate.

The matter of how the camera-ready copy will be made available was discussed. Jim Gibb moved that when camera-ready copy is ready for mailing that the BIF office make available a list of all the fact sheets and a copy of those which are ready to every member organization for the camera-ready copy to be ordered from BIF free of charge. Seconded by Scarth, carried.

The question was asked when would the Fact Sheets be ready. Daryl Strohbehn said that he could not give an exact answer but that they should all be be completed within the next 2 to 3 months.

The matter of whether future Fact Sheets would be made from material in the BIF Uniform Guidelines was asked. It was a concensus to wait until the Fall Mid-Year Board Meeting to make any decision relative to this.

9. REPORT ON BIF SLIDE SETS - Eller reported that the two slide sets for junior audiences done by Connie Pelton and Larry Corah at Kansas State are to be reviewed during the BIF meeting by the Utilization Committee. The two slide sets to be put together by Daryl Strohbehn have not yet been started. President Borror asked Ellis, Charman; Gibb, Strohbehn, and Cook to review the slide set and make in-put to Corah and Pelton during the Utilization Committee Meeting.

   The matter of how slides would be handled and whether or not cost would be recovered was brought up. The concenses was that the Review Committee appointed above come up with a projected cost and it appeared logical to the board that depending on their projection that perhaps slides would be mailed to those ordering slide sets on approval along with a bill.

   The two slide sets that were to be done by Strohbehn apparently will not be done by him. Others to put those slide sets together will have to be identified and the whole project to be evaluated at the mid-year board meeting.

10. REPORT OF COMMERCIAL HERD SOFTWARE PROGRAM COMMITTEE - Roger McCraw, Committee Chairman, reported that a program has been developed which was the program that was originally developed by Mankin at Idaho. Dr. Dennis Lamm at Colorado State University has made most of the beneficial modifications to the program and that the modified program will be presented in the Utilization Committee at the Atlanta meeting. McCraw indicated that Lamm and the Colorado State group is willing to make changes and write documentation for the program and that CSU would like to recupe some $1500 to recover costs that they will have in reproducing the program and making the changes necessary such that the program will run on a large number of kinds of hardware equipment.

    There were several comments and suggestions made relative to how this software package once it is finished will be gotten into the hands of users. It was the concensus of the board that BIF should make the Software Package available to states through the Land-Grant University Cooperative Extension Services of those states. Eller suggested that the mid-year board meeting in November be the target date to make final decisions as to making this software package available. Greg Martin moved that BIF appropriate $2,000 to complete the program with documentation. Seconded by Glenn Butt's and carried with one negative vote.

11. NOTIFICATION OF MEMBER ORGANIZATIONS OF GUIDELINES' CHANGES - President Borror asked Eller if the membership had been advised of the change that the board approved relative to formulas for calculating adjusted yearly weight in central test stations. Eller said that only through the UpDate was sent to all member organizations. As soon as portions of the Uniform Guidelines are printed this information will be gotten out to all member organizations.

12. HUBBARD'S SURVEY ON TEST STATIONS AND BCIA ORGANIZATIONS - Dixon Hubbard reported that he had surveyed all states and had pulled together information about all State BCIA's and all Central Bull Test Stations and he passed out copies of the summaries. These summaries will be made part of the Proceedings of the Atlanta Convention.

13. REPORT ON USING PERFORMANCE DATA IN COLLEGIATE AND 4-H JUDGING CONTESTS Jim Gibb reported that the Collegiate Coaches after appointing a committee have decided to put in one performance cattle class in the collegiate contests in San Francisco, Louisville, Eastern National and Wichita in 1984. Each of these classes with reasons. Doug Parrett,Chairman of the Coaches Group, has sent that decision to all collegiate coaches and Dr.Parrett will be in the Utilization Committee along with Dave Siburt to report on these activities. Dave Siburt Chairman of the 4-H Coaches Group has gotten the information out that one class of cattle with performance data will included in the national contest at Louisville in 1984.

14. PLANS FOR STANDING COMMITTEE ACTIVITY - President Borror asked the committee chairman to do a thorough job with their committees in the Atlanta meeting and to make sure that a written report is sent to the Executive Director for the Proceedings. He asked the committee chairmen to especially look at matters that would change the Guidelines. Roy Wallace indicated that in the Reproduction Committee that age adjustment for scrotal circumference was the main project to be worked on but advised that there was probably not complete enough data from research work to support a recommendation at this time. Greg Martin suggested that the Live Animal Evaluation Committee would be concerned primarily with a frame size chart.

15. AUSTRALIAN REQUEST - Jim Gibb reported that individuals interested in Beef Cattle Improvement in Australia had requested BIF to consider a cooperative effort whereby information exchange could be initiated. This activity was looked upon favorably by the board. Jim Gibb will contact the appropriate individual in Australia, send Eller his name and other information such that BIF materials can be mailed to him on a regular basis.

The May 4th Board Meeting convened at 6:00 a.m. with Bill Borror presiding. At that board meeting all directors who were in attendance on May 2 plus Darrell Wilkes, Frank Baker and newly elected directors were in attendance. The new directors that were elected were: Steve Wolfe, Western BCIA - Wallowa, Oregon; Al Smith, At-Large - Dublin, Virginia; Dr. Bill Warren, Santa Gertrudis Breeders International and John Crouch, American Angus Association.

16. ELECTION OF OFFICERS - Bob Scarth, Chairman of the Nominating Committee, placed in nomination the following:
President - Gene Schroeder, Vice-President - Henry Gardiner. Baker moved that the nominations be closed and that Gene Schroeder be elected to the office of President and Henry Gardiner to the office of Vice-President by acclamation, seconded by McCraw, carried. Bill Borror thanked the nominating committee and thanked the directors going off the board for their service including Jack Farmer, Les Holden, Greg Martin, and Bob Scarth.

17. MID-YEAR BOARD MEETING - Baker moved that the Mid-Year Board Meeting be held November 1 and 2, 1984 at Kansas City. Seconded by Crouch and carried. Eller asked Craig Ludwig to again make arrangements at the Sheraton Inn near the airport which he agreed to do.

18. 1985 ANNUAL CONVENTION PROGRAM COMMITTEE - President Schroeder appointed the following committee - Henry Gardiner, Chairman; Keith VanderVelde, Daryl Strohbehn, Jim Gibb, and Steve Radakovich. He charged the committee to get their work done and have a report to present at the mid-year board meeting November 1 and 2.

19. 1986 BIF CONVENTION DATES IN KENTUCKY - After discussion, Lemmon moved that the board recommend to the Kentucky people that the BIF Convention dates be selected in the second week of May (following the week of the Kentucky Derby) and leave the exact dates during that week up to the Kentucky people. Seconded by Butts, carried.

20. ELECTRONIC DATA SYSTEM - Eller indicated that in conversation with Bert Rutherford of the Western Livestock Journal the matter of utilizing a system such as Agri-Data Network to carry BIF information and perhaps sire summary data for member organizations might be considered by BIF. Rutherford was on hand to explain Agri-Data Network and the fact that Western Livestock Journal is a user. After discussion, President Schroeder appointed a committee to study the matter and report to the board in the fall mid-year board meeting. Committee composed of Earl Peterson, Chairman; Jim Gibb and Bill Borror.

21. DATA BANKS STUDY - Frank Baker reported briefly to the board on the Data Banks Project and indicated that the final report would be ready by mid-summer. Baker was scheduled to make a short presentation of the study at the Atlanta Convention on May 4th. The matter of releasing information relative to the Data Bank Study was discussed briefly. Frank Baker and Bert Rutherford were to contact the Livestock Publications Council President, Bob Day of the American Hereford Journal.

There being no further business the meeting was adjourned at 7:00 a.m.

The following awards were presented at the Awards' Banquet held the evening of May 3.

Continuing Service - James Bennett, Red House, Virginia
M. K. Cook at Athens, Georgia
Dr. Craig Ludwig, American Hereford Association

Pioneer Awards were presented to Max Hammond, Bartow, Florida
Bill Graham, Albany, Georgia
Dr. T. J. Marlowe, Blacksburg, Virginia

Seedstock Producer of the Year Award went to Lee Nichols, Iowa (deceased)

Commercial Producer of the Year to Sharon and Bob Beck of Oregon

Respectfully submitted,

A. L. Eller, Jr.
Executive Director, BIF

BEEF IMPROVEMENT FEDERATION

FINANCIAL STATUS - CALENDAR YEAR 1983

by

A. L. Eller, Jr.

	1-1-83	12-31-83
Checking Account	318.76	85.08
Savings Account	1,216.64	--
Certificate of Deposit	37,734.78	--
Money Market Account	--	47,916.59
	$39,270.18	$48,001.67

1983 BIF INCOME

Interest	$ 3,196.01
Proceedings	254.00
Dues	9,310.00
1983 BIF Convention (includes 2 cks. from Calif.)	4,813.26
TOTAL INCOME	$17,573.27

1983 BIF EXPENSES

Postage	1,450.70
Printing	913.74*
Bank Charges	13.02
Mid-Yr. Bd. Meet Director Travel	1,679.57
Meals	605.04
1983 Conv. Speaker Travel	1,705.43
Ex. Dir. Travel	1,106.50
Supplies	490.88
Salary & Taxes (Office Sec.)	2,012.55
TOTAL EXPENSES	$9,977.43

* $913.74 printing expense includes printing for Convention Programs (123.76) and Convention Proceedings ($784.98)

BEEF IMPROVEMENT FEDERATION

FINANCIAL STATUS - January 1, 1984 - April 20, 1984

BY

A. L. Eller, Jr.

Checking Account	$ 2,807.54
Money Market	49,051.77
	$51,859.31

<u>1984 BIF Income</u>

Dues	$ 8,658.00
Proceedings	16.00
Interest (Checking)	48.80
Interest (Money Market)	1,135.18
Annual Convention	600.00
TOTAL INCOME	$10,457.98

<u>1984 BIF Expenses</u>

Printing (Program & Certif.) & BIF Update)	$ 346.14
Salary & Taxes (Office Sec.)	991.07
Supplies	18.39
Postage	611.03
Exec. Dir. Travel-Beef Data Bank Meeting	543.00
Convention (Ribbons $17.75 Lettering on Certif. $31.00)	48.75
Other (Data Bank Study)	4,000.00
Legal Fee	35.00
State Corporate Tax	5.00
TOTAL EXPENSES	$6,598.38

PAID

BIF MEMBER ORGANIZATIONS AND AMOUNT FOR DUES - 1984

June 15, 1984

State BCIA'S	DUES
Alabama	$100.00
California	$100.00
Florida	$100.00
Georgia	$100.00
Hawaii	$ 50.00
Idaho	$ 50.00
Illinois	$ 50.00
Indiana	$100.00
Iowa	$100.00
Kansas	$100.00
Kentucky	$100.00
Minnesota	$100.00
Mississippi	$ 50.00
Missouri	$100.00
Montana	$100.00
Nevada	$100.00
New Mexico	$100.00
New York	$ 50.00
North Carolina	$100.00
North Dakota	$ 50.00
Ohio	$100.00
Oklahoma	$100.00
Oregon	$100.00
Pennsylvania	$ 50.00
South Carolina	$100.00
South Dakota	$100.00
Tennessee	$100.00
Texas	$ 50.00
Utah	$100.00
Virginia	$100.00
Washington	$ 50.00
West Virginia	$100.00
Wisconsin	$100.00
Wyoming	$ 50.00

Breed Associations	Dues
American Angus	$600.00
American Brahman Breeders	$300.00
American Chianina Assoc.	$200.00
American Gelbvieh Assoc.	$200.00
American Hereford Assoc.	$600.00
Am.-International Charolais	$300.00
Am. Polled Hereford Assoc.	$600.00
American Red Poll	$100.00
American Salers Assoc.	$200.00
Am. Shorthorn Assoc.	$300.00
Am. Simmental Assoc.	$300.00
International Brangus Breeders	$200.00
North American Limousin	$300.00
Red Angus Assoc.	$200.00

Breed Associations	Dues
Santa Gertrudis Breeders International	$300.00
Beefmaster Breeders Universal	$300.00
Canadian Charolais Assoc.	$200.00
Canadian Hereford Assoc.	$100.00

Others	Dues
Nat'l. Assoc. of An. Breeders	$100.00
Performance Registry Int'l.	$100.00
Nat'l. Cattlemen's Assoc.	$100.00
Am. Breeders Service	$100.00
Midwest Breeders Coop.	$100.00
NOBA, Inc.	$100.00
Select Sires, Inc.	$100.00
Manitoba Agriculture/Beef Program of An. Industry Branch	$100.00
Marland Farms	$ 50.00
Agriculture Canada - Regional Development Branch	$100.00
Carnation Genetics	$100.00
Central Alberta Livestock,Ltd.	$100.00
Beefbooster Cattle Limited	$100.00

BIF MEMBERS WHO HAVE NOT PAID MEMBERSHIP DUES FOR 1984
(As of June 15, 1984)

Arkansas BCIA - $50.00
Colorado BCIA - $50.00
Louisiana BCIA - $50.00
Nebraska BCIA - $100.00

American Tarentaise - $50.00
Texas Longhorn Breeders Assoc. of America - $200.00

Bovine Test Center - $50.00
Boeing Computer Services - $100.00

United States Department of Agriculture | Extension Service | Office of the Administrator | Washington, D.C. 20250

LISTING OF STATE BEEF CATTLE IMPROVEMENT ASSOCIATIONS

ALABAMA	ALABAMA BCIA (1964) Richard E. Deese Extension Beef Cattle Specialist 215 Animal Science Bldg Auburn University Auburn University, AL 36849	205/826-4377
ARIZONA	ARIZONA CATTLE GROWER ASSOCIATION (?) Tommie Martin 5025 East Washington -- Suite 110 Phoenix, AZ 85034	602/
ARKANSAS	No BCIA	
CALIFORNIA	CALIFORNIA BCIA (1959) Judy Knowles, Secretary 6325 Tim Bell Road Oakdale, CA 95361	209/847-8419
COLORADO	COLORADO BCIA (1982) W. Dennis Lamm Extension Beef Cattle Specialist 108A Dept of Animal Sciences Colorado State University Ft. Collins, CO 80523	303/491-6903
CONNECTICUT	CONNECTICUT BCIA (?) Louis A. Malkus Extension Livestock Specialist University of Connecticut Storrs, CT 06268	203/486-2636
DELAWARE	DELMARVA BEEF CATTLEMEN'S ASSOCIATION (1984) Kenneth Kephart University of Delaware Substation RD #2, Box 48 Georgetown, DE 19947	302/856-5250
FLORIDA	FLORIDA BCIA (1960) Robert S. Sand, Secretary 231 Ani Sci Bldg #459 University of Florida Gainesville, FL 32611	904/392-1916
GEORGIA	GEORGIA BCIA (1958) M. K. Cook, Head Extension Animal Science Dept University of Georgia Athens, GA 30602	404/542-2584

HAWAII	HAWAII BCIA (1966) James C. Nolan, Jr., Advisor University of Hawaii 1800 East West Road Honolulu, HI 96822	808/948-7090
IDAHO	No BCIA	
ILLINOIS	ILLINOIS BCIA (1955) Gary E. Ricketts Extension Livestock Specialist 326 Mumford Hall 1301 West Gregory Drive Urbana, IL 61801	217/333-7351
INDIANA	INDIANA BEEF PERFORMANCE TESTING PROGRAM (1964) L. A. Nelson or K. G. MacDonald Animal Sciences Dept Lilly Hall of Life Sciences Purdue University West Lafayette, IN 47907	317/494-4834 317/494-4833
IOWA	IOWA BEEF IMPROVEMENT ASSOCIATION (1960) Jim Glenn 123 Airport Road Ames, IA 50010	515/233-3636
KANSAS	KANSAS BEEF IMPROVEMENT COMMITTEE (1968) Keith Zoellner Extension Beef Cattle Specialist Weber Hall Kansas State University Manhattan, KS 66506	913/532-6131
KENTUCKY	KENTUCKY BCIA (1958) Carla Gale Nichols 803 Ag Science Center South University of Kentucky Lexington, KY 40546	606/257-7514
LOUISIANA	LOUISIANA BCIA (1961) John S. Sullivan, Jr. Extension Beef Cattle Specialist Knapp Hall Louisiana State University Baton Rouge, LA 70803	504/388-2219

MAINE	No BCIA
MARYLAND	MARYLAND BCIA (1955) William A. Curry 301/454-7825 Extension Livestock Specialist Animal Science Center Room 0131 University of Maryland College Park, MD 20742
MASSACHUSETTS	MASSACHUSETTS BEEF CATTLE IMPROVEMENT PROGRAM (1959) J. P. Tritschler, II 413/545-2340 Extension Livestock Specialist Stockbridge Hall University of Massachusetts Amherst, MA 01003
MICHIGAN	MICHIGAN BCIA (1967) William T. Magee 517/355-0327 Dept of Animal Science 102 Anthony Hall Michigan State University East Lansing, MI 48824
MINNESOTA	MINNESOTA BEEF CATTLE IMPROVEMENT ASSOCIATION (1968) Charles J. Christians, Supervisor 612/373-1166 101 Peters Hall University of Minnesota St. Paul, MN 55108
MISSISSIPPI	MISSISSIPPI BCIA (1959) William M. Swoope 601/325-3515 Extension Livestock Specialist Mississippi State University Box 5425 Mississippi State, MS 39762
MISSOURI	MISSOURI BEEF CATTLE IMPROVEMENT ASSOC, INC. (1958) John W. Massey 314/882-7289 Extension Beef Cattle Specialist S111 Animal Science Center, Rm S132A University of Missouri Columbia, MO 65211
MONTANA	MONTANA BEEF PERFORMANCE ASSOCIATION (1956) Steven B. Church 406/ 405 Linfield Hall Montana State University Bozeman, MT 59717-22
NEBRASKA	BEEF IMPROVEMENT COMMITTEE OF NEBRASKA STOCK GROWERS ASSOCIATION (1961) Jim Gosey 402/472-6417 Extension Beef Cattle Specialist Marvel Baker Hall University of Nebraska Lincoln, NE 68583

NEVADA	NEVADA BCIA (1968) W. C. Behrens Extension Livestock Specialist Dept of Animal Science University of Nevada Reno, NV 89507	702/784-1621
NEW HAMPSHIRE	No BCIA	
NEW JERSEY	No BCIA	
NEW MEXICO	NEW MEXICO BEEF CATTLE PERFORMANCE ASSOCIATION (1956) Ron Parker Extension Beef Cattle Specialist New Mexico State University Box 3AE Las Cruces, NM 88003	505/646-1709
NEW YORK	NEW YORK BCIA (1940's) William M. Greene Extension Beef Cattle Specialist Cornell University Ithaca, NY 14853	607/256-7712
NORTH CAROLINA	NORTH CAROLINA BCIA (1959) Roger L. McCraw Extension Beef Cattle Specialist North Carolina State University P. O. Box 7621 Raleigh, NC 27695-7621	919/737-2761
NORTH DAKOTA	NORTH DAKOTA BEEF CATTLE IMPROVEMENT ASSOC, INC (1963) Melvin A. Kirkeide, Secretary Hultz Hall, University Station North Dakota State University Fargo, ND 58105	701/237-7646
OHIO	OHIO BCIA (1961) Eugene Byers Loundonville, OH 44842	
OKALHOMA	No BCIA	
OREGON	BEEF CATTLE IMPROVEMENT COMMITTEE OF OREGON CATTLEMEN'S ASSOCIATION (1959) W. Dean Frischknecht Extension Livestock Specialist Animal Science Department Oregon State University Corvallis, OR 97331	503/754-4926

PENNSYLVANIA	PENNSYLVANIA BCIA (1957) Lester A. Burdette Extension Livestock Specialist 317 Henning Bldg Pennsylvania State University University Park, PA 16802	814/863-3670
PUERTO RICO	NO SUBMISSION	
RHODE ISLAND	No BCIA	
SOUTH CAROLINA	SOUTH CAROLINA BCIA (1960's) Henry W. Webster Extension Beef Cattle Specialist 145 P&AS Bldg Clemson University Clemson, SC 29631	803/656-3424
SOUTH DAKOTA	SOUTH DAKOTA BCIA (1956) Joseph G. Schimmel Executive Secretary 801 San Francisco Street Rapid City, SD 57701	605/
TENNESSEE	TENNESSEE BEEF CATTLE IMPROVEMENT PROGRAM (1956) David Kirkpatrick Extension Beef Cattle Specialist University of Tennessee P. O. Box 1071 Knoxville, TN 37901	615/974-7294
TEXAS	No BCIA	
UTAH	UTAH BCIA (1969) Nyle J. Matthews Extension Livestock Specialist 250 North Main Richfield, UT 84701	801/896-4609
VERMONT	VERMONT BCIA (1983) Paul F. Saenger Extension Livestock Specialist Carrigan Hall University of Vermont Burlington, VT 05705	802/656-2070
VIRGIN ISLANDS	VIRGIN ISLANDS BCIA (1977) Harold Hupp CVI Ag Experiment Station Senepol Research Program P.O. Box 920, Kingshill St. Croix, VI 00850	809/778-0050

VIRGINIA	VIRGINIA BCIA (1955) A. L. Eller, Jr. Extension Beef Cattle Specialist Animal Sciences Building Virginia Polytechnic Institute and State University Blacksburg, VA 24061	703/961-5252
WASHINGTON	WASHINGTON BCIA (1968) Wm. E. McReynolds Extension Beef Cattle Specialist 121 Clark Hall Washington State University Pullman, WA 99163	509/335-2922
WEST VIRGINIA	WEST VIRGINIA BEEF CATTLE PERFORMANCE TESTING PROGRAM (1960) Wayne R. Wagner Extension Livestock Specialist G022 Ag Science Bldg P. O. Box 6108 Morgantown, WV 26506-6108	304/293-3392
WISCONSIN	WISCONSIN BEEF IMPROVEMENT ASSOCIATION (1953) Ellie Larson, President Route 1, 3427 Bohn Road Mt. Horeb, WI 53527	608/437-5660
WYOMING	WYOMING BEEF CATTLE IMPROVEMENT ASSOCIATION (1984) Doug L. Hixon Executive Secretary University of Wyoming P. O. Box 3354, University Station Laramie, WY 82071	307/766-3100

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April 1984

CENTRAL BULL TESTING SUMMARY - APRIL, 1984

NAMES, ADDRESSES, AND CONTACT PERSONS FOR BULL TESTING STATIONS

STATE	NAME OF STATION	CONTACT AND ADDRESS	YEAR ESTABLISHED	BULLS TESTED IN LAST COMPLETE YEAR OF TESTING	NO. OF BULLS SOLD
ALABAMA	Auburn University Bull Test	Richard E. Deese Extension Beef Cattle Specialist 215 Animal Science Bldg Auburn University Auburn University, AL 36849 PHONE: 205/826-4377	1951	96	70
	North Alabama BCIA Bull Test	SAME AS ABOVE	1973	35	31
	BCIA Grazing Test	SAME AS ABOVE	1979	59	26
ARIZONA	NO TEST STATION				
ARKANSAS	Univ of AR Bull Test Station	A. Hayden Brown Extension Livestock Specialist Department of Animal Science University of Arkansas Fayetteville, AR 72701 PHONE: 501/575-4855	1962	60	?
	Univ of AR Bull Test Sta	W. C. Loe Southwest Research & Extension Ctr Route 3, Box 258 Hope, AR 71801 PHONE: 501/	1962	85	?
	Univ of AR Bull Test Sta	James A. Horsby Southeast Research & Extension Ctr P.O. Box 3508, UAM Monticello, AR 71655 PHONE: 501/	1977	56	?
CALIFORNIA	CBCIA "On Ranch" Bull Test	C. Richard Benson Extension Beef Cattle Specialist University of California Davis, CA 95616 PHONE: 916/752-1278	1981	600	77
	Cal Poly Bull Test	Frank Fox Department of Animal Science Cal Poly State University San Luis Obispo, CA 93401 PHONE:	1957	260	105
	Bovine Test Center	Jerry Maltby 11900 28 Mile Road Oakdale, CA 95361 PHONE:	1979	400	235*
COLORADO	Northeast Colorado Bull Test Association	Burdette Rt., Box 59 Akron, CO 80720 PHONE: 303/	1976	294	130
	Southeast Colorado Bull Test Association	George Ellicott Area Extension Livestock Spec County Courthouse Eads, CO 81036 PHONE: 303/438-5321	1973	106	62
	4-Corners Bull Test Assn	Al Denham 18683 State Hwy 140 Hesperus, CO 81326 PHONE: 303/	1949	275	150
	Western Colorado Bull Test Association	Herman Soderquist Area Extension Livestock Spec Courthouse Annex 5th & Palmer Delta, CO 81416 PHONE: 303/874-3519	1981	183	105
CONNECTICUT	NO TEST STATION				

* 235 Total = 140 Private Treaty
95 Sale

STATE	NAME OF STATION	CONTACT AND ADDRESS	YEAR ESTABLISHED	BULLS TESTED IN LAST COMPLETE YEAR OF TESTING	NO. OF BULLS SOLD
DELAWARE	NO TEST STATION				
FLORIDA	NO TEST STATION				
GEORGIA	North Georgia Bull Evaluation Center	Rick Hardin P. O. Box 95 Calhoun, GA 30701 PHONE: 404/	1969	117	71
	Tifton Bull Evaluation Sta	Robert Stewart Extension Beef Cattle Specialist Rural Development Center Box 1209 Tifton, GA 31793 PHONE: 912/386-3407	1957	137	86
	Rollins Beef Research Ctr	Luther Miller Berry College Mount Berry. GA 30149 PHONE:	1974	77	42
	Georgia Pasture Fed Bull Test	Mike Crider Extension Beef Cattle Specialist Box 1898 Statesboro, GA 30458 PHONE: 912/681-5638	1980	74	46
HAWAII	BCIA Test Station	James C. Nolan, Jr. Extension Beef Cattle Specialist University of Hawaii 1800 East West Road Honolulu, HI 96822 PHONE: 808/948-7090	1979	133*	No Sale
* 133 Total =	120 On Ranch Testing Program 13 On Station				
IDAHO	Northwest Bull Test Station	Jim White Caldwell, ID 83605 PHONE: 208/722-6517	1983	189	140
	KE Bull Test Station	Gerald Elson, Manager New Plymouth, ID 83655 PHONE: 208/	1983	160	100
ILLINOIS	Bull Test Station	Gary Daniel, Manager Dept of Animal Industries Southern Illinois University Carbondale, IL 62901 PHONE:	1974	72	54
	Beef Evaluation Station	Loren Robinson Dept of Agriculture Western Illinois University Macomb, IL 61455 PHONE: 309/	1971	72	54
INDIANA	Indiana Beef Evaluation Program	Larry A. Nelson, Coordinator Department of Animal Science Room 3-224 Lilly Hall Purdue University West Lafayette, IN 47907 PHONE: 317/494-4834	1976	267*	146

* Includes 30 Gets-of-Sire of at least 3 Bulls

STATE	NAME OF STATION	CONTACT AND ADDRESS	YEAR ESTABLISHED	BULLS TESTED IN LAST COMPLETE YEAR OF TESTING	NO. OF BULLS SOLD
IOWA	Orient Bull Test Station Harold Williams, Manager Orient, IA 50858 PHONE: 515/337-5763	Jim Glenn Iowa Beef Improvement Association 123 Airport Road Ames, IA 50010 PHONE: 515/233-3636	1981	122	64
	Grundy Center Bull Test Station Dennis Dolmage, Manager 801 12th Street Grundy Center, IA 50638 PHONE: 319/824-3586	SAME AS ABOVE	1973	288	203
	Storm Lake Bull Test Station Kruse Bros. Feedlot R.R. #1 Storm Lake, IA 50588 PHONE: 712/732-1119	SAME AS ABOVE	1976	86	52
KANSAS	Kansas Bull Test - Beloit	Willard Olson Extension Beef Cattle Specialist Weber Hall Kansas State University Manhattan, KS 66506 PHONE: 913/532-6131	1970	658	340
	Kansas Bull Test - Potwin	SAME AS ABOVE	1982	492	249
	Silver Key Bull Test	Larry Stucky Route #1 McPherson, KS 67460 PHONE:	1974	60	
	Colby Bull Test	Danny Simms Area Extension Livestock Spec KSU Extension Service 170 West Fourth Colby, KS 67701 PHONE: 913/462-3971	1981	153	90
KENTUCKY	Central Bull Test Station	Carla C. Nichols Extension Beef Cattle Specialist 803 Ag Science South University of Kentucky Lexington, KY 40546 PHONE: 606/257-7514	1969	228	153
LOUISIANA	Bull Testing Station at Alexandria	John E. Pontif Dean Lee Ag Center LSUA LeCompte, LA 71346 PHONE:	1956	120	60
MAINE	NO TEST STATION				

State	Name of Station	Contact and Address	Year Established	Bulls Tested in Last Complete Year of Testing	No. of Bulls Sold
MARYLAND	NO TEST STATION				
MASSACHUSETTS	NO TEST STATION				
MICHIGAN	West Michigan Centennial Bull Test Station	Richard Crissman 585 - 36th Street, S.W. Grand Rapids, MI 49509 PHONE:	1974	32	No sale
MINNESOTA	Minnesota Bull Test Station	C. J. Christians Extension Livestock Specialist University of Minnesota St. Paul, MN 55108 PHONE: 612/373-1166	1968	134	68
	St. Croix Valley Bull Test Station	Rudy Erickson Animal Science Department University of Wisconsin River Falls, WI 54022 PHONE:	1978	50	40
	Bigalk Central Test Station	Earl Bigalk Route #2 Harmony, MN 55939 PHONE:	1982	94	60
MISSISSIPPI	Hinds Bull Test	Billie Banes, Manager Hinds Junior College Raymond, MS 39154 PHONE:	1982	100	75
	NEMBES Bull Test	Dalton Garner, Manager Booneville, MS 38829 PHONE:	1979	46	30
MISSOURI	North Missouri Center RFD #1 Spickard, MO 64679	Jerry Lipsey S111 Animal Science Center Rm S134 University of Missouri Columbia, MO 65211 PHONE:	1970	89	?
	Central Testing Station Columbia, MO	SAME AS ABOVE	1960	138	No sale
MONTANA	Midland Bull Test Station	Leo McDonnell, Jr. Columbus, MT 59019 PHONE: 406/322-5597	1963	1,450	700
NEBRASKA	Western Nebraska Bull Test Station Ogallala, NE 69153 Bill Rischel, Manager P. O. Box 1511 North Platte, NE 69101 PHONE:	Jim Gosey Extension Beef Cattle Specialist Marvel Baker Hall University of Nebraska--Lincoln Lincoln, NE 68583 PHONE: 402/472-6417	1961	386	193

STATE	NAME OF STATION	CONTACT AND ADDRESS	YEAR ESTABLISHED	BULLS TESTED IN LAST COMPLETE YEAR OF TESTING	NO. OF BULLS SOLD
NEVADA	University Main Station Field Lab	Don Albert Main Station Field Lab Kimlick & Boynton Lane Reno, NV 89502 PHONE: 702/	1968	78	0
NEW HAMPSHIRE	NO TEST STATION				
NEW JERSEY	NO TEST STATION				
NEW MEXICO	Tucumcari Bull Test	Ron Parker Extension Beef Cattle Specialist New Mexico State University Box 3AE Las Cruces, NM 88003 PHONE: 505/646-1709	1961	136	93
NEW YORK	Cornell University Bull Test Station	William Greene Extension Beef Cattle Specialist Morrison Hall Cornell University Ithaca, NY 14853 PHONE: 607/256-7712	1977	80	38
NORTH CAROLINA	Rocky Mount, NC Station	Roger L. McCraw Extension Beef Cattle Specialist North Carolina State University Box 7621 Raleigh, NC 27695-7621 PHONE: 919/737-2761	1969	86	51
	Salisbury, NC Station	SAME AS ABOVE	1973	77	48
	Waynesville, NC Station	SAME AS ABOVE	1980	54	28
NORTH DAKOTA	NO TEST STATION				
OHIO	Ohio Bull Test Station	Charles Boyles Route 6 Caldwell, OH 43724 PHONE:	1969	225	125
OKLAHOMA	Oklahoma BEEF, Inc.	Charles A. McPeake Extension Beef Cattle Specialist 201 Animal Science Bldg Oklahoma State University Stillwater, OK 74078 PHONE: 405/624-6060	1973	700	200
	Gelbievh Test Station	Les Hutchens 119 West Hartman Stillwater, OK 74074 PHONE: 405/377-8037	1982	50	38
	Noble Foundation	Clay Wright Ardmore, OK 73402 PHONE: 405/223-5810	1983	72	Sale to be held in Apri
	Simmental Test El Reno, OK	Gary Harding Conners State College Warner, OK 74469 PHONE: 918/463-2931	1980	108	88
	Conners State College	Gary Harding Conners State College Warner, OK 74469 PHONE: 918/463-2931	1962	145	88
	Panhandle State University Test	Jerry Martin Goodwell, OK 73939 PHONE: 405/349-2611	1952	102	62

State	Name of Station	Contact and Address	Year Established	Bulls Tested in Last Complete Year of Testing	No. of Bulls Sold
OREGON	NO TEST STATION				
PENNSYLVANIA	Pennsylvania Meat Animal Evaluation Station	(Vacancy), Director Fox Hollow Road University Park, PA 16802 PHONE: 814/	1973	88	51
PUERTO RICO	NO SUBMISSION				
RHODE ISLAND	NO TEST STATION				
SOUTH CAROLINA	Clemson University Gain Test	Henry W. Webster Extension Beef Cattle Specialist 145 P&AS Bldg Clemson University Clemson, SC 29631 PHONE: 803/656-3424	1969	85	40
	Edisto Forage Bull Test	Larry Olson Area Extension Livestock Specialist Edisto Research Station Blackville, SC 29817 PHONE: 803/284-3344	1982	45	35
SOUTH DAKOTA	Top Notch Test Center	Forrest Ireland Kadoka, SD 57543 PHONE: 605/	1982	124	90
TENNESSEE	Univ of Tennessee Bull Test Station Middle Tennessee Expt Sta Spring Hill, TN	David Kirkpatrick Extension Beef Cattle Specialist University of Tennessee P. O. Box 1071 Knoxville, TN 37901 PHONE: 615/974-7294	1971	117	86
TEXAS	Livestock Performance Ctr	Homer Higdon P. O. Box 520 Castroville, TX 78009	1982	600	400
	Sul Ross Beef Evaluation Center	SRSU Box C110 Alpine, TX 79832 PHONE:	1981	184	0
	Cooke County College	Cooke County College Box 815 Gainesville, TX 76240 PHONE:	1972	250	?
	Luling Foundation	Archie Abramett, Manager Drawer 31 Luling, TX 78648 PHONE:	1963	74	35
	Lone Star Testing Center	Sam Massey Box 518 Wickett, TX 79788 PHONE:	1973	284	190
	Central Texas College	Raiford Williams Agricultural Department Hwy 190 West Killeen, TX 76541 PHONE:	1975	0	No sale
	Stephen F. Austin State University Station	Joe Gotti Agriculture Department Stephen F. Austin State University Nacogdoches, TX 75961 PHONE:	1982	52	?
UTAH	Utah Beef Improvement Association Test Station	Nyle J. Matthews Extension Livestock Specialist Utah State University 250 North Main Richfield, UT 84701 PHONE: 801/896-4609	1969	200	75

STATE	NAME OF STATION	CONTACT AND ADDRESS	YEAR ESTABLISHED	BULLS TESTED IN LAST COMPLETE YEAR OF TESTING	NO. OF BULLS SOLD
VERMONT	NO TEST STATION				
VIRGIN ISLANDS	NO TEST STATION				
VIRGINIA	Culpeper Agricultural Enterprises P. O. Box 658 Culpeper, VA 22701 Bole Pace, Manager PHONE: 703/547-2188	Virginia BCIA Department of Animal Science Virginia Polytechnic Institute and State University Blacksburg, VA 24061 PHONE: 703/961-5252	1958	228	155
	Red House Bull Evaluation Center Red House, VA 23963 James Bennett, Manager PHONE: 804/376-3567	SAME AS ABOVE	1972	211	121
	Southwest Bull Test Station Route 2, Box 94 Wytheville, VA 24382 Brent Moore, Manager PHONE: 703/228-5906	SAME AS ABOVE	1979	162	78
WASHINGTON	NO TEST STATION				
WEST VIRGINIA	West Virginia Bull Test Station	Wayne R. Wagner Extension Livestock Specialist G022 Agricultural Science Bldg Box 6108 Morgantown, WV 26506-6108 PHONE: 304/293-3392	1966	220	127
WISCONSIN	Wisconsin Beef Improvement Association	Ellie Larson, President Route 1, 3427 Bohn Road Mt. Horeb, WI 53527 PHONE: 608/437-5660	1957	130	85
WYOMING	NO TEST STATION				
TOTALS					

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April 1984

BIF AWARDS PROGRAM

The Commercial Producer Honor Roll of Excellence

Chan Cooper	MT	1972
Alfred B. Cobb, Jr.	MT	1972
Lyle Eivens	IA	1972
Broadbent Brothers	KY	1972
Jess Kilgore	MT	1972
Clifford Ouse	MN	1973
Pat Wilson	FL	1973
John Glaus	SD	1973
Sig Peterson	ND	1973
Max Kiner	WA	1973
Donald Schott	MT	1973
Stephen Garst	IA	1973
J. K. Sexton	CA	1973
Elmer Maddox	OK	1973
Marshall McGregor	MO	1974
Lloyd Mygard	ND	1974
Dave Matti	MT	1974
Eldon Wiese	MN	1974
Lloyd DeBruycker	MT	1974
Gene Rambo	CA	1974
Jim Wolf	NE	1974
Henry Gardiner	KS	1974
Johnson Brothers	SD	1974
John Blankers	MN	1975
Paul Burdett	MT	1975
Oscar Burroughs	CA	1975
John R. Dahl	ND	1975
Eugene Duckworth	MO	1975
Gene Gates	KS	1975
V. A. Hills	KS	1975
Robert D. Keefer	MT	1975
Kenneth E. Leistritz	NE	1975
Ron Baker	OR	1976
Dick Boyle	ID	1976
James D. Hackworth	MO	1976
John Hilgendorf	MN	1976
Kahua Ranch	HI	1976
Milton Mallery	CA	1976
Robert Rawson	IA	1976
Wm. A. Stegner	ND	1976
U. S. Range Experiment Station	MT	1976
John Blankers	MN	1977
Maynard Crees	KS	1977
Ray Franz	MT	1977
Forrest H. Ireland	SD	1977
John A. Jameson	IL	1977
Leo Knoblauch	MN	1977
Jack Pierce	ID	1977
Mary & Stephen Garst	IA	1977
Odd Osteroos	ND	1978
Charles M. Jarecki	MT	1978
Jimmy G. McDonnal	NC	1978
Victor Arnaud	MO	1978
Ron & Malcolm McGregor	IA	1978
Otto Uhrig	NE	1978
Arnold Wyffels	MN	1978
Bert Hawkins	OR	1978
Mose Tucker	AL	1978
Dean Haddock	KS	1978
Myron Hoeckle	ND	1979
Harold & Wesley Arnold	SD	1979
Ralph Neill	IA	1979
Morris Kuschel	MN	1979
Bert Hawkins	OR	1979
Dick Coon	WA	1979
Jerry Northcutt	MO	1979
Steve McDonnell	MT	1979
Doug Vandermyde	IL	1979
Norman, Denton & Calvin Thompson	SD	1979
Jess Kilgore	MT	1980
Robert & Lloyd Simon	IL	1980
Lee Eaton	MT	1980
Leo & Eddie Grubl	SD	1980
Roger Winn, Jr.	VA	1980
Gordon McLean	ND	1980
Ed Disterhaupt	MN	1980
Thad Snow	CAN	1980
Oren & Jerry Raburn	OR	1980
Bill Lee	KS	1980
Paul Moyer	MO	1980
G. W. Campbell	IL	1981
J. J. Feldmann	IA	1981
Henry Gardiner	KS	1981
Dan L. Weppler	MT	1981
Harvey P. Wehri	ND	1981
Dannie O'Connell	SD	1981
Wesley & Harold Arnold	SD	1981
Jim Russel & Rick Turner	MO	1981
Oren & Jerry Raburn	OR	1981
Orin Lamport	SD	1981
Leonard Wulf	MN	1981
Wm. H. Romersberger	IL	1982
Marvin & Donald Stoker	IA	1982
Sam Hands	KS	1982
Larry Campbell	KY	1982
Lloyd Atchison	CAN	1982
Earl Schmidt	MN	1982

Milton Krueger	MO	1982	Bill Jones	MT	1983
Carl Odegard	MT	1982	Harry & Rick Kline	IL	1983
Raymond Josephson	ND	1982	Charlie Kopp	OR	1983
Clarence Reutter	SD	1982	Duwayne Olson	SD	1983
Leonard Bergen	CAN	1983	Ralph Pederson	SD	1983
Kent Brunner	KS	1983	Ernest & Helen Schaller	MO	1983
Tom Chrystal	IA	1983	Al Smith	VA	1983
John Freitag	WI	1983	John Spencer	CA	1983
Eddie Hamilton	KY	1983	Bud Wishard	MN	1983

1984

Bob & Sharon Beck	OR	1984	Don Moch	ND	1984
Norman Coyner & Sons	VA	1984	Neil Moffat	CAN	1984
Franklyn Esser	MO	1984	William H. Moss, Jr.	GA	1984
Leonard Fawcett	SD	1984	Dennis P. Solvie	MN	1984
Fred & Lee Kummerfeld	WY	1984	Robert P. Stewart	KS	1984
Edgar Lewis	MT	1984	Charlie Stokes	NC	1984
Boyd Mahrt	CA	1984			

BIF AWARDS PROGRAM

The Seedstock Breeder Honor Roll of Excellence

John Crowe	CA	1972	Joseph P. Dittmer	IA	1975
Dale H. Davis	MT	1972	Dale Engler	KS	1975
Elliot Humphrey	AZ	1972	Leslie J. Holden	MT	1975
Jerry Moore	OH	1972	Robert D. Keefer	MT	1975
James D. Bennett	VA	1972	Frank Kubik, Jr.	ND	1975
Harold A. Demorest	OH	1972	Licking Angus Ranch	NE	1975
Marshall A. Mohler	IN	1972	Walter S. Markham	CA	1975
Billy L. Easley	KY	1972	Gerhard Mittness	KS	1976
Messersmith Herefords	NE	1973	Ancel Armstrong	VA	1976
Robert Miller	MN	1973	Jackie Davis	CA	1976
James D. Hemmingsen	IA	1973	Sam Friend	MO	1976
Clyde Barks	ND	1973	Healy Brothers	OK	1976
C. Scott Holden	MT	1973	Stan Lund	MT	1976
William F. Borror	CA	1973	Jay Pearson	ID	1976
Raymond Meyer	SD	1973	L. Dale Porter	IA	1976
Heathman Herefords	WA	1973	Robert Sallstrom	MN	1976
Albert West III	TX	1973	M. D. Shepherd	ND	1976
Mrs. R. W. Jones, Jr.	GA	1973	Lowellyn Tewksbury	ND	1976
Carlton Corbin	OK	1973	Harold Anderson	SD	1977
Wilfred Dugan	MO	1974	William Borror	CA	1977
Bert Sackman	ND	1974	Rob Brown, Simmental	TX	1977
Dover Sindelar	MT	1974	Glenn Burrows, PRI	NM	1977
Jorgensen Brothers	SD	1974	Henry & Jeanette Chitty	FL	1977
J. David Nichols	IA	1974	Tom Dashiell, Hereford	WA	1977
Bobby Lawrence	GA	1974	Lloyd DeBruycker, Charolais	MT	1977
Marvin Bohmont	NE	1974	Wayne Eshelman	WA	1977
Charles Descheemaeker	MT	1974	Hubert R. Freise	ND	1977
Bert Crame	CA	1974	Floyd Hawkins	MO	1977
Burwell M. Bates	OK	1974	Marshall A. Mohler	IN	1977
Maurice Mitchell	MN	1974	Clair Percel	KS	1977
Robert Arbuthnot	KS	1975	Frank Ramackers, Jr.	NE	1977
Glenn Burrows	NM	1975	Loren Schlipf	IL	1977
Louis Chesnut	WA	1975	Tom and Mary Shaw	ID	1977
George Chiga	OK	1975	Bob Sitz	MT	1977
Howard Collins	MO	1975	Bill Wolfe	OR	1977
Jack Cooper	MT	1975	James Volz	MN	1977

A. L. Grau		1978
George Becker	ND	1978
Jack Delaney	MN	1978
L. C. Chestnut	WA	1978
James D. Bennett	VA	1978
Healey Brothers	OK	1978
Frank Harpster	MO	1978
Bill Womack, Jr.	AL	1978
Larry Berg	IA	1978
Buddy Cobb	MT	1978
Bill Wolfe	OR	1978
Roy Hunt	PA	1978
Del Krumwied	ND	1979
Jim Wolf	NE	1979
Rex and Joann James	IA	1979
Leo Schuster Family	MN	1979
Bill Wolfe	OR	1979
Jack Ragsdale	KY	1979
Floyd Mette	MO	1979
Glenn and David Gibb	IL	1979
Peg Allen	MT	1979
Frank and Jim Willson	SD	1979
Donald Barton	UT	1980
Frank Felton	MO	1980
Frank Hay	CAN	1980
Mark Keffeler	SD	1980
Bob Laflin	KS	1980
Paul Mydland	MT	1980
Richard Tokach	ND	1980
Roy & Don Udelhoven	WI	1980
Bill Wolfe	OR	1980
John Masters	KY	1980
Floyd Dominy	VA	1980
James Bryan	MN	1980
Blythe Gardner	UT	1980
Richard McLaughlin	IL	1980
Charlie Richards	IA	1980
Bob Dickinson	KS	1981
Clarence Burch	OK	1981
Lynn Frey	ND	1981
Harold Thompson	WA	1981
James Leachman	MT	1981
J. Morgan Donelson	MO	1981
Clayton Canning	CAN	1981
Russ Denowh	MT	1981
Dwight Houff	VA	1981
G. W. Cornwell	IA	1981
Bob and Gloria Thomas	OR	1981
Roy Beeby	OK	1981
Herman Schaefer	IL	1981
Myron Aultfather	MN	1981
Jack Fagsdale	KY	1981
W. B. Williams	IL	1982
Garold Parks	IA	1982
David A. Breiner	KS	1982
Joseph S. Bray	KY	1982
Clare Geddes	CAN	1982
Howard Krog	MN	1982
Harlin Hecht	MN	1982
Willard Kottwitz	MO	1982
Larry Leonhardt	MT	1982
Frankie Flint	NM	1982
Gary & Gerald Carlson	ND	1982
Bob Thomas	OR	1982
Orville Stangl	SD	1982
C. Ancel Armstrong	KS	1983
Bill Borror	CA	1983
Charles E. Boyd	KY	1983
John Bruner	SD	1983
Leness Hall	WA	1983
Ric Hoyt	OR	1983
E. A. Keithley	MO	1983
J. Earl Kindig	VA	1983
Jake Larson	ND	1983
Harvey Lemmon	GA	1983
Frank Myatt	IA	1983
Stanley Nesemeier	IL	1983
Russ Pepper	MT	1983
Robert H. Schafer	MN	1983
Alex Stauffer	WI	1983
D. John & Lebert Shultz	MO	1983

1984

Philip A. Abrahamson	MN	1984
Ron Bieber	SD	1984
Jerry Chappell	VA	1984
Charles W. Druin	KY	1984
Jack Farmer	CA	1984
John B. Green	LA	1984
Ric Hoyt	OR	1984
Fred H. Johnson	OH	1984
Earl Kindig	VA	1984
Glen Klippenstein	MO	1984
A. Harvey Lemmon	GA	1984
Lawrence Meyer	IL	1984
Donn & Sylvia Mitchell	CAN	1984
Lee Nichols	IA	1984
Clair K. Parcel	KS	1984
Joe C. Powell	NC	1984
Floyd Richard	ND	1984
Robert L. Sitz	MT	1984

Continuing Service Awards

Clarence Burch	Oklahoma	1972
F. R. Carpenter	Colorado	1973
E. J. Warwick	ARS-USDA Wash.DC	1973
Robert De Baca	Iowa State Univ.	1973
Frank H. Baker	Okla. State Univ.	1974
D. D. Bennett	Oregon	1974
Richard Willham	Iowa State Univ.	1974
Larry V. Cundiff	RLHUSMARC	1975
Dixon D. Hubbard	USDA-FES,Wash.DC	1975
J. David Nichols	Iowa	1975
A. L. Eller, Jr.	VPI & SU	1976
Ray Meyer	South Dakota	1976
Don Vaniman	Montana	1977
Lloyd Schmitt	Montana	1977
Martin Jorgensen	South Dakota	1978
James S. Brinks	Col. State Univ	1978
Paul D. Miller	Am. Breeding Svc-Wisconsin	1978
C. K. Allen	Am. Angus Assn.	1979
Wm. Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	Univ. Neb.	1980
Mark Keffeler	South Dakota	1981
J. D. Mankin	Idaho	1982
Art Linton	Montana	1983
James Bennett	Virginia	1984
M. K. Cook	Univ.of GA	1984
Craig Ludwig	Am. Hereford Assoc.	1984

Commercial Producer of the Year

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Baker	OR	1976
Steve and Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979
Jess Kilgore	MT	1980
Henry Gardiner	KS	1981
Sam Hands	KS	1982
Al Smith	VA	1983

1984

Bob & Sharon Beck	OR	1984

Seedstock Breeder of the Year

John Crowe	CA	1972
Mrs. R. W. Jones	GA	1973
Carlton Corbin	OK	1974
Leslie J. Holden	MT	1975
Jack Cooper	MT	1975
Jorgensen Brothers	SD	1976
Glenn Burrows	NM	1977
James D. Bennett	VA	1978
Jim Wolf	NE	1979
Bill Wolfe	OR	1980
Bob Dickinson	KS	1981
A. F. "Frankie" Flint	NM	1982
Bill Borror	CA	1983

1984

Lee Nichols	IA	1984

Organizations of the Year

Beef Improvement Committee, Oregon Cattlemen's Assn.	1972
South Dakota Livestock Production Records Assn.	1973
American Simmental Association, Inc.	1974
American Simmental Association, Inc. (Breed)	1975
Iowa Beef Improvement Association (BCIA)	1975
The American Angus Association (Breed)	1976
The North Dakota Beef Cattle Improvement Assn. (BCIA)	1976
The American Angus Association (Breed)	1977
The Iowa Beef Improvement Association (BCIA)	1977
The American Hereford Association (Breed)	1978
Beef Performance Committee or Cattlemen's Assn.	1978
The Iowa Beef Improvement Association (BCIA)	1979

Pioneer Awards

Jay L. Lush	Iowa State Univ.	Research	1973
John H. Knox	New Mexico State Univ.	Research	1973
Ray Woodward	American Breeders Svc.	Research	1974
Fred Willson	Montana State Univ.	Research	1974
Charles E. Bell, Jr.	USDA-FES	Education	1974
Reuben Albaugh	Univ. of California	Education	1974
Paul Pattengale	Colorado State Univ.	Education	1974
Glenn Butts	Performance Registry Intl.	Service	1975
Keith Gregory	RHLUSMARC	Research	1975
Bradford Knapp, Jr.	USDA	Research	1975
Forrest Bassford	Western Livestock Journal	Journalism	1976
Doyle Chambers	Louisiana State Univ.	Research	1976
Mrs. Waldo Emerson Forbes	Wyoming Breeder	Breeder	1976
C. Curtis Mast	Virginia BCIA	Education	1976
Dr. H. H. Stonaker	Colorado State Univ.	Research	1977
Ralph Bogart	Oregon State Univ.	Research	1977
Henry Holszman	South Dakota State Univ.	Education	1977
Marvin Koger	Univ. of Florida	Research	1977
John Lasley	Univ. of Missouri	Research	1977
W. C. McCormick	Tifton, Georgia Test Stn.	Research	1977
Paul Orcutt	Montana Beef Perf. Assn.	Education	1977
J. P. Smith	Performance Registry Intl.	Education	1977
James B. Lingle	Wye Plantation	Breeder	1978
R. Henry Mathiessen	Virginia Breeder	Breeder	1978
Bob Priode	VPI&SU	Research	1978
Robert Koch	RLHUSMARC	Research	1979
Mr. & Mrs. Carl Roubicek	Univ. of Arizona	Research	1979
Joseph J. Urick	U.S. Range Livestock Experiment Station	Research	1979
Bryon L. Southwell	Georgia	Research	1980
Richard T. "Scotty" Clark	USDA	Research	1980
F. R. "Ferry" Carpenter	Colorado	Breeder	1980
Clyde Reed	Oklahoma State Univ.		1981
Milton England	Panhandle A&M College		1981
L. A. Maddox	Texas A&M Univ.		1981
Charles Pratt	Oklahoma		1981
Otha Grimes	Oklahoma		1981
Mr. & Mrs. Percy Powers	Texas		1982
Gordon Dickerson	Nebraska		1982
Jim Elings	California		1983
Jim Sanders	Nevada		1983
Ben Kettle	Colorado		1983
Carroll O. Schoonover	Univ. of Wyoming		1983
W. Dean Frischknecht	Oregon State Univ.		1983

1984

Bill Graham	Georgia	1984
Max Hammond	Florida	1984
Thomas J. Marlowe	VPI&SU	1984

1984 BIF Seedstock Producer of the Year Award To Lee Nichols of Iowa

The Beef Improvement Federation Seedstock Producer of the Year Award for the year 1984 was presented posthumously to Lee Nichols of Bridgewater, Iowa. The award was presented during the 1984 BIF Annual Convention in Atlanta, GA on May 3rd to Mrs. Lillian Nichols on behalf of her recently deceased husband, who was a partner in the well known cattle breeding firm of Nichols Farms at Anita, Iowa. This most unusual and unprecedented presentation went to a deceased cattle breeder of great stature in his home state of Iowa and across the United States. Lee Nichols' untimely death in August of 1982 followed a lifetime of successful cattle breeding and farming and his being named Seedstock Producer of the Year in the state of Iowa by the Iowa Beef Improvement Association in 1982.

Lee Nichols was the quiet, hard-working giant in the Nichols Farm operation comprised of himself, his wife Lillian, his brother David and his wife Phyllis, and their mother Gladys. They produced seedstock of the Angus, Simmental, and Polled Hereford breeds. They also fed a substantial number of commercial feedlot cattle each year. The Nichols operation is known nation-wide for its innovative breeding and merchandising methods. Lee Nichols must be given credit for the great success of this performance oriented cattle breeding operation along with his brother David. Lee Nichols was the one in the operation who was directly involved with the cattle and the personnel and as a result, was probably less visible than his brother Dave. Lee Nichols had an unbending dedication to produce ever better seedstock cattle. He never made excuses for his cattle either in drawing up breeding plans nor in offering them for sale. He was described as being more critical of his own cattle than he might have been of other people's cattle. The influence of Lee Nichols was widely known although his method was always low-key. He was active in the Iowa Beef Improvement Association and served as board member and secretary and was as well, very much involved locally as president of his county's cattlemen's association and as a 4-H leader. Lee was also very much involved with students from nearby Hawkeye Technical Institute and provided learning experiences for students from that two-year program. Since his death, ten full scholarships to Hawkeye Technical Institute have been established through funds provided by friends.

Lee Nichols, along with his brother David and their wives, increased the size of the farming operation started by their father, Merrill Nichols, from 240 acres and 40 cows to 3,400 acres and 1,100 cows of the three breeds. Performance testing has been the hallmark of the development of the Nichols herd. Weaning weights increased from 437 pounds in 1959 to 606 pounds in 1983. Yearling weights increased from 868 pounds in 1959 to 1136 pounds in 1983. Calves born the first thirty days of the calving season went from 45% in 1959 to 87% in 1983. Today, a 60 day calving season is employed.

Extreme use of sire summaries, since their inception, has been employed in the Nichols herd. Eleven Nichols bulls have found their way into breed association sire summaries, at least three of them as trait leaders. Estimated breeding values are used exclusively in the selection of replacement females.

The Nichols operation produces 350 to 400 performance tested bulls made available annually as yearlings to commercial producers. Innovative private treaty selling methods were initiated a number of years ago by Lee Nichols and his brother Dave and are still utilized to merchandise that large number of commercial bulls to over 50% repeat customers each year.

The influence of Lee Nichols was widely known although his method was always low key. His dedication to performance cattle was exemplified in one of the last questions he asked before he died, "Did Landmark (their herd sire) top the sire summary?" Lee Nichols lived his life well and left a legacy of real worth to the cattle industry and the people he touched.

Lee Nichols' nomination for BIF Seedstock Producer of the Year was made by the Iowa Beef Improvement Association, Ames, Iowa.

1984 BIF Commercial Producer of the Year Award
To Bob and Sharon Beck of Oregon

In 1957 Bob and Sharon Beck of Alicel Rt., Cove, Oregon, begun running 30 commercial Hereford cows on shares. From the first calf crop they traded five of their steers for five of the best heifers in the herd. Two years later, after using an Angus bull on the Hereford cows, and seeing those crossbred calves, they bought 20 head of registered Angus cows and a bull.

In 1959 they enrolled the registered cows in Performance Registry International. Later, when the American Angus Association came out with a computerized method of recording cattle performance data, they switched to the Angus program.

Over the years, they expanded the land base and cattle numbers. In 1977, Becks purchased additional mountain land, and 115 head of Hereford cows came with it. These, added to their by then, 180 head of Angus crossbred cows, provided the nucleus of the present herd of 500 commercial cows. Also, they run a herd of 80 registered Angus cows on the home ranch, and raise their own Angus bulls for the commercial herd.

When they began weighing and recording commercial calves at weaning in 1972, their steers averaged 388 pounds and heifers 394 pounds. It's not often that the heifers are heavier than the steers, but through the years they found it can happen. In 1983 steers weighed 554 pounds for an increase of 166 pounds over 1972. Heifers in 1983 weighed 528 pounds for an increase of 134 pounds.

Becks have used two Angus 100% Certified Meat Sires. They also did some out-crossing with carefully selected half-blood Beef Freisian X Angus bulls using artificial insemination. Becks found this genetic pool too limiting, so they used Simmental X Angus bulls that had lots of performance data. These changes helped make the dramatic improvement in weaning weights.

Outside Activities

Bob is on the advisory committee for the Eastern Oregon Experiment Station, and for the Oregon State University Extension Service. He served as an Oregon delegate to the American Angus Association and as a Director of Western States Angus Association for several years. He was Union County Cattlemen's Association president for two years, was Oregon Cattlemen's Association vice-president for two years in 1980 and 1981, and is presently chairman of the Rancher Sportsman Committee for OCA. He also is a member of OCA Central Committees for Transportation & Beef Improvement.

Bob was selected Outstanding Young Farmer of the Year by both the Union Soil Conservation District and Union County Chamber of Commerce in 1960; and in 1972 was chosen Cattleman of the Year. He served as president of the Eastern Oregon Livestock Show for 1974, 1975, and 1976 and remains active on their board of directors. He is a trustee for the Pacific International Livestock Exposition at Portland and chairs the club calf show and sale as well as being on the replacement heifer show and sale committee.

Sharon was county Cowbelle president in 1974, state vice-president of Oregon Cowbelles in 1980 and 1981 and is active in both organizations. She is presently on three central committees for the Oregon Cattlemen's Association, including the Land Resources Committee, Land Use Committee, and Rancher Sportsman Committee.

Sharon recently completed a 4-year term on the Natural Heritage Advisory Council, an appointment by the Governor, and is in her second term on the county planning commission having served for six years as chairman.

A Family Operation

This operation has depended on the whole family for making everything work. Several years ago, Bob and Sharon devised a record keeping system of their own based on BIF Guidelines, and this worked adequately for a number of years. Now their son, Rob, 23 has graduated from Oregon State University, is married, and has returned home to ranch. He is knowledgeable about computers and has written a program for use on their recently acquired computer.

Becks also have two daughters. Christi, 25, is a registered dental hygienist in California where her husband is a mechanical engineer. Tracy, the youngest, is a junior at Oregon State University in the School of Business.

While growing up, the three children actually supported themselves on the cattle they raised. They earned their own spending money and money for school; although the ranch and cattle provided them an opportunity to make their own.

The children were active in 4-H and FFA programs. The activities included organizing and hosting many livestock tours and field days for 4-H, FFA, and college judging teams. The Beck family, along with others, started the Oregon Junior Angus Association; and Sharon was a 4-H leader for 13 years. Bob and Sharon received Honorary Chapter Farmer degrees from neighboring Union and La Grande FFA chapters for donating a heifer to each chapter, helping members in their projects and speaking to them about the importance of performance records.

The ranch has hosted many visiting livestock groups from Canada, Australia, Oregon and other states. "Showing and Telling" about the cattle operation, and getting the beef raising story across to urban visitors is all in the day's activities.

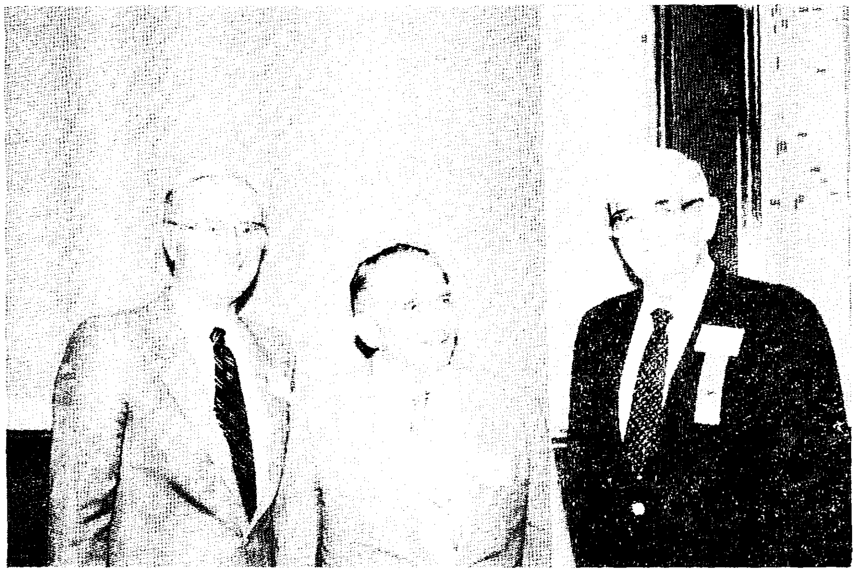
Seedstock Producer of the Year Nominees
Fred Johnson, Ohio
Mrs. Lee Nichols, Iowa
Robert Sitz, Montana
Philip Abrahamson, Minnesota
Harvey Lemmon, Georgia
Jack Farmer, California
Ric Hoyt, Oregon
John Green, Louisiana
Glen Klippenstein, Missouri
Jerry & Louisa Chappell, Virginia

Commercial Producer of the Year Nominees
Edgar Lewis, Montana
Don Moch, North Dakota
William Moss, Georgia
Robert Stewart, Kansas
Neil Moffat, Manitoba
Bob & Sharon Beck, Oregon

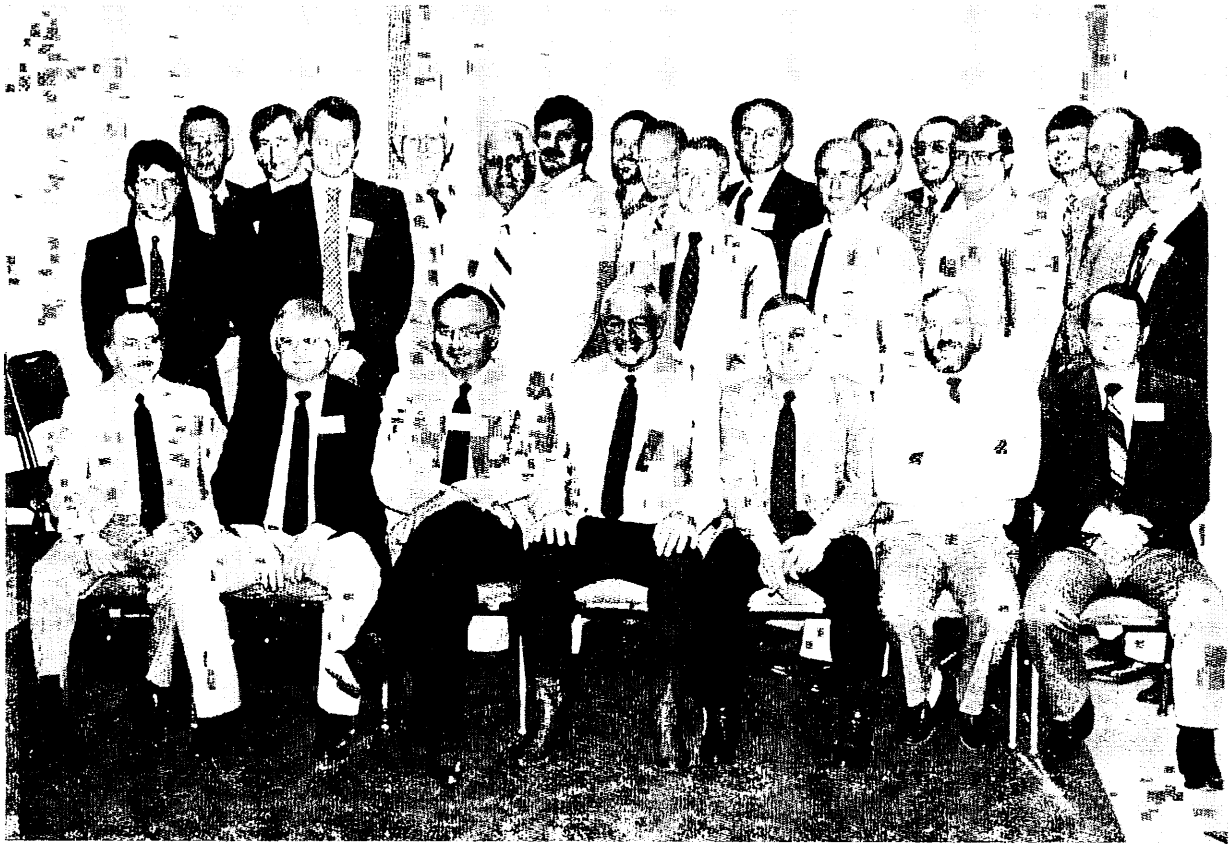
BIF Seedstock Producer of the Year Award
(L to R) Dave Nichols, brother and Mrs. Lillian Nichols, wife of deceased recipient Lee Nichols of Anita, Iowa, and Frank Baker, BIF Director, presenting the award.

BIF Commercial Producer of the Year Award
(L to R) Bob and Sharon Beck of Cove, Oregon and Frank Baker, BIF Director, presenting the award.

BIF Continuing Service Awards
(L to R) James Bennett, Red House, Virginia, M. K. Cook, Athens, Georgia, Frank Baker, BIF Director, presenting the awards and Craig Ludwig, Kansas City, Missouri.



BIF Pioneer Awards
(L to R) Bill Graham, Miami Lakes, Florida, Max Hammond, Bartow, Florida and Frank Baker, BIF Director, presenting the awards. Awardee not pictured Thomas J. Marlowe, Blacksburg, Virginia.



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