PROCEEDINGS

BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM & ANNUAL MEETING

April 26 - 27 - 28, 1972

NEW TOWER HOTEL COURTS

Omaha, Nebraska

PROCEEDINGS OF BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM AND ANNUAL MEETING

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NON-ADDITIVE GENETIC EFFECTS ON REPRODUCTION IN BEEF CATTLE[1]

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Genetic variation is caused by either additive or non-additive effects of genes. Additive effects of genes determine an animal's breeding value. Parents transmit a sample one-half of their genes to their offspring; therefore, the average performance of an animal's progeny measures half of his breeding value relative to other progeny groups in a contemporary environment. Heritability, that portion of variation due to additive effects of genes or differences in breeding value, has been discussed earlier this morning by Brinks and Dearborn for fertility traits in cattle.

Non-additive gene effects are caused by interaction of genes. These occur when specific pairs or combinations of genes produce favorable effects as a result of being present together in the individual. Parents cannot consistently transmit these effects to their offspring because only half of their genes, one of each pair, is passed on to the next generation. Thus, systematic mating procedures are used to restore these combinations of genes and their non-additive effects from one generation to the next.

Theoretical Considerations

The importance of non-additive gene effects has been studied in cattle through crossbreeding and inbreeding experiments. This is possible because breeds are more homozygous than breed crosses and inbred lines within pure breeds are more homozygous than pure breeds. Figure 1 shows homozygosity and heterozygosity expected in pure breeds and in inbred lines relative to crossbreds.

Inbreeding "is the mating of animals more closely related to each other than the average relationship within the population concerned" (Lush, 1945), in this case, cattle. The primary effect of inbreeding is to make pairs of genes homozygous and to lower correspondingly the percentage of heterozygous genes. This is why sire-daughter matings are often considered to test for deleterious recessives. Inbreeding in sire-daughter matings is 25% relative to the pure breed involved. Thus, the proportion of heterozygous "carriers" resulting from such matings are expected to be reduced 25% and half of these are expected to emerge as homozygous recessives exposing any deleterious recessive traits.

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[1] Presented at the Research Symposium on Reproduction in Beef Cattle, Beef Improvement Federation Conference and Annual Meeting, Omaha, Nebraska, April 26, 1972.

[2] Beef Cattle Research Branch, Animal Science Research Division, A.R.S., U.S.D.A., Lincoln, Nebraska 68503.

The amount of inbreeding that has occurred within breeds relative to crossbreds or relative to foundation cattle is not known because records are not available on the matings made in the earliest formation of breeds. In 1937, Willham conducted a thorough study of pedigrees in the Hereford breed and reported that the inbreeding coefficient had increased from 8.1% in the 12.9 generations from 1860 to 1930 (Willham, 1937). Thus, with inbreeding increasing, 0.68% per generation from 1860 to 1930, inbreeding would be expected to be about 13.4% today relative to the Hereford breed in 1860. Similar levels of inbreeding were found in other breeds of cattle and studies by Lush and his students in the 1930's and early 1940's (Lush, 1945).

Willham was not able to study the levels of inbreeding achieved early in the formation of the breed because records were too fragmentary, but it is likely that breeders used the Bakewell system of breeding, which involved close matings to increase prepotency, fix type and form relatively uniform and distinct breeds of cattle. Also, it is likely that considerable inbreeding occurred in the species due to geographic barriers long before pedigree barriers and herd books were established. Thus, it seems reasonable to estimate that pure breeds are on the average at least 20% more inbred or less heterozygous than their crosses.

Differences in inbreeding or proportion of heterozygosity would not have any effect on mean performance of crossbreds, purebreds or inbreds if gene effects were completely additive. However, figure 2 shows that with any degree of dominance, partial or complete, the mean performance of crossbreds is greater than purebreds. Similarly, performance of inbred lines within a breed would be expected to decline on the average relative to the pure breed or line crosses within a pure breed. This phenomenon is called inbreeding depression. It is due to non-additive effects of genes and the reduction in heterozygosity in inbred lines which uncovers undesirable recessives that would otherwise be concealed or partially concealed by dominant genes. Its reverse is referred to as heterosis, when heterozygosity is restored to the pure breed level by crossing inbred lines within a breed or to the crossbred level when crossing pure breeds. The effect of non-additive gene action on mean performance relative to level of inbreeding may or may not be linear as portrayed in figure 2. Dickerson (1970) has shown (figure 3) that it may be curvilinear if the detrimental effect of losing an additional useful gene effect becomes more serious as the total number of useful gene effects present in the system declines with inbreeding.

It helps our understanding to review theoretical expectations of inbreeding in the presence of non-additive gene effects. However, we don't have to depend on this entirely because cattle have been asked about the importance of non-additive gene effects in a number of crossbreeding and inbreeding experiments.

Experimental Evidence

Crossbreeding Results

To begin, I will review results from the U.S.D.A. and Nebraska heterosis experiment conducted at the Fort Robinson Beef Cattle Research Station involving Herefords, Angus and Shorthorns. This experiment was initiated by Gregory et al. (1965, 1966a, b, c) in 1958. The first phase involved four calf crops produced from 1960 through 1963. Matings were made to produce all possible straightbreds and reciprocal crosses (table 1). Heterosis effects were measured by the difference in performance between crossbreds and the average of the straightbreds. This phase of the experiment measured effects of heterosis on the individual, or that expressed by the F_1 calf, since all dams were straightbred and all bulls were purebred.

Heterosis effects on survival of calves are shown in table 2 (Wiltbank et al., 1967). Calf crop weaned was 3% greater for crossbred calves than straightbred calves. This was entirely due to increased survival of crossbred calves since there was no difference in calf crop born.

Table 3 shows results for heifers developed and bred as yearlings on age and weight at puberty (Wiltbank et al., 1966). On the average, crossbreds reached puberty 35 days earlier than straightbreds. Though 35 days younger, they reached puberty at about the same weight, only 7 pounds less, because of their more rapid growth rate. When age at puberty was adjusted for differences in preweaning growth rate, the effect of heterosis was still 27 days, indicating that three-fourths of the effect of heterosis on age at puberty was independent of effects associated with more rapid preweaning growth.

The females produced in phase I of the experiment were retained for replacement to evaluate heterosis effects on reproductive and maternal performance in phase II. Maternal heterosis was determined as the difference between crossbred and straightbred cows when both were exposed to the same bulls of a third breed. The number of matings and the experimental design for phase II, which were produced from 1963 through 1968, are shown in table 4.

Heterosis effects on certain major fertility traits are given in table 5 (Cundiff, 1970). Calf crop weaned out of crossbred cows was 6.3% greater than that out of straightbred cows. This was primarily associated with a 6.5% increase in first service conception and a 5.1% increase in fall pregnancy rate. Thus, in phase II of the experiment there was no increase in survival of calves when all calves were crossbreds. The effect of heterosis on the crossbred cow is due to her higher level of fertility.

Figure 4 shows a cumulative effect of heterosis of 9.3% on calf crop weaned. Three percent is due to increased survival of crossbred calves over straightbred calves and 6.3% is due to increased fertility of crossbred cows over straightbred cows. This compared closely to the 9.5% increase in calf crop weaned observed in 5-6 experiments involving Herefords, Angus and Shorthorns summarized by Warwick (1968) which includes the Fort Robinson experiment shown in table 6.

Warwick (1968) also summarized data from a number of experiments in Southern Regional Project S-10, involving Brahman-British crosses (table 6) indicating that the effect of heterosis on calf crop weaned in F1 Brahman-British calves was small, about 1%. However, the effect of heterosis on fertility of Brahman-British crossbred cows averaged 13.8%. Turner et al. (1968) also reported that on the average calf crop weaned was 15.4% greater out of Brahman-Angus and Brahman-Hereford crossbred cows than out of the straightbreds. It appears that the total effect of heterosis in Brahman-British crosses on calf crop weaned is about 15%. This is larger than heterosis effects observed to date involving other breeds. Perhaps this is to be expected in crosses of such diverse genotypes.

Inbreeding Results

Early efforts in the Western, North Central and Southern Regional Projects involved selection within inbred lines. This work was carried on longer and more extensively in the Western Regional Project W-1 than in NC-1 or S-10.

Recently Brinks (1971) has summarized results from an extensive analysis involving data from 44 lines collected at eight stations in the Western region (table 7). Lines were carried from 4 to 32 years. Inbreeding of the calves averaged 17% overall and lines ranged from 4 to 41% in inbreeding.

Partial regression analysis indicated that on the average fertility (% cows pregnant) declined 2% and 1.2% as inbreeding of the dam and calf, respectively, increased 10%. Percent calf crop weaned declined 1.1% and 1.65% with 10% increments in inbreeding of the dam and calf. These results compare to crossbreeding experiments indicating that homozygosity of the cow has its greatest influence on fertility or ability to conceive while homozygosity of the calf has a greater effect on survival of the calf to weaning.

Brinks (1971) also observed considerable variation between lines in response to inbreeding. Favorable regressions were observed in about 40% of the lines with respect to each, effects of inbreeding of dam and inbreeding of the calf on fertility and calf crop weaned (table 7). This suggests that opportunity exists to improve fertility within a breed by selection between lines, i.e., by culling the poorest lines.

Dinkel et al. (1972) has recently reported on the effect of inbreeding on reproduction in an experiment at South Dakota. This experiment is unique in that a control population of the same Hereford foundation has been maintained throughout the experiment enabling contemporary direct comparison to four inbred lines. Inbreeding has been minimized in the control population by avoiding close matings and using four sires per year. The inbred lines have been single sire lines and inbreeding has advanced to an average of 27%.

Table 8 summarizes effects of inbreeding on calf crop born and calf crop weaned on the average over 13 years in this experiment. Average inbreeding of matings was 23% and average inbreeding of dams was 14% for the inbred lines, while corresponding coefficients in the control population were 3% and 2%, respectively. On the average, calf crop born was 8% greater and calf crop weaned was 7% greater for the control population than for the inbred lines. Variation was observed between lines; but, the best inbred line has not exceeded the control population for either trait. Indications were that the depressing effects of inbreeding occurred early in formation of the lines and did not increase significantly over time as inbreeding increased.

Effects of inbreeding on calf crop born was studied by Krehbiel et al. (1969) in data from the Virginia and U.S.D.A. experiment at the Front Royal

Beef Cattle Research Station (table 9). In Angus, there were four inbred lines, two selection lines with a low level of inbreeding and an outbred line. Fertility of the inbred lines and the selection lines was significantly poorer than in the outbred line. In similarly classified Shorthorn lines, differences in fertility were not significant; however, inbreeding coefficients were higher in all lines and differences between lines in inbreeding of the dams were especially small. They also observed considerable variation between lines.

Summary

Results of crossbreeding and inbreeding experiments indicate that non-additive genetic effects have a very important influence on reproduction, relatively much more important than on any other economic trait in beef cattle.

Crossbreeding experiments with Herefords, Angus and Shorthorns indicate that calf crop weaned can be increased about 8-9% by systematic crossing of these breeds. At least half of this is dependent on use of the crossbred cow.

Results with Brahman crosses indicate even greater total heterosis effects. Early results with Charolais-British breed crosses indicate heterosis effects on survival to weaning comparable to those observed in British breed crosses. Heterosis effects on reproduction have not been reported in crosses with other breeds or on maternal ability of Charolais crosses to date.

Inbreeding experiments within pure breeds indicate non-additive gene effects similar in magnitude to the average. Considerable variation has been observed between lines suggesting that opportunity exists for genetic improvement within breeds for reproduction by selection among inbred lines, i.e., stringent culling of the poorest lines. However, such improvement would have a high cost in terms of effort, generation interval and opportunity to select for other more highly heritable traits and needs thorough evaluation relative to alternatives of mass selection, progeny testing or selection among families of lower relationships, such as half-sibs, before appropriate recommendations can be made.

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FIGURE 1
EFFECTS OF INBREEDING ON HETEROZYGOSITY
OR HOMOZYGOSITY

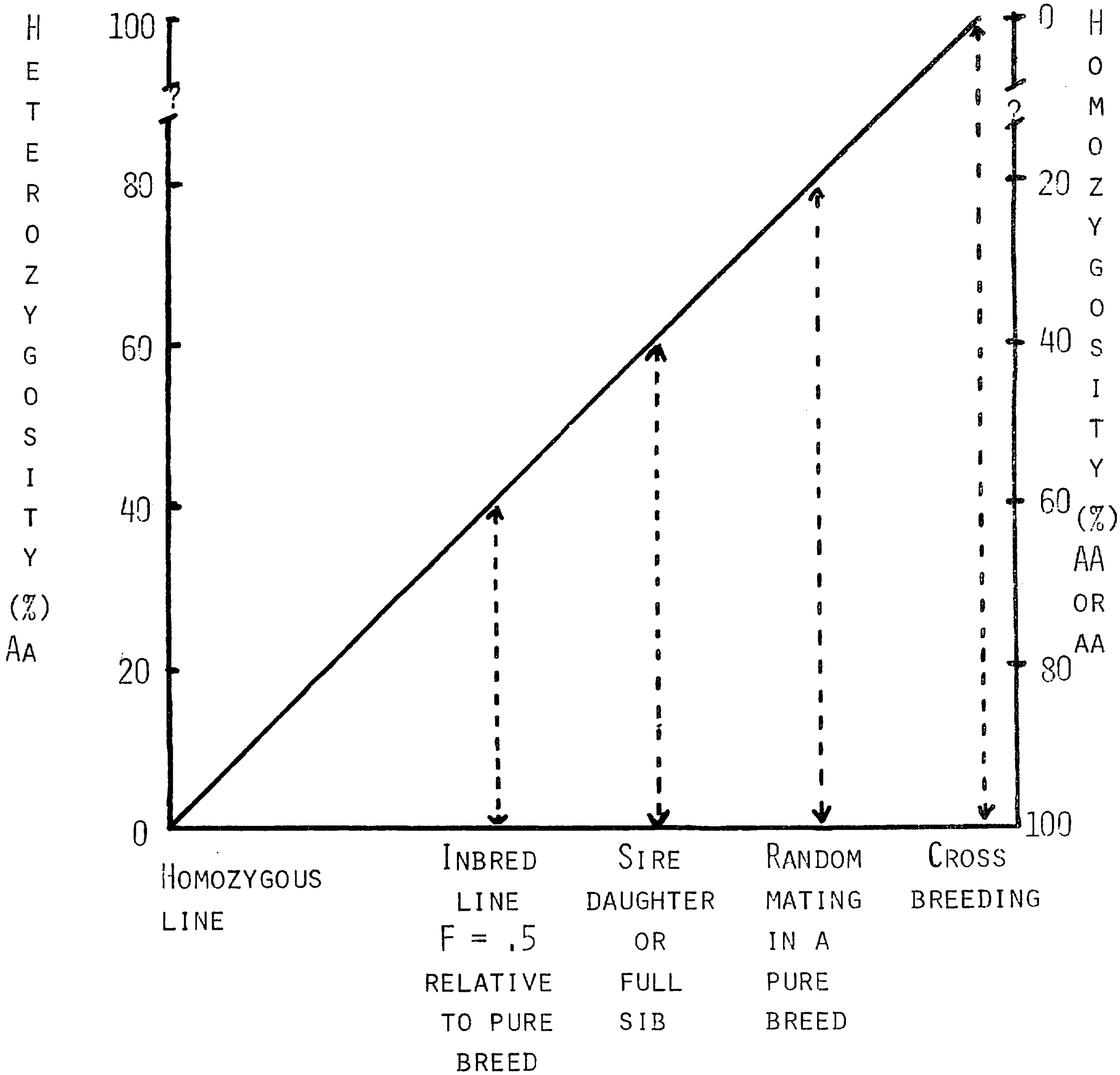
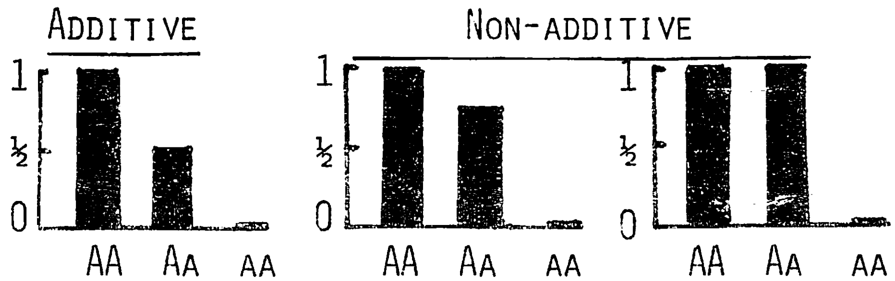


FIGURE 2
THEORETICAL SITUATION



MATING TYPE	ZYGOTIC FREQUENCY IN PERCENT RELATIVE TO CROSSBREDS AA	Aa	aa	ADDITIVE MEAN	PARTIAL DOMINANCE MEAN	COMPLETE DOMINANCE MEAN
CROSSBREDS	0	100	0	.5	.75	1.0
PUREBREDS	10	80	10	.5	.70	.9
SIRE-DAUGHTER	20	60	20	.5	.65	.8
INBRED LINE (F=.5)	30	40	30	.5	.60	.7
	40	20	40	.5	.55	.6
HOMOZYGOUS LINE	50	0	50	.5	.50	.5

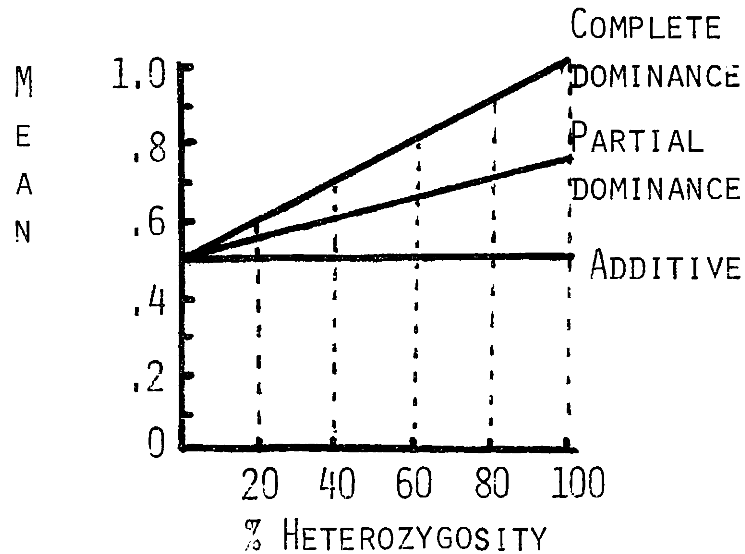
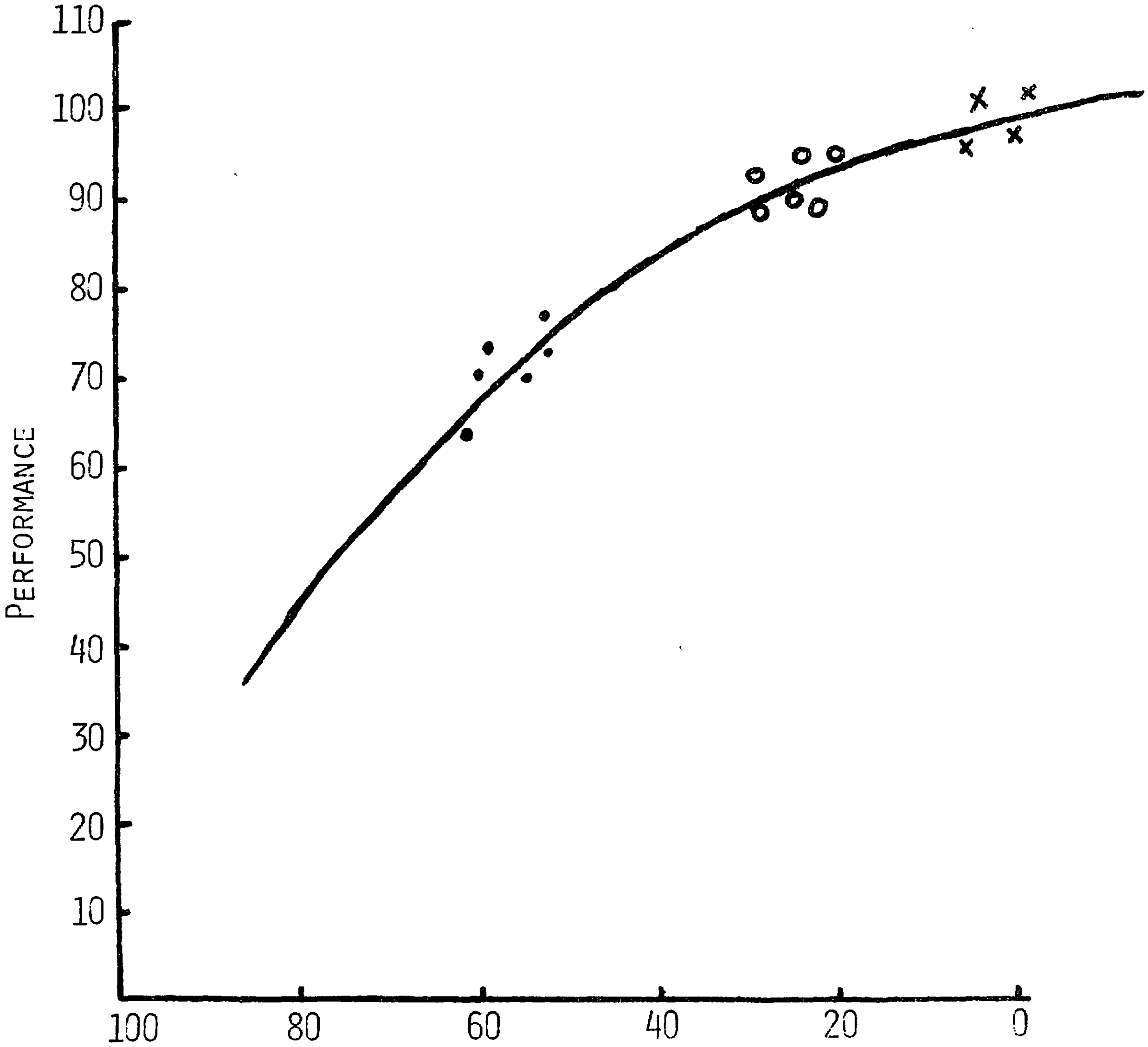


FIGURE 3
EFFECT OF INBREEDING MAY NOT
BE LINEAR



INBREEDING (F) RELATIVE TO MEAN FOR CROSSBREDS = 0
(FROM DICKERSON, 1970)

TABLE 1

EXPERIMENTAL DESIGN FOR PHASE I OF THE FORT ROBINSON HETEROSIS EXPERIMENT SHOWING TOTAL NUMBER OF COWS EXPOSED OVER 4 YEARS[a,b]

	Breed sire		
Breed of cow	Hereford (16)	Angus (17)	Shorthorn (16)
Hereford	150	75	80
Angus	79	140	80
Shorthorn	80	75	157

[a] From Wiltbank et al. (1967), J. Anim. Sci. 26:1005.

[b] U.S.D.A., A.R.S., Animal Science Research Division and University of Nebraska.

TABLE 2

HETEROSIS EFFECTS ON SURVIVAL IN PHASE I OF FORT ROBINSON HETEROSIS EXPERIMENT[a,b]

	Number matings	Calves born	Calves born alive	Calves alive at 2 weeks	Calves weaned
		%	%	%	%
Crossbreds	470	89	87	86	84
Straightbreds	447	89	84	82	81
Difference		0	+3	+4*	+3
H x A and reciprocal	154	87	86	84	83
Average of H & A	290	89	85	82	82
Difference		-2	+1	+2	+1
H x S and reciprocal	160	94	91	90	88
Average of H & S	307	88	84	82	80
Difference		+6*	+7*	+8**	+8*
A x S and reciprocal	156	87	85	84	83
Average of A & S	297	88	84	83	82
Difference		-1	+1	+1	+1

[a] From Wiltbank et al. (1967), J. Anim. Sci. 26:1005.

[b] USDA, ARS, Animal Science Research Division and University of Nebraska.

* $P < .05$.

** $P < .01$.

TABLE 3

HETEROSIS EFFECTS ON AGE AND WEIGHT AT FIRST HEAT IN THE FORT ROBINSON HETEROSIS EXPERIMENT[A,B]

	1962 and 1963 Calf Crop			
	No.	Age at 1st Heat	Wt. at 1st Heat	Age at 1st Heat Adj. for A.D.G. Birth to Wean.
		Days	Lbs.	Days
Crossbreds	95	321	580	324
Straightbreds	76	356	587	351
Difference		-35	-7	-27
H x A & Recip.	28	361	630	364
Av. H & A	51	375	613	372
Difference		-14	+17	-8
H x S & Recip.	36	300	559	303
Av. H & S	51	366	604	359
Difference		-66	-45	-56
A x S & Recip.	31	303	551	305
Av. A & S	50	328	544	322
Difference		-25	+7	-17

[A]From Wiltbank et al. 1966. J. Animal Sci. 25:744.

[B]USDA, ARS, Animal Science Research Division and University of Nebraska.

TABLE 4

EXPERIMENTAL DESIGN FOR PHASE II OF THE FORT ROBINSON HETEROSIS EXPERIMENT SHOWING THE NUMBER OF SIRES AND MATINGS FOR 6 YEARS[a]

Dams	Sires		
	Hereford	Angus	Shorthorn
Hereford (H)		A X H = 103	S X H = 104
Angus (A)	H X A = 99		S X A = 96
Shorthorn (S)	H X S = 82	A X S = 86	
H X A			S X HA = 132
A X H			S X AH = 109
H X S		A X HS = 105	
S X H		A X SH = 120	
A X S	H X AS = 95		
S X A	H X SA = 126		

[a] U.S.D.A., A.R.S., Animal Science Research Division and University of Nebraska.

TABLE 5

HETEROSIS EFFECTS ON FERTILITY TRAITS IN PHASE II OF THE FORT ROBINSON HETEROSIS EXPERIMENT[a,b]

Breed of cow	Number of matings	Conceived on 1st estrus	Pregnant in fall	Calf born	Live calf at birth	Live calf weaned
		%	%	%	%	%
Crossbreds	687	59.3	88.1	86.8	86.3	83.8
Straightbreds	570	52.8	83.0	80.9	80.6	77.5
Difference		+6.5	+5.1	+5.9	+5.7	+6.3
H X A & recip.	241	73.5	92.3	92.6	91.4	86.9
Av. H & A	200	65.1	87.0	84.7	83.7	81.1
Difference		+8.4	+5.3	+7.9	+7.7	+5.8
H X S & recip.	225	57.6	86.3	83.4	82.6	82.0
Av. H & S	189	47.1	80.8	78.3	78.3	77.5
Difference		+10.5	+5.5	+5.1	+4.3	+4.5
A X S & recip.	221	47.0	85.8	84.8	84.9	82.6
Av. A & S	181	46.2	81.3	79.8	79.8	73.9
Difference		+.8	+4.5	+5.0	+5.1	+8.7

[a] Unpublished.

[b] U.S.D.A., A.R.S., Animal Science Research Division and University of Nebraska.

FIGURE 4

CUMULATIVE HETEROSIS EFFECTS FOR PERCENT CALF CROP WEANED FORT ROBINSON USDA and Nebraska

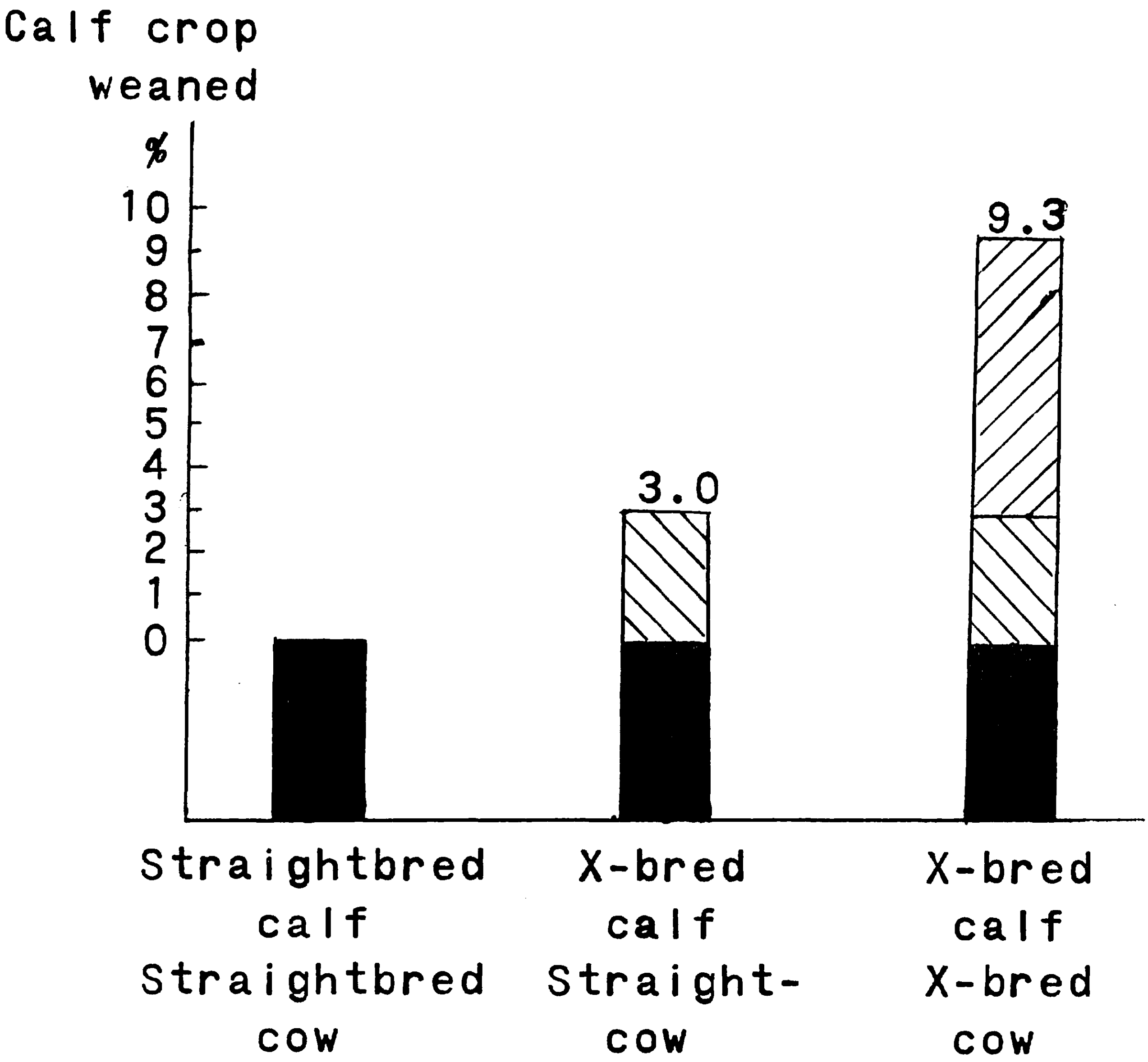


TABLE 6

HETEROSIS EFFECTS ON CALF CROP WEANED (%)

SUMMARY

Breeds	Source	Crossbreds - Straightbreds		
		F_1 calf (H^I)	F_1 cows (H^M)	Total
Brahman	- British crosses			
	S-10 experiments (Warwick, 1968)	1.0%	13.8%	14.8%
	Louisiana (Turner, 1968)		15.4%	
Charolais	- British crosses			
	Missouri (Lasley, preliminary report)	5.8%		
	Ohio (Klosterman <u>et al.</u>, 1968)	.5%		
	USDA and Montana (Bellows, 1966)	2.2%		
British crosses				
	USDA and Nebraska - Fort Robinson (Wiltbank, 1966; Cundiff, 1970)	3.0%	6.3%	9.3%
	6-5 experiments (Warwick, 1968)	4.9%	4.6%	9.5%

TABLE 7
INBREEDING EFFECTS ON FERTILITY IN WESTERN REGION[1]

DESCRIPTION DATA

8 STATIONS	13,323 MATINGS
44 LINES	AVERAGE INBREEDING = 17%
4 - 32 YEARS	RANGE IN MEAN F 4 - 41

EFFECTS OF INBREEDING ON FERTILITY (PARTIAL REGRESSION)

	% PREGNANT	% WEANED
INBREEDING OF DAM (F_D), %/%	-.200**	-.11*
INBREEDING OF CALF (F_M), %/%	-.122*	-.165**

VARIABILITY IN RESPONSE TO INBREEDING BY LINE

		FAVORABLE REGRESSIONS		UNFAVORABLE REGRESSIONS	
		NO. LINES	%	NO. LINES	%
FERTILITY	FD	17	39	27	61
	FM	18	41	26	59
% WEANED	FD	17	40	26	60
	FM	16	37	27	63

[1] BRINKS, J. S. 1971. PRESENTED AT AMERICAN GENETICS ASSOCIATION SYMPOSIUM, SEPTEMBER 1-2, 1971, COLORADO STATE UNIVERSITY.

TABLE 8

EFFECTS OF INBREEDING ON CALF CROP BORN AND WEANED SOUTH DAKOTA[a]

Line	Av. inbreeding Calf	Av. inbreeding Dam	Calf crop born %	Calf crop weaned %
Inbred 1			84	77
2			78	65
3			80	71
4			80	79
Inbred line average	.23	.14	81	73
Control (4 sire line common foundation)	.03	.02	89	80
Control - inbred			8**	7*

[a] Dinkel et al., 1972. J. Anim. Sci. (in press).

* P = .10

**P = .005

TABLE 9

EFFECTS OF INBREEDING ON CALF CROP BORN VIRGINIA AND U.S.D.A.[1]

	No. LINES	AVERAGE INBREEDING, % MATINGS	COWS	SIRES	CALF CROP BORN, %[2]
ANGUS					
OUTBRED	1	.8	.3	1.2	91[a]
SELECTION	2	2.6	.8	4.0	76[b]
INBRED	4	13.6	3.2	4.7	65[b]
SHORTHORN					
OUTBRED	1	5.8	8.0	3.4	59[a]
SELECTION	2	4.0	5.4	1.5	63[a]
INBRED	4	11.7	10.6	10.2	59[a]

[1] KREHBIEL, E. V. ET AL., 1969. J. ANIM. SCI. 29:528.

[2] MEANS WITH DIFFERENT SUPERSCRIPTS WITHIN BREED ARE SIGNIFICANTLY DIFFERENT ($P<.05$).

Heritability of Fertility Components in Beef Bulls

J. S. Brinks

Colorado State University

There are two basic types of genetic variation that can be used to improve performance traits. The first is called additive genetic variation and it is important in determining the amount of improvement that can be made through selection. The second is non-additive genetic variation and is important in determining the amount of hybrid vigor that is obtained through crossing schemes.

Traits that are highly heritable (high proportion of additive genetic variation) respond to selection whereas traits that are lowly heritable usually exhibit hybrid vigor in significant amounts (high proportion of non-additive genetic variation).

Response to selection depends on how effective we are in changing gene frequency - increasing the frequency of desirable genes which in turn decreases the frequency of undesirable genes. Therefore, what genes are present is important in determining performance. The amount of hybrid vigor depends on the combinations of genes - whether alleles are in the homozygous or heterozygous state and on the dominance relationship between alleles. Therefore, the gene combinations present determine the level of hybrid vigor.

Measures of fertility in all species fit the category of low heritability but show significant amounts of hybrid vigor. The reason for low heritability is that natural selection has fixed most of the desirable genes for measures of fertility and reproduction. However, favorable gene combinations cannot be fixed since each parent passes on only a sample half of his genes and the gene combinations that may have made the parent excell are broken up.

Fertility or other measures of reproduction are complex traits made up of several components. Some researchers feel that if these components were measured and analyzed separately, that certain of them may be found to be somewhat more highly heritable than the overall measures. My presentation will deal with specific measures of semen evaluation in young beef bulls.

Data

The data were collected on yearling beef bulls raised at the San Juan Basin Experiment Station, Hesperus, Colorado from 1957 through 1970. Sixteen lines of Hereford cattle were represented with 264 inbred and 534 linecross bulls being studied. Bull calves were weaned at an average age of about 205 days. After weaning they were given a two to three-week warm-up period and then placed on a 140-day performance test. At the completion of the performance test semen was collected by electro-ejaculation and was examined under microscope for vigor (motility) and sperm morphology. Slides were prepared using a live-dead stain and detailed observations were recorded.

The semen traits studied include concentration (sperm number per milleliter x 10^6), vigor or motility %, percent alive, percent primary abnormalities, percent secondary abnormalities and percent normal sperm. Separate analyses were performed for the inbred and linecross data.

Results

The level of significance for the effects of line differences, sire within line differences and age of bull on the various semen traits for the linecross data is shown in table 1.

Table 1. Level of Significance of Factors Affecting Semen Traits.

Source	d.f.	concentration	vigor	% alive	% Primary abnormality	% secondary abnormality	% normal sperm
Lines	15	***			*		
Sires/Lines	59	***	**	*	***		**
Age	1	***	**	**		*	**
Residual	445						

* P< .10
** P< .05
*** P< .01

The effect of line differences was important in determining sperm concentration and percent primary abnormalities in the linecross data. In the inbred data line differences were significant for all semen characteristics. Differences among sire groups of bulls within the same lines of breeding were significant for all traits except percent secondary abnormalities. Age of bull had a significant effect on all semen traits except % primary abnormalities, though the bulls did not vary over three months in age.

Heritability estimates for the semen traits were obtained by paternal half-sib analyses on the linecross data. The estimates are shown in table 2.

Table 2. Heritability Estimates for Semen Traits

Trait	Heritability %
Concentration	28
Vigor	23
% Alive	17
% Primary abnormalities	30
% Secondary abnormalities	-5
% Normal sperm	24

All the semen traits studied except percent secondary abnormalities appear to be moderately heritable (17 to 30%) and should respond to selection, although progress would be slow. The -5% for percent secondary abnormalities is an impossible value and this value should be estimated at 0% in these data.

The genetic, environmental, and phenotypic correlation estimates among the semen traits are presented in table 3.

Table 3. Genetic, Environmental and Phenotypic Correlations among Semen Traits.

Trait		/ Vigor	% Alive	% Princ. Abn.	% Sec. Abn.	% Normal
Conc.	G	.53	.26	-.67	--	.63
	E	.24	-.01	-.00	-.07	.06
	P	.31	.05	-.20	-.11	.21
Vigor	G		.44	-.93	--	.87
	E		.49	-.15	-.19	.23
	P		.44	-.35	-.21	.38
% Alive	G			-.37	--	.72
	E			-.26	.01	.20
	P			-.28	-.17	.31
% Princ. Ab.	G				--	-1.01
	E				.02	-.72
	P				.10	-.81
% Sec. Abn.	G					--
	E					-.67
	P					-.65

The genetic correlations between concentration and other semen traits were larger than corresponding environmental or phenotypic correlations. Correlations involving percent primary abnormalities with other semen traits were larger than corresponding correlations with percent secondary abnormalities. The genetic correlation involving percent secondary abnormalities were impossible to obtain due to a negative genetic variance estimate.

In addition to the semen evaluations, all bulls are given a physical examination relating to breeding soundness. In an earlier study on some of the same data, heritability estimates were obtained: prepuberal adhesions, 139; defects of the prepuce, 85%; defects of the testicles, 36%; defects of the epididymus and vas deferens, 49% and defects of the feet and legs, 59%.

Thus, while semen characteristics appear to be low to moderately heritable, physical defects related to breeding soundness are apparently highly heritable. Selection for physically sound bulls should be practiced and unsound bulls should definitely be avoided.

HERITABILITY AND RELATIVE INFLUENCE OF FERTILITY COMPONENTS ON REPRODUCTION[1/]

D. D. Dearborn

Reproductive failures and calf mortality inflict extensive economic losses to the beef cattle industry. Ideally, every beef breeding female, two years of age and older, should give birth without assistance and wean a healthy calf each year. In addition, each female should rebreed and calve the following year on a 12 month interval.

The ideal level of reproduction is seldom realized. Reproductive failures and calf mortality occur at each of the following stages of the reproductive cycle: (1) failure of cow to exhibit estrus, (2) failure to conceive and early embryonic loss that occurs before the pregnancy is detectable, (3) fetal mortality, (4) stillbirths, and (5) postnatal death loss.

The results from several studies have been combined and are reported in table 1. The table has been subdivided so that reproductive performance from experiment station and commercial herds are reported separately. The purpose of this table is to verify the less than optimum reproductive efficiency which is prevalent in the beef cattle industry. Note that the average percent of cows which wean live calves based on these studies is about 70 percent.

The purpose of the columns which represent successive stages of the reproductive cycle is to present a general picture of the magnitude of losses that occur at the various stages. The blanks indicate data from a particular study did not include information on that particular stage of reproduction which was left blank.

Total reproductive efficiency is related to accumulative performance of sequential component traits. Several experiments that have evaluated the heritability of one or more reproductive traits have been reviewed and are summarized in table 2. The breed of cattle on which the data are based and the location of the study are also included. Most of the heritability estimates are low.

Additional study of reproductive traits in beef cattle appears desirable because of the economic importance, the difficulty of interpreting calving interval with beef cattle operations using breeding seasons limited in length, the inadequacy of the trait "services per conception" since it doesn't include the cows that failed to conceive and since previous studies did not evaluate the effects, either transmitted or direct, of the bull to which the cows were exposed.

Therefore, a study that included four analyses of data collected at the Fort Robinson Beef Cattle Research Station was conducted. The following were analyzed as traits of the dam utilizing data from 315 first calf heifers by 43 sires in the crossbreeding experiment: (1) failure to cycle, (2) failure

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1/ The information for this presentation was obtained from the Ph.D. dissertation "An Analysis of Reproductive Traits in Beef Cattle" prepared by D. D. Dearborn.

to conceive, (3) fetal mortality, (4) stillbirths, (5) early postnatal death loss, (6) death loss from two weeks until weaning, (7) first service conception, (8) conceptions per estrus cycle exposed, and (9) dystocia. The same traits, except (1) failure to cycle, were considered as traits of the individual. Reproductive performance of all heifers and cows including 1249 exposures to 70 bulls in the crossbreeding experiment were included in the latter analysis.

Pregnancy in the fall and postnatal death loss were studied as traits of the dam and of the individual, utilizing data collected from approximately 800 first calf heifers by 107 sires and exposed to 132 bulls in the selection experiment.

The objectives of this study were: (1) to identify the magnitude of losses that occurred during the various stages of the reproductive cycle, (2) to estimate heritabilities associated with each of the component traits, (3) to evaluate the effects of the dam's genotype for maternal ability on both prenatal and postnatal livability, and (4) to partition the total effects, both transmitted and direct, of the sire on conception.

Failure to conceive including embryonic loss that occurs prior to an early pregnancy diagnosis was the most important stage at which losses occurred in the crossbreeding experiment. Thirty-one percent of the heifers exposed for breeding failed to wean a calf. Two-thirds of these represented failure to conceive or early embryonic loss. Eighteen percent of the second calf and older cows failed to wean a calf. Nearly half of these failures were not diagnosed pregnant.

The greatest magnitude of losses in the selection experiment was related to postnatal livability. Of the total number of heifers calving, 19 percent lost calves prior to weaning.

Heritability estimates for all reproductive traits were low. The only traits where the heritability estimates exceeded their standard errors were: (1) first service conception rate ($h^2 = 0.22 \pm .17$), (2) conceptions per estrus cycle exposed ($h^2 = 0.27 \pm .17$), (3) postnatal death loss ($h^2 = 0.16 \pm .14$), and (4) postnatal death loss ($h^2 = 0.25 \pm .16$). The first two were derived from the crossbreeding experiment and represent traits of the dam in first calf heifers. The last two were derived from the selection experiment; (3) is a trait of the dam in first calf heifers and (4) represents the trait of individual offspring from first calf heifers.

Comparison of the two analyses from the crossbreeding experiment suggests that genetic variation in maternal environment was more important than variation in the genotypes of the fetus for traits related to pre- and postnatal mortality. The results from the two analyses of the selection experiment do not support this conclusion. Their comparison suggests variation in genotypes of the individual were more important than genetic variation in maternal environment for postnatal death loss.

Bulls may vary in their ability to impregnate cows due to differences in transmitted effects or differences in direct effects of their own phenotype. Therefore, a clear cut genetic interpretation of the sire component, σs^2 for conception as a trait of the individual is not possible. However, effects of sires were highly significant ($P<.01$) for each trait that included the direct effects of the bull on conception in the crossbreeding experiment and were not significant ($P>.05$) for any trait that did not include the direct effects. This suggests the direct effects may influence between sire variation in conception rate more than transmitted effects.

Possible application of the results include: (1) consideration of selection for first service conception rate, (2) a need for identifying the direct effects of the bull that influence conception rate, and (3) using a bull that has been proven superior for postnatal livability by progeny test for mating to first calf heifers.

TABLE 1. REPRODUCTIVE LOSSES IN BEEF CATTLE AND THE STAGE AT WHICH THEY OCCUR

Area	Period	Cow years	Cycled during breeding season (%)	Pregnant (%)	Calving (%)	Cows giving birth to live calves (%)	Cows with live calves at 2 wks. of age (%)	Cows weaning live calves (%)
				Experiment Station Herds				
Montana[1]	1925-42	4753			85.6			81.0
Montana[2]	1928-57	7619			82.6			
South[3]	1957-60	19388			77.3			69.1
Virginia[4]		612	98.0	88.0	84.0	76.0	73.0	72.0
Louisiana[4]		121	88.0	77.0	74.0	71.0	63.0	63.0
Nebraska[4]		300	98.0	92.0	90.0	84.0	78.0	77.0
New Mexico[5]	1933-64	999		94.5	92.5	86.8		82.4
South Carolina[6]		844		88.0		76.0		74.0
California[7] (Supplemented)	1936-48	448		89.5	87.9	84.8		81.9
California[7] (Unsupplemented)	1936-48	456		75.0	73.7	71.2		66.2
				Commercial Herds				
Plains[8]	1954	38300				90.5		79.9
West[8]	1954	94600				76.6		67.2
Northwest[8]	1954	17900				87.8		74.0
South[8]	1954	65500				77.2		45.7
Wyoming[9]	1940-51	4470				86.0		66.7

Reference:

[1]Baker and Quesenberry, 1944
[2]Rice *et al.*, 1961
[3]Temple, 1967
[4]Wiltbank, 1967
[5]Gosey, 1967
[6]Hurst, 1965
[7]Wagnon and Carroll, 1966
[8]Ensminger *et al.*, 1955
[9]Stonaker, 1958

TABLE 2. HERITABILITIES OF REPRODUCTIVE TRAITS IN CATTLE

Trait	Breed[1]	Location	h^2	Reference
Standing heat	8	Germany	0.07	Hahn, 1969
Regularity of heat	8,9	Beltsville	0.05	Pou *et al.*, 1953
Intensity of heat symptoms	5,9,10	Denmark	0.21	Rottensten & Touchberry, 1957
Postpartum interval		Kentucky	0.32	Olds and Seath, 1953
Cystic ovaries	8	Wisconsin	0.43	Casida and Chapman, 1951
Non-return to first service	8	New York	0.004	Dunbar and Henderson, 1953
Conception	6	Wisconsin	0.06	Collins *et al.*, 1962
Conception	8	Wisconsin	0.085	Inskeep *et al.*, 1961
Conception	5,9,10	Denmark	0.04	Rottensten & Touchberry, 1957
Conception (bulls)		New Zealand	0.55	Shannon & Searle, 1962
Services per conception	6	California	0.05	Everett *et al.*, 1966
Services per conception	8	California	0.03	Everett *et al.*, 1966
Services per conception	8	Louisiana	0.10	Branton *et al.*, 1956
Services per conception	8,9	Beltsville	0.07	Pou *et al.*, 1953
Services per conception		Iowa	0.08 (herd 1) -0.15 (herd 2)	Carmen, 1955
Services per conception	2,6,8,9	North Carolina	0.026	Legates, 1954
Services per conception	7	Oklahoma	-0.24 to 0.05	Lindley *et al.*, 1958
Breeding efficiency (calving interval)	8	New Jersey	0.32	Wilcox *et al.*, 1957
Calving interval	2,6,8,9	North Carolina	0.00	Legates, 1954
Calving interval	1	Virginia	0.03	Schalles, 1967
Calving interval	1	Mexico	-0.18 to 0.012	Brown *et al.*, 1954
Live calf born	7	Colorado	0.15	Davenport *et al.*, 1965
Stillbirths	4,12	Switzerland	<0.10	Gaillard, 1969
Calf survival	11	Texas	0.03	Dickey and Cartwright, 1966
Dystocia	7	Colorado	0.00	Brinks, 1969
Dystocia	4,12	Switzerland	<0.10	Gaillard, 1969
Dystocia	3	Germany	0.043	Smidt and Cloppenburg, 1967

[1] Breed code:
1, Angus; 2, Ayrshire; 3, Black Pied; 4, Brown Swiss; 5, Danish Black and White; 6, Guernsey; 7, Hereford; 8, Holstein; 9, Jersey; 10, Red Danish; 11, Santa Gertrudis; 12, Simmental.

FACTORS AFFECTING DYSTOCIA AND THE EFFECTS OF DYSTOCIA ON SUBSEQUENT REPRODUCTION IN BEEF CATTLE[1]

D. B. Laster[2]

U. S. Department of Agriculture

Calving difficulty is an economically important problem in the beef cattle industry because it is a major cause of calf mortality (Bellows, 1971) and because it can represent a major increase in labor requirements. This problem is receiving increased attention in the beef cattle industry because of the utilization of some of the larger sire breeds in crossbreeding programs. No research results have been reported on calving difficulty in Hereford and Angus cows bred to Simmental, Limousin and South Devon bulls. There is also little information on the effects of calving difficulty on subsequent reproductive performance of the cow (Konermann, Daerr and Frerking, 1969).

A study at the U.S. Meat Animal Research Center, involving four years of data and 1889 beef cows, was made to examine the effects of sire breed, dam breed, dam age, calf sex and calf birth weight on calving difficulty in Hereford and Angus cows. The calves were sired by Hereford, Angus, Jersey, South Devon, Limousin, Simmental and Charolais bulls. The influence of calving difficulty on subsequent reproduction was also evaluated. The cows were bred by artificial insemination (AI) for approximately 45 days followed by a 25 day "cleanup" period. Breeding began approximately 20 days after the end of the calving period.

The cows were observed closely for calving difficulty throughout the calving season. All parturitions were given a difficulty score, ranging from 1 to 6, based on the amount of assistance required for calving. However, only three classifications were used for this study: no difficulty, difficulty, and observed posterior presentation. Cows that calved with no assistance and those given minor hand assistance but delivered their calves without the use of a mechanical calf puller were classified as no difficulty. Those requiring assistance with a mechanical puller or surgical removal of the calf were classified as difficult parturitions. Posterior presentations (17 calves) were not included in the analysis of factors associated with calving difficulty but were included in the study of the effects of calving difficulty on subsequent reproductive performance. All calves were weighed within 24 hr. of birth. The number of cows included in the analysis of factors associated with calving difficulty are presented in table 1 and the number included in the effects of calving difficulty on subsequent reproductive performance are shown in table 2.

Interval from calving to first breeding and interval from calving to conception were determined only in cows that returned to estrus during the AI period. The AI period was approximately 45 days, beginning approximately 25 days after the end of a 70 day calving period. All cows, including those bred during the natural mating period, were included in the conception rate analysis. Date of conception was confirmed by relating genotype of the calf and date of parturition to the insemination date(s).

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[1]Presented at the Beef Improvement Research Symposium on Reproduction in Beef Cattle, Third Annual Beef Improvement Federation Program, March 21, 1972, Omaha, Nebraska.

[2]U.S. Meat Animal Research Center, Animal Science Research Division, A.R.S., U.S.D.A.

The effects of sire breed and cow age on calving difficulty and birth weight are shown in table 3. Charolais, Simmental, Limousin and South Devon sired calves had heavier birth weights and experienced significantly ($P<.01$) more calving difficulty than those sired by Hereford, Angus and Jersey bulls. There were no significant differences in percent difficulty among the Charolais, Simmental, Limousin and South Devon sired calves nor between the Angus and Jersey sired calves. Percent calving difficulty was higher ($P<.05$) in Hereford than in Jersey sired calves.

Cow age was a major factor influencing calving difficulty (table 3). Calving difficulty in 2-yr.-old cows was 36% higher than in 3-yr.-olds and 45% higher than in 4 and 5-yr.-olds. Although the overall calving difficulty in 3-yr.-old cows was much lower than that in 2-yr.-olds, 9.8 to 28.6% of the 3-yr.-old cows giving birth to calves from the larger sire breeds required assistance at calving.

Calf birth weight had a major influence on calving difficulty. Each increase in 1 lb. at birth resulted in a 1.05% increase in calving difficulty. Hereford cows had 8% more calving difficulty than Angus cows.

Figure 1 illustrates the relationship between calving difficulty, sire breed and dam age. Although calves sired by the larger sire breeds experienced more calving difficulty in all ages of cows, there was some indication of an interaction between cow age and sire breed.

Calving difficulty had a large influence on subsequent reproductive performance (table 3). The percentage of cows detected in estrus during a 45 day AI period was 14.4% lower in cows requiring assistance at calving than in those not requiring assistance. Conception rate was 15.6% lower during the artificial insemination period and 15.9% lower during the total breeding period in cows with calving difficulty than in those with no calving difficulty.

The influence of calving difficulty on subsequent rebreeding in cows detected in estrus during AI and in those conceiving to AI is shown in table 4. It does not appear from these data that calving difficulty affected the interval from calving to first breeding or the interval from calving to conception. These intervals were calculated only for cows detected in estrus during AI. If estrus had been detected for an extended period rather than for a 45 day period, the interval probably would have been longer in cows experiencing calving difficulty. For cows having calving difficulty, only 60% were observed in estrus during the AI period and only 51% had conceived by the end of this period. Comparable values for cows with no calving difficulty were 74 and 69%, respectively.

The influence of precalving energy level on calf birth weight and calving difficulty in Hereford and Angus cows calving first as 2-yr.-olds is being studied. The preliminary results of this study are shown in table 5. Increasing average daily gains of the cows prior to calving increased calf birth weights, but did not influence calving difficulty. It should be noted that the average birth weight in the highest energy level group was less than 65 lb. In breed-crosses with large calf birth weights, calving difficulty might be influenced by small changes in birth weight.

TABLE 1. NUMBER OF COWS INCLUDED IN THE ANALYSIS OF FACTORS ASSOCIATED WITH DYSTOCIA[a]

Breed of Sire	Breed of dam		Age of dam, years[b]		
	Angus	Hereford	2	3	4 and 5
Hereford	296	217	359	107	47
Angus	231	245	328	115	33
Jersey	75	55	70	29	31
South Devon	45	31	48	12	16
Limousin	69	79	65	48	35
Simmental	87	78	32	66	67
Charolais	190	174	42	139	183
Total	993	879	944	516	412

[a]A total of 1872 cows were included in this analysis.

[b]Approximate age at the time of parturition.

TABLE 2. NUMBER OF COWS INCLUDED IN THE ANALYSIS FOR EFFECTS OF CALVING DIFFICULTY ON SUBSEQUENT REPRODUCTION

Item	Interval		
	Calving to 1st breeding	Calving to conception	Conception rate
No calving difficulty, No.	1084	976	1423
Calving difficulty, No.	279	236	466
Total	1363	1212	1889

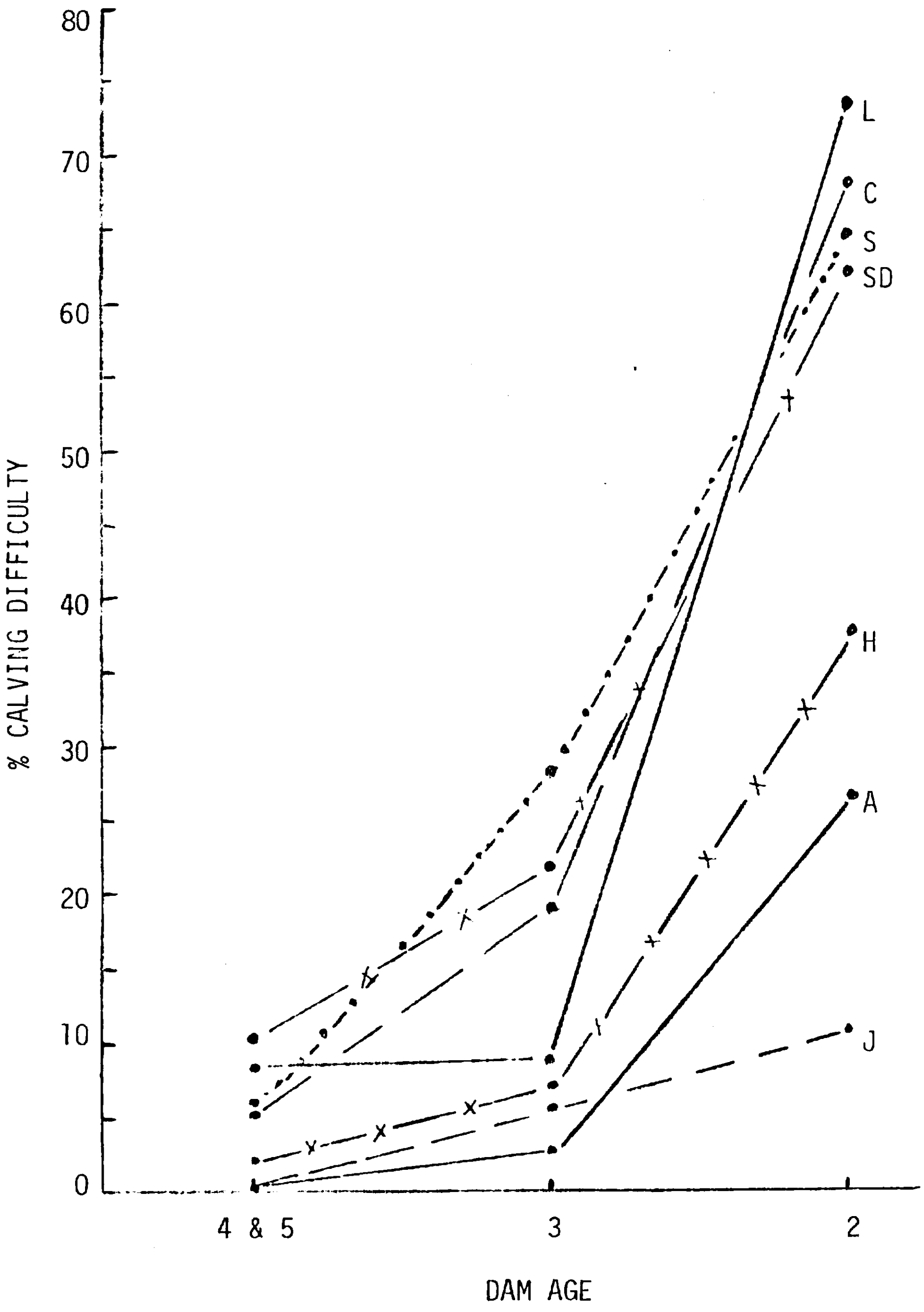

Figure 1. Relationship between calving difficulty, sire breed and dam age.

TABLE 3. LEAST-SQUARES MEANS FOR PERCENT CALVING DIFFICULTY AND BIRTH WEIGHT BY BREED OF SIRE AND AGE OF DAM IN HEREFORD AND ANGUS COWS

	Cow age							
	2		3		4 and 5		$\overline{X}$	
Breed of sire	Calving diff., %	Birth wt., lb.	Calving diff., %	Birth wt., lb.	Calving diff., %	Birth wt., lb.	Calving diff., %	Birth wt., lb.
Hereford	38.3	66.7	7.1	71.3	2.1	74.4	15.8	70.8
Angus	27.0	63.4	2.6	68.4	0.0	73.0	9.9	68.2
Jersey	12.2	58.7	5.5	65.6	1.6	62.7	6.5	62.3
South Devon	62.5	71.7	28.6	79.0	5.9	77.7	32.3	76.1
Limousin	73.9	73.0	9.8	79.4	8.7	83.6	30.8	78.7
Simmental	65.6	76.3	22.2	83.1	10.2	84.5	32.7	81.3
Charolais	67.5	75.2	19.0	79.8	6.2	85.3	30.9	80.1
$\overline{X}$	49.6	69.3	13.5	75.2	5.0	77.3	22.7	73.9

TABLE 4. EFFECT OF CALVING DIFFICULTY ON CONCEPTION RATE, PERCENT DETECTED IN ESTRUS DURING THE AI PERIOD AND CONCEPTION RATE TO AI

Group: Dystocia class.	Group: Cow age	No.	During AI period: Detected in estrus, %[a]	During AI period: Conception rate, %[a]	Total conception rate, %[a]
No dystocia	2	584	68.3±1.9	66.0±2.0	79.6±1.6
Dystocia	2	366	59.3±2.3	50.6±2.5	71.4±2.0
Difference			9.0**	11.6**	8.2***
No dystocia	3	451	71.8±2.1	63.6±2.2	86.6±1.8
Dystocia	3	69	55.1±5.3	46.0±5.7	72.6±4.6
Difference			16.7**	17.6**	14.0**
No dystocia	4 & 5	388	86.1±2.2	77.9±2.4	89.7±2.0
Dystocia	4 & 5	31	77.4±8.0	64.1±8.6	64.1±7.0
Difference			8.7	13.8**	25.6***
No dystocia	all	1423	74.3±1.2	69.2±1.3	85.3±1.0
Dystocia	all	466	59.9±3.3	53.6±3.5	69.4±2.9
Difference			14.4***	15.6**	15.9***
Total		1889	70.6±1.8	61.4±1.9	77.3±1.5

[a] Mean±S.E.

** P<.01.

*** P<.005.

TABLE 5. EFFECT OF TDN LEVEL DURING LAST TRIMESTER OF GESTATION ON BIRTH WEIGHT AND CALVING DIFFICULTY IN 2-YR.-OLD HEREFORD AND ANGUS COWS (U.S. MARC, PRELIMINARY RESULTS)

Energy level[a]	No. cows	ADG lb.[b]	Body wt., lb.	Pelvic area, cm^2	No. cows calved	Birth wt., lb.	Calving diff., %
Low	124	0.72	790	235±2	94	57.8+0.8	28
Medium	124	1.74	883	234±2	94	61.1+0.9	28
High	122	2.28	919	241±2	90	63.4+0.7	23

[a]Calculated TDN consumption for the 90-day precalving period was 10.8, 13.7 and 16.9 lb./h/d for the low, medium and high energy levels.

[b]During the 90-day precalving period.

RELATIONSHIPS BETWEEN SIZE AND REPRODUCTION[1]

W. T. Butts[2]

Reproductive performance is of paramount importance in the overall efficiency of any beef production system. However, direct selection for high reproductive rate is assumed to be relatively ineffective in improving the trait. Heritabilities of 0 to 10 percent have been found by most workers. Confirmation of these low estimates of heritability is provided by the presence of substantial heterotic response of the trait to crossbreeding. A further consideration is that selection pressure is naturally applied against low reproduction, in most beef production systems, in that lowly fertile animals within a population leave fewer descendants than do more prolific ones. Hence, little emphasis is given to reproduction in current performance testing and selection procedures. However, the foregoing statements do not preclude the possibility of relationships among reproductive ability, genotype and environment. Also, at least one study (Deese and Koger, 1967) in Florida has reported moderate heritabilities for the trait. This discussion is addressed to certain observations from past and present research which suggest that reproduction may be associated with other characteristics which are affected by selection and management. It is emphasized that this information is presented as a basis for further research and not as demonstrated research facts.

In a broad sense, it is apparent that there are differences among genotypes in reproductive performance. Performance differences between Zebu and British cattle in various environments are well known. Many geneticists suspect that these differences are the result of long time adaptation to different environments. This would suggest a genetic basis of some sort for reproductive performance. Mason (1971) in a review of beef performance of the large breeds of Western Europe concluded that less desirable effects associated with larger size are greater gestation lengths, heavier calves at birth, more calving difficulties and more stillbirths. More recently, work with dairy breeds used for beef production has suggested that some production situations do not provide adequate nutrition for acceptable reproduction from large and/or heavy milking cows. In this latter case, the genetic solution of changing the cattle to fit the situation may often be preferable to the alternative course of changing the environment to fit the cattle.

Reproductive performance can be defined in a number of ways. A limited number of females are incapable of becoming pregnant. These individuals are estimated to make up approximately 5 percent of the population and are one measure of the base fertility in beef cattle. However, the industry measures reproduction as percent calf crop weaned. This is a composite measure which includes not only potential fertility but a considerable number of circumstances which are necessary for the production of a calf from a particular breeding season. Pertinent to this discussion are those apparently normal cows which

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[1]Prepared for presentation at the Annual Meeting of the Beef Improvement Federation. April 26, 1972, Omaha, Nebraska.

[2]Investigations Leader, S-10, Animal Science Research Division, ARS, USDA, Knoxville, Tennessee.

fail to produce a calf when exposed to bulls capable of siring offspring. The breeder is interested in differences between these cows and herd mates which do reproduce and differences among herds which vary in percent calf crop weaned. To the extent that such differences are associated with traits under selection, they are of importance in choosing goals of selection.

A limited number of studies have provided some insight into characteristics of cows related to reproductive performance. Hawkins, Parker and Klosterman (1965) reported that heavier cows before calving and at weaning produced fewer calves. Reynolds, DeRouen and High (1963) found gain from 6 months to 2 years of age to be positively related to reproduction in Brangus and Africander-Angus cattle in South Louisiana. Quirk, Turner and MacDonald (1970) and others have reported heterosis for age at puberty. Texas A & M University has been engaged over a number of years in a very comprehensive study of growth and its relationship to production efficiency. Cartwright (personal communication, 1971) stated that their work indicated that large cows tended to wean heavier calves, to have longer calving intervals and to wean fewer calves per year. Early maturing cows were smaller at maturity, had shorter calving intervals and produced more calves. Correlations between number of calves weaned per year and mature size (r =-.24) and rate of maturity (r = .36) were found in their data. Sanders (personal communication, 1972) working with Tennessee data from a herd of Hereford cows in which no culling was practiced provided estimates of an even more pronounced relationship between shape of weight-age curve of cows and reproduction. Correlations of -.45 and 0.55 were found between calves/year and mature weight and rate of maturing, respectively. However, the antagonism between mature weight and reproductive performance was not found when mature weight was adjusted for variation in body composition. Butts, Koger, Pahnish, Burns and Warwick (1971) reported significant line-location interactions in reproductive performance of Hereford cattle from lines originating in Montana and Florida. Cows from lines originating in Montana were heavier at maturity than Florida originating cows at both locations. Reproduction was similar for both lines in Montana but was higher for the Florida originating line in Florida. It is interesting to note that shape of the growth curves of the two lines maintained in Montana was quite similar; whereas, at the Florida location, calves and yearlings from the line originating in Florida grew much more rapidly relative to their subsequent mature weight than did animals from the Montana originating line. A general conclusion from the research cited is that reproductive performance is related to mature weight and developmental pattern. Whether this is a genetic or an environmental association remains unanswered.

Recent research on developmental patterns of cattle (Brown, Brown and Butts, 1971; Fitzhugh and Taylor, 1971; and Joandet and Cartwright, 1969) have established a number of general characteristics of growth and development in cattle. Of particular significance in this discussion, is that, within a breed, mature weight and rate of maturing are negatively related in those breeds which have been studied. Cattle exhibiting large mature weights tend to mature more slowly than do cattle maturing to lighter weights. Differences were found between Hereford and Angus cattle in the degree to which mature size and rate of maturing were related. While in both cases the direction of the relationship was the same, more variation was found in shape of weight-age curve in the Angus than in the Hereford. Level of nutrition affected the age at which cattle reached equivalent levels of maturity but notrelationships between mature size and rate of maturing. Both traits were found to be moderately heritable. These studies indicated that selection for change in shape of growth curve would be expected to be effective.

Davis, Bishop and Cembrowicz (1971), in a discussion of reproductive expectancy in cattle, concluded that a more or less constant proportion of normal cows returns to oestrus after insemination and a minority require several inseminations before becoming successfully pregnant. They suggested that an expectation of approximately 60 calves for each 100 inseminations represented a reasonable norm. Hence, reproductive performance could vary among animals or among herds purely as a function of the number of heat cycles possible during the breeding season even though potential fertility of all animals and herds was similar. Replacement heifers which are cycling at the beginning of the breeding season would thus have a higher mathematical chance of becoming pregnant and would appear to be more fertile than slower maturing heifers. By the same logic, heifers which calve late in their first year have a somewhat lower chance of breeding in subsequent years than do herd mates which calved early. Thus, differing developmental patterns could manifest different reproductive rates in particular production systems.

It is well recognized that nutritional requirements for successful reproduction vary rather widely among different kinds of cattle. A strong circumstantial argument can be advanced that this also is related to mature size and rate of maturing. A production system which provides a level of nutrition adequate for small early maturing females to reach puberty at the proper age to breed as yearlings would probably not allow equivalent development of large slower maturing cattle. It is interesting to note that, while it may be entirely coincidental, performance of crossbred cattle is consistent with this general thesis. Crossbreds eat more feed, gain more rapidly at young ages relative to their subsequent mature size and reach puberty earlier than straightbred contemporaries. In effect, the increased appetite of the crossbred creates a higher level of nutrition than that enjoyed by the straightbred when maintained in the same operation. The realtionship between reproductive performance and differences in developmental patterns of straightbreds and crossbreds is similar to that suggested from studies of within breed variation in shape of growth curve. Again, it should be emphasized that, while a relationship appears evident, a proven cause and effect is not implied.

An overview of certain published research findings and preliminary results from current studies indicates that percent calf crop is related to the interplay of mature size, rate of maturing and production situation. Sufficient evidence appears to exist to justify increased consideration of the reproductive consequences of selection for other traits. In particular, specific research is needed to establish the direct and correlated genetic aspects of reproductive performance.

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FERTILITY AND RECORD OF PERFORMANCE PROGRAMS

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Record of Performance Programs are designed--or should be--to assist cattlemen in improving productivity and profitability of their beef operation. Thus, my attention will be focused on the ways and means of incorporating measures of fertility--a major factor affecting profitability--not ROP programs.

The initial problem is to define fertility. A practical definition, which should suit both the cattlemen and his banker, is the birth of a live calf, what I call Realized Fertility. Even though we may call a cow or bull "fertile" if they produce eggs or sperm capable of fertilization, Realized Fertility is the final result of a biological chain of events (figure 1), all of which must be successful. A weak link anywhere in this chain affects the probability of Realized Fertility, which is essentially the product of the probabilities of success for each link in the biological chain. For example, you are in an A.I. program and your technique for detecting cows in heat is so poor that you miss ovulating cows half the time (i.e. P(CD) = 50%). Even with 100% probability of success for all other links, the probability of Realized Fertility will only be 50%.

Cattlemen can improve the phenotype for Realized Fertility through both genotypic and environmental improvements. ROP programs can effectively serve to assist both types of improvements.

As discussed in other papers in this symposium, the opportunities for genotypic improvement of fertility through selection appears limited. Natural selection over the centuries has removed much of the genetic variation in fertility. However, we should remember that nature has favored those genotypes which leave more progeny per generation not necessarily those which produce a calf every 12 months. There is a possibility of genotype X environment interactions so that the genotype long favored in the natural environment may be less fit in a man-altered environment. Two examples come to mind. Are there semen characteristics essential to successful freezing of semen which are irrelevant under natural mating? Has there been natural selection for long calving intervals (perhaps, by favoring long postpartum anestrus) among cattle adapted to harsh environments, such as the Criollos of Latin America and many Zebu from many parts of Asia?

Most crossbreeding research reports indicate appreciable gains in Realized Fertility from hybrid vigor. Texas work with Brahman-Hereford cross females indicated a mean advantage over purebred females of 12%. An additional advantage from crossbreeding is complementarity, the judicious matching of sire and dam lines to achieve optimal productivity. An obvious characteristic of both superior sire and dam lines is good fertility.

Genotypic improvement of Realized Fertility, whether by selection or crossbreeding, depends on the accurate identification of fertile individuals and lines. Individual differences in fertility can best be assessed by expressing them relative to the herd average. Sub-fertile individuals can then be culled. The more sophisticated selection techniques utilizing information on relatives would almost certainly require the use of computer programs to estimate breeding values for various measures of fertility. Cattlemen are unlikely to be able to compare fertility of various breed crosses on their own ranch. Instead, this will probably depend on research results to assist them in choosing the combination of lines or breeds best suited to their conditions.

Perhaps, the best opportunity for using ROP programs to improve Realized Fertility lies in the improvement of environment. Management of the cattle herd for optimal fertility involves maintaining good nutritional and health status and providing adequate opportunity for fertilization. A good record system will spotlight managerial shortcomings.

Although the use of computers in conjunction with an ROP program is not absolutely necessary, the effectiveness of the performance records, particularly through their summarization, is greatly improved by use of computers. Thus, my discussion of measures of fertility incorporated in ROP programs assumes that a computer will be used.

My basic philosophy for the design of ROP computer systems is that the system should be flexible and minimize record keeping effort by the cattlemen. Computers can do arithmetic--time intervals, ratios and averages--easily and accurately; few cattlemen (or their wives) can or want to spend their evenings on such arithmetic. Thus, data input to the computer should be simple codes, dates (let the computer calculate differences between dates) and counts. Simplicity is the key word. Design the system so that the computer serves the needs of the cattlemen; avoid making cattlemen serve the computer.

Indicators of fertility must be readily measureable or observable to be useful under commercial conditions. Counting number of prior services or calculating days open from last parturition will identify problem breeders and allow for corrective action. The use of these types of data to correct problems during the breeding season will require multiple inputs during the season. Other measures such as calving interval to conception, services per conception, and percent nonreturns allow retrospective consideration of individual and herd fertility.

Subjective scores for body condition or weight/height ratios indicate nutritional and health status. Codes for inseminators and palpators, types of treatment, semen characteristics and sexual behaviour build a historical record which may provide clues for management changes to improve herd fertility. Pelvic measurements on heifers might predict potential for calving difficulty. A partial list of traits which can be measured, observed (some with more difficulty than others) or calculated includes:

<u>Subjective Observations</u>:

1 Nutritional and health status
2 Sexual behaviour and temperament
3 Calving ease
4 Semen characteristics

Objective Observations:

1 Type of inseminations
2 Weights and measurements
3 Services to conception
4 Pregnancy status
5 Number born
6 Inseminator or palpator

Calculated Traits:

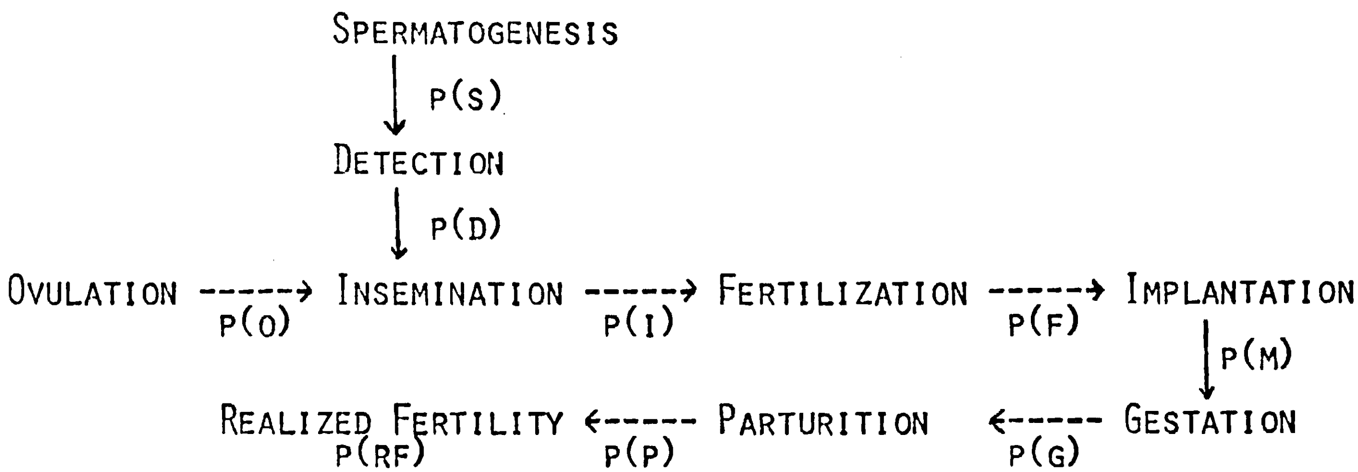
1 Gestation length
2 Postpartum interval to conception
3 Calving interval
4 Percent born (or weaned)
5 Percent nonreturns to first, second, etc. service

Use of these traits and others in ROP programs offers the cattlemen the information he needs for a two step attack to improve the fertility in his herd:

a. Cull sub-fertile individuals based on their performance relative to the herd average.

b. Monitor and modify management techniques to improve herd average.

FIGURE 1. THE BIOLOGICAL CHAIN OF EVENTS FOR REALIZED FERTILITY



PROBABILITY OF REALIZED FERTILITY:

$$P(RF) = P(O) \cdot [P(S) \cdot P(D)] \cdot P(I) \cdot P(F) \cdot P(M) \cdot P(G) \cdot P(P)$$

THE SIMMENTAL APPROACH TO THE USE OF REPRODUCTION DATA IN PERFORMANCE RECORDS

Don Vaniman
Secretary, American Simmental Association

Boy, did I take a ribbin' comin' down here to talk about fertility, bein' a bachelor and all. First time I heard the word mentioned was at a poker game. Indian said, "Why you no cut cards before deal?". Cowboy said, "You don't get calves if you cut the bull!".

An old timer told me that in the "good ol' days", fertility was rather spotty. He said, "Why, he knew people who neighbored each other that all of one man's cows would have twins while his neighbor's cows never had a calf!". Other times, like on a long trail drive, fertility was cussed. The calves were either knocked in the head or given a hot foot so they wouldn't slow up the drive. Today, everyone I know says all they want is twin Simmental heifer calves.

How heritable is fertility? It was so low Miles City didn't even list it. Brinks and Willham didn't list it two years ago for selection or breeding value estimates. (Happens to be 10% though!) Then I got to thinkin-- is fertility simply keeping records and breedin' for that 10%, or do other things enter in? How 'bout the other 90%? How 'bout disease, weather, nutrition, and management? Here is the worst disease we have up North--it's called "Montana Hollowbelly!"

Our record system is called SMILE. It stands for Simmental Management Improver and Labor-saving Evaluation system. We have done all we can to help nature EXPOSE INFERTILITY. Our SMILE system is a free service to members. This is a cyclic reporting system run on an IBM 360 Model 70 at Boeing Computer Services. All reports fit our standard 11" x 14" Herd Book. It is "God awful" big, but that way our breeders can't hide it in the kitchen drawer! They must look at it!

First we get a complete cow herd inventory. The breeder lists every cow he intends to be fertile. Then we have room for him to list manually his AI services and natural matings. From this we issue a Breeding Report/ Calving Field Data sheet.

We tell him on the Sire Summary how many cows were bred to each bull. He just has to wait nine months to see if we're right. I remember "Bull" Durham wanting to find out what makes bears hibernate and gestate at the same time, so he could give a shot of it to his cows and one to his wife so he wouldn't have to feed 'em while they were pregnant for nine months every year!

If we know how many cows were "exposed" and the vet doesn't tickle the calf to death when he palpates, and you don't have any neighbors covetin' your cows, we should be able to issue a Calvin' Report from the data you submitted to us. (We'll also tell you when to weigh for weaning!)

On the Sire Summary, we calculate percent of AI conception, first service, and percent conception of the second service. This is an indication of fertility.

We'll skip our Weanin', Yearlin', and Carcass reports and show you the Herd Summary which shows which cows were fertile and which were not. If they were, they have performance data for their calf as long as records were taken. The most obvious record is generated annually. It is the Lifetime Production Card. It lists the cow's performance data and that of each calf. This is proof of the puddin! From the calvin' dates you can tell if she is fertile or not, if she had twins or not, if she breeds back regularly, if she is gaining or losing a month.

There is one word applicable to markedly increasing fertility--it is a "good" four letter word not used enough--"cull". Cull against low heritable traits and select for traits of high heritability!

All these data are stored on tapes. The tapes are run through a CDC 6600 computer at Boeing Computer Services and generate our National Simmental Sire Summary.

We do not summarize fertility in bulls as a trait on a national basis because it is too easily affected by management. Fertility should be a within-herd thing, so we hope our breeders will do their own thing and "cull" or slaughter infertile cows.

Select females by record, but you must also select for femininity. Sometimes the highest gaining females tend to have too many "male hormones" and are not fertile.

Select bulls that are masculine and have been fertility tested. Create your own selection program--don't just go along with what the boys are doin' this year--then follow it through!

I think most of us are in the cow business because we like the out-of-doors and feel somehow closer to God in ranchin'. Use the tool he has given you and good luck!

FARM AND RANCH PREWEANING AND POSTWEANING TEST COMMITTEE REPORT

The Farm and Ranch Preweaning and Postweaning Test Committee opened with a lively discussion on methods of measuring cow efficiency. Measures that would reflect TDN efficiency, profits, etc. were discussed. It was also emphasized that the measure should be simple. Two methods were discussed:

1) 205 day weight unadjusted for age of dam ÷ weight of cow at weaning x 100.

2) 205 day weight ratio ÷ cow weight ratio x 100 where cow weight ratios are computed on a within 2 year, 3 year, 4 year, 5-10 and 10 and over age of cow basis.

The next item discussed was the possibility of adjusting for individual dam effects in computing sire summaries and adjusting for individual sire effects in computing dam summaries. Pros and cons were discussed and no action was taken.

The committee adjourned for lunch and reconvened in the afternoon beginning with further discussion on cow efficiency. It was moved that a sub-committee be appointed to study existing measures of cow efficiency and report back to the Farm and Ranch Committee an appropriate recommendation. The committee secretary will request members to serve on this committee.

Ray Meyer called on Art Linton to report on the activities of their sub-committee which had been appointed in 1971 to study a new method of scoring based on visually appraised characteristics. The committee consisted of Art Linton, Gary Ricketts, Stan Anderson and Bill McReynolds. Art reported that the committee had agreed on developing a system that scored frame, muscle, trimness, structural soundness and sex character on a scale from 1 to 7. The system would be purely descriptive and not imply that 7 was superior to 6 or inferior to 6. Considerable discussion followed. Some expressed resistance to changing from the present system because breeders are used to it. It was moved by Art Linton that the sub-committee be charged with developing their recommendations in final written form for consideration by the committee before final acceptance. Mrs. Forbes seconded the motion. Motion carried.

The next item discussed was incorporation of fertility into record of performance programs. The motion was made that the Board of Directors be requested to appoint a special committee on reproduction including representation from the Farm and Ranch Pre- and Postweaning Testing Committee and the Record Utilization Committee to develop tentative guidelines for thorough consideration at next year's Annual Meeting. Motion was seconded and carried.

The committee approved the following resolution:

WHEREAS, registering beef cattle greatly influences the direction of commercial cattle, and

WHEREAS, the use of performance records are now an accepted method for developing commercial breeding programs.

Therefore, be it resolved that the BIF Board of Directors be requested to recommend to beef breed associations that minimum performance records be a requirement for registration of all beef cattle.

The final item of business was a motion that raw data be collected and reported on animals outside of the age range of 160 to 250 days and this information should be included in weaning summaries and identified as irregular but not omitted.

Larry V. Cundiff

REPORT OF BEEF CARCASS DATA SERVICE COMMITTEE

The meeting was called to order at 10:35 a.m. by Chairman Burton Eller, with twenty-eight committee members and other interested parties present. Chairman Eller reported on the two previous meetings of the BCDS Committee.

Robert Leverette, Agricultural Marketing Service, USDA, reported that specifications had been drawn for the ear tags which would be an orange shield lower portion with specification of a high (90-95) retention of at two years. May 1, 1972 was set as bid date with at least part of the tags available by August 1, 1972. He stated that the cost of the tags was not known but anticipated that the cost of the tags to cooperating organizations possibly would be 30¢ per tag with the information, upon collection being approximately $1.10. With a cost of handling charge to the cooperating organization, the cost of tags to the producer could be approximately 40¢ for the tags and approximately $1.20 for the carcass information; this would be optional but a maximum cost would have to be determined.

Chairman Eller reported that currently the preliminary tag needs were from 28,000 to 42,000. He further indicated that within 1-3 weeks the cooperating organizations would be contacted for firm orders.

Bill Wharton moved that BIF Board of Directors approve that BIF act as liaison in implementing and carrying out the Carcass Data Service program. Seconded by Roger French. Motion carried.

Recommendations from Committee:

1. Specific Educational Programs similar to the National Sire Evaluation program, be implemented to publicize and educate producers.

2. That BIF provide producers with some guidelines as to the percent of calves that should be tagged to provide meaningful information.

3. That BIF provide cooperating organizations with lists of packing plants that have Federal Grading.

4. That the BCDS program be promoted as an Industry Program supported by USDA Agricultural Marketing Service.

5. The AMS provide carcass information as listed on their Pilot Study Carcass Data Form: conformation, maturity, marbling, quality grade, fat thickness, ribeye area, % pelvic, kidney and heart fat, and yield grade as well as date and location were obtained.

Respectfully submitted,

Keith Zoellner, Secretary

DRAFT DRAFT DRAFT

COOPERATIVE AGREEMENT
between the
AGRICULTURAL MARKETING SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
and the

____

NAME OF PROJECT.........(Federal Cooperative) Carcass Data Service

LEADERS................. ______________________________ (hereinafter called Cooperator) and the Deputy Administrator, Marketing Services, Agricultural Marketing Service, United States Department of Agriculture (hereinafter called Federal Agency).

HEADQUARTERS............Washington, D.C., and ______________________

DATE EFFECTIVE..........

LEGAL AUTHORITY.........Agricultural Marketing Act of 1946 (7 U.S.C. 1621 et. seq.)

OBJECT..................To provide a cooperative Carcass Data Service for the purpose of certifying quality and yield grade factors on carcasses officially identified for this service. The quality and yield grade factors are presently certified to users of the meat grading service who own the chilled carcasses. Under the Carcass Data Service, these factors also will be furnished to the person or persons who owned the animals at the time the eartag was attached. The information gained from this service will provide breeders and feeders with data which can serve as guidelines toward producing and growing the type of beef considered most desirable in their operations. Such a service will benefit the public by improving the quality and yield of beef.

ORGANIZATION...........The organization for carrying on this work will consist of Federal graders and supervisors, and persons employed by the Cooperator. Cooperator employees used for services under this agreement will not be considered Federal employees for any purpose.

METHOD OF PROCEDURE
Part I
Federal Agency..........(a) will provide qualified graders as are required to perform the technical evaluation of the carcasses.

(b) will furnish the official data forms necessary to conduct the service covered by this agreement.

(c) will design, procure, and maintain an inventory supply of official eartags needed for work under this agreement. These eartags will be provided to the Cooperator on a reimbursable basis.

(d) will maintain records as are necessary to identify serially numbered official eartags purchased by the Cooperator.

(e) will arrange for Federal or State inspectors to transfer tags at time of slaughter.

(f) will forward data forms when completed by meat grader through a central Federal office to Cooperator.

(g) will bill Cooperator on a monthly basis for eartags and data service provided. Charges for such services will be determined in accordance with Part III(c). Collections for eartags sold to Cooperator and for preparation of data forms will be deposited into the Treasury of the United States to the credit of a Trust Fund Account used in the meat grading program.

Part II
Cooperator.............(a) will purchase a minimum of 1,000 eartags from Federal agency and distribute eartags to those desiring to use this service.

(b) will keep sufficient records to match tag users with carcass data forms so that distribution of the forms can be made when they are received from the Federal agency.

(c) will make this service available to all
(organization)
interested members within the (association) and to other interested parties that are nonmembers.

(d) will cooperate with the Federal agency in the dissemination of information and conduct other educational work among meat packers, pro-
(organization) (nonorganization)
cessors, (association) members and (nonassociation) members for the purpose of accomplishing widespread use and efficient operations of the Carcass Data Service.

(e) will, on request, furnish the Federal agency with the names and addresses of all persons purchasing eartags.

METHOD OF PROCEDURE
Part III

Mutual Agreements.......It is mutually understood and agreed that:

(a) details of procedure and methods employed (and standards of quality and grades) in the conduct of this work will be those of the Federal Agency and the grading and other work will be conducted in accordance with the rules and regulations of the Secretary of Agriculture and such instructions as may be issued by the Federal Agency. Cooperator may issue any additional or supplemental instructions not inconsistent with the instructions issued by the Federal Agency; such additional supplemental instructions to be concurred in by the Federal Agency.

(b) determination of the quality grade and yield grade factors will be made by an official USDA meat grader.

(c) because of the possibility of loss, purchase of eartags does not guarantee receipt of data on every animal identified for the service provided under this agreement.

(d) the Cooperator will collect from the users of the service compensation for services performed. It is agreed that these charges will not exceed _________ per eartag and ________ for each completed data form. The Cooperator will make payment to the Federal Agency at the rate of _______ per eartag and _______ for each completed data form. Changes in any of these rates will be mutually agreed upon by the Federal Agency and Cooperator.

(e) all records of the cooperator relating to this agreement shall be available to the Federal Agency or its authorized representatives at any reasonable time, upon request. Such records shall be retained for a period of (3) years subsequent to the fiscal year (July 1-June 30) to which they pertain.

MEMBER OF CONGRESS CLAUSE..............No member of Congress or resident commissioner shall be admitted to any share or part of this agreement or to any benefit to arise therefrom, unless it be made with a corporation for its general benefit.

DURATION................This agreement may be terminated by either party by giving written notice to the other party thirty (30) days in advance of a specified date, on which it wants to proceed to terminate this agreement. After the date specified for proceeding to terminate, no eartags may be sold by the Cooperator. However, to protect the interests of users of the service who have already purchased eartags and services, the parties will continue with their other responsibilities under this agreement for three (3) years after the date specified for proceeding to terminate. At the end of such three-year period, the termination shall be effective.

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Deputy Administrator, Marketing Services
Agricultural Marketing Service

REPORT OF THE COMMITTEE ON MARKETS AND MARKETING

It is the recommendation of this Committee that the Beef Improvement Federation endorse and encourage the activities of all member organizations and other segments of the beef industry in aiding the development of marketing programs through which the true value of cattle of superior growth potential, cutability, and quality will be returned to the feeder and producer. The impact of this will be to emphasize that the total value of a beef carcass is determined as much by qualitative traits as by tonnage.

This Committee will continue to develop data that can be used to establish these values.

It is further recommended that the Board of Directors of BIF appoint a special committee to meet with the National Livestock & Meat Board to develop new methods of marketing cattle which will return to the feeder and the producer their full share of the true value of their animals.

This Committee also recommends that the Beef Improvement Federation should encourage the use of yearling bulls and put forth an effort to enlighten producers as to the advantages inherent in this practice.

The Committee on Markets and Marketing will meet again before the next Annual Meeting of the Beef Improvement Federation to study further and implement the above cited objectives.

Respectfully submitted,

Mack Patton, Chairman

REPORT OF THE CENTRAL TEST STATION COMMITTEE

The Committee recommends that BIF, in some way, certify those central test stations that follow the BIF recommendations for central tests. State associations could receive applications from test stations and forward to BIF with recommendations for action.

Bob Rankin will poll the Committee by mail to determine what they think the minimum requirements should be.

The Committee recommended that an annual list be prepared to include the test schedule of all stations. It was also suggested that test reports be exchanged between stations.

REPORT OF YOUTH EDUCATIONAL ACTIVITIES COMMITTEE

Chairman - C. J. Christians
Secretary - Michael Simpson

State Livestock Specialist and National Breed Association representatives met and discussed the role BIF could play in the coordination and implementation of performance records in youth programs.

There was a common concern to introduce a measure of performance into the steer and heifer projects. These performance records should be used as one of the measurements in the steer show evaluation.

--We recommend the appointment of Michael Simpson to coordinate the BIF recommendations with the U. S. Beef Breeds Council.

--We recommend the development of an educational materials library and publication of a list of these materials. C. J. Christians will be responsible for this project.

--We recommend the directors appoint a sub-committee of State Livestock Specialist and Breed Youth Directors to write and publish new materials. These materials will include lesson plans with visual aids on the subjects relating to performance records, beef cattle breeding and selection programs.

--We recommend that National Beef Breed Associations continue to publish supplemental materials which encourage the use of performance records.

REPORT OF RECORD UTILIZATION COMMITTEE

Members of the committee are Doug Bennett, Del Dearborn, Vern Felts, A. F. Flint, Dean Frischknecht, H. A. Herman, Jerry Litton, Mack Maples, Mack Patton, Russ Vanderkolk, Bob Long, L. A. Mattox (secretary), and Richard Willham (chairman). Also in attendance were Henry Matheson, Lowell Anderson, Glenn Richardson, Jim Gosey, Miss Burroughs and Paul Miller.

The charge of this committee is to devise ways and means of increasing and improving the utilization of records. The initial report (1971) listed four ordered steps to accomplish the charge. They are as follows:

1. Develop a set of guidelines for performance programs offered to the beef industry by BIF member organizations so that the programs offer records that can be best utilized by the participants.

2. Develop means to promote the enrollment and continued participation of cattlemen in performance programs.

3. Develop pamphlets and brochures on performance record use for all segments of the beef industry including allied industry.

4. Promote record utilization throughout the beef industry using the educational pamphlets and brochures as well as through the many forms of the news media.

To date we have developed a set of guidelines for breeding stock programs. These guidelines have been circulated to all BIF member organizations asking for a response in the form of a questionnaire. The results are tabulated (a copy of the results and of the guidelines are attached to this report).

Agenda

I. IDEAS TO ACCOMPLISH THE CHARGE: New ideas expressed were concerned with both how to use performance records as within herd improvement tools and over herd improvement tools to include the merchandising of stock on records. Convincing literature preparation or step 3 seemed to be the means to accomplish this for next year. A publication by BIF on pure record utilization was suggested as was one to bank loan officers. Also the uses to be made of the fertility information being considered by the Farm and Ranch Committee must be developed.

II. DISCUSSION OF EXISTING GUIDELINES FOR BREEDING STOCK PERFORMANCE PROGRAMS: The results of the questionnaire were outlined. A copy is attached.

III. REPORT ON COMMERCIAL PERFORMANCE GUIDELINES DEVELOPMENT: L. A. Maddox reported to the Committee on the guidelines developed. Each member of the Committee will receive a copy by mail to study. L. A. Maddox was chosen to head a sub-committee of this Committee to work on the implementation of commercial programs.

IV. DISCUSSION OF WRITING PROMOTIONAL MATERIAL: The material received was considered. The remainder of the material will be collected this year. The Chairman is to be responsible for compiling the material into a form suitable for the record utilization publication and the bank publication.

V. DISCUSSION OF PROMOTIONAL CAMPAIGN: The material must be prepared before work can start on this phase, so it was not considered.

VI. COORDINATION WITH COMPUTER SYSTEMS AND REQUIREMENTS COMMITTEE: This Committee met with the Record Utilization Committee. The Computer Standardization Committee is now to be a sub-committee of the Record Utilization Committee.

VII. The next year of effort by this Committee will be in the development of record utilization material for publication.

Report on Record Utilization Committee Questionnaire

R. L. Willham

Questionnaires should never be sent out by an inexperienced survey student. This much of the report is crystal clear. In total 57 questionnaires were sent out of which only 47 could have active programs. Probably fewer actually have programs. Of the 47, there were 16 replies. Eleven were from state BCIA groups, four from breed associations, and the report from PRI. There were problems encountered by those filling out the report. Clarity was not a virtue of the questionnaire. However, the results of the survey may serve a useful purpose. The results are given in the table. The row totals do not sum to 16 as they should because some reports were

Results of Record Utilization Questionnaire

Guideline	Using	To Use	Not Use
1. Description	15	0	0
2. Calendar	8	6	1
3. Breeding	7	4	4
4. Registration	5	3	3
5. Simplicity	13	2	0
6. Flexible	11	2	0
7. Timing	13	1	0
8. Relatives	3	6	2
9. Worksheet	8	5	1
10. Accuracy	14	0	0
11. Pedigrees	5	4	2
12. Sires	7	3	2
13. Utilization	7	5	2
14. Education	10	5	0
15. Abbreviated	8	2	4

left blank for some of the guidelines. In general, most programs seemed to be using guidelines for description, simplicity, flexible, timing, accuracy, and education. Roughly half the reporting programs were using guidelines for calendar, breeding, registration, pedigrees, and utilization. This result is gratifying since breeding, registration, pedigrees and utilization are relatively new innovations in performance programs. The use of relative information is being used by three and contemplated by six others which indicates the need to provide the breeder with some form of analyzed results to use in selection. The worksheet guideline reflects similar interest. Over half of the programs indicated that compiling sire data over herds for sire evaluation could be done. Over half reported some abbreviated program was possible. Hopefully the real value of the questionnaire was to get the sponsors of the various programs for beef testing to analyze their program in light of the guidelines.

Guidelines for Breeding Stock Performance Programs
Beef Improvement Federation

A performance record is a written measure of the performance of an individual made during some specified test. BIF organizations have collected a set of such tests and the resulting records into a performance program which is offered to the participants. The usual program is a system involving the measurement, adjustment, and summarization of weaning weights by calf crops. Feedlot tests to obtain yearling weights and slaughter tests for the evaluation of carcass merit have been included in many performance programs.

The essence of record use is SELECTION in the broad sense. That is, records must be used in decision making of the enterprise or they are simply an expense. In breeding stock programs, records must be used in selecting parents in order to make genetic change. Also, records properly evaluated can aid in many management decisions. The key to tomorrow's success is the development of a PERFORMANCE REPUTATION through the utilization of records.

Basically the problem involved with beef record keeping is that three calf crops must be considered each calendar year. These are last year's yearlings, this year's crop from birth through weaning to near yearling age, and the breeding for next year's calf crop. The normal sequence for once a year calving is birth of current calf crop, yearling evaluation of last year's crop, breeding cows for next year's calf crop, weaning current crop, and testing of current crop in a particular test. To date, breeders keeping records like to keep records and have developed their own subsidiary set of records to compliment the ones from a particular BIF organization. To increase the number of breeders keeping records, a complete record system that is simple and useful needs to be the rule.

What follows is a listing of specific points in the BIF guidelines:

1. CLEAR CONCISE WRITTEN DESCRIPTION OF PROGRAM. Such should give procedures to follow in enrolling and for continued participation. Steps in the program and the degree of flexibility need to be defined. Some example breeding programs developed around the record system should be given. Such a pamphlet or book should be re-written often to assure that updates are understood by the users. Possibly a loose-leaf system should be used.

2. RECORD KEEPING CALENDAR. Such a calendar either needs to be provided separately or in the written description such that breeders can plan their programs easily. The order usually is calving, yearling, breeding, weaning, etc.

3. BREEDING RECORDS. Each calf crop starts with the mating decisions a year prior to the birth of the calf crop. A complete breeding stock program should have convenient forms to record matings planned and matings made as well as date of breeding with particulars, if possible. At the conclusion of breeding or after a pregnancy exam these breeding records can be sent in where these records could constitute the prelist for birth and weaning data the following year. Currently breeding records must be kept by the breeder using his own system. Use of breeding records helps keep track of the reproductive performance of the cows in a herd.

4. REGISTRATION INFORMATION. Those performance organizations also involved in animal registration should develop a system using either the breeding or calving forms to register calves. Such a system would make registration much simpler for the breeder, probably result in more registrations, and would promote performance as the primary issue rather than registration.

5. SIMPLE SYSTEM. A performance program must be simple for the customer or the breeder. It may or may not be simple from a data flow, computer, or office routine point of view. The following items help to make a program simple and easy to use:

a. Minimum of desk work. Final data forms sent in should be those on which the data were collected. As little inside desk work as possible should be required.

b. Useful sequence in pre-listing. A useful program must be flexible enough to provide alternate possibilities for pre-listing. Cow number order or calf number order should be the decision of the breeder and in some situations both orders might be useful.

c. Form or data sheets. A sea of numbers scares anybody. All forms should be as simple yet as flexible as possible. Forms should be of a convenient size to the breeder not fit the standard computer paper. Data sheets represent a compromise between a width that is convenient for the breeder yet has enough columns to report data on one animal in a row. Current sheets go from 4" x 6 1/2" to 8 1/2" x 11" to 11" x 14" and on up in width. Probably the best compromise is to eliminate the redundent data and get the data sheets down to 8 1/2" x 11". Then many record systems in terms of standard notebooks are available. Extra or unlabeled columns need to be provided for flexibility so the breeder can measure some traits he considers to be important.

The quality of the paper in both the working forms and the completed forms needs to be of a quality that will withstand a reasonable amount of moisture and manure. The space given on the working forms for recording the weight or the measure should be large enough (at least 2/8") for cold fingers to record. The turning of pages to find particular animals needs to be facilitated. Also previously recorded weights help considerably in reducing mistakes of mis-identification. Proper sequence in listing is a must. Using carbons on the ranch needs to be avoided whenever possible. With the advent of copy machines, hand copying of records by breeders is obsolete and besides errors are generated.

6. CONVENIENT, FLEXIBLE DATA FLOW. Records direct from the breeder can be copied and sent back in a relatively short time period. Few breeders are without access to copy facilities (local banks) and could send in copies of their data for processing.

Participating breeders should be allowed the flexibility to record a limited number of extra traits they feel need to be considered. Without this opportunity the programs will get very rigid and inflexible. Growth is essential to program survival.

7. ANALYZED DATA RETURN. Each performance program must be designed so that the adjusted and analyzed records are back in the hands of the breeder at the time they can be used in selection and in other decision making. Also the data needs to be in a form that the breeder can take to the lot and use without further study and work such as ranking. The general rule for record processing is raw data in---processed data out as soon as is physically possible. Weaning and yearling weights must be sent back to the breeder when they can be used, otherwise he will find another way to get this done. Sire and dam summaries need to be sent on call and preferably when the calves are weaned for the dam and when sires are being evaluated for use in breeding. Often less than a calf crop is sent for processing. These contemporary groups should be processed immediately and returned. Such should encourage short calving seasons which help to compare more individuals accurately within contemporary groups. To miss evaluation of sires based on their carcass steers due to system lag time, means another year added to an already long generation interval.

8. USE OF AVAILABLE RELATIVE INFORMATION. Most performance programs if properly programmed are capable of retrieving all of the relevant relative information on a trait for a set of individuals to be compared in a test. The records on close relatives exist in the data sets for herds and can easily be programmed to provide the breeder with all the relevant information available from the performance program. Provided the data sets are properly stored, the average performance of paternal and maternal half-sibs can be combined with the individuals' own performance record to rank the contemporary individuals based on their estimated breeding value. When progeny are available, this average can also be incorporated. To do this requires sorting through the data, finding the relevant records, and computing the breeding values using multiple regression techniques. With current computers such a task can be done very quickly. For the breeder to do this is a physical impossibility. Thus, the performance program can provide a service that is impossible for the breeder to do. Ranking of individuals on their estimated breeding value using all available information for a trait such as weaning or yearling weight will increase the accuracy of selection.

9. SELECTION WORKSHEETS. Selection is the issue in breeding stock herds. Providing breeders with a selection worksheet that ranks each contemporary animal based on their estimated breeding value at the time selections must be made would be advantageous. At weaning the bull and heifer calves could be ranked separately based on their own weight and the average weight of their paternal and maternal half-sibs. From this selection worksheet (a current ranking to be USED) a breeder could make his tentative heifer selections and decisions on which bulls to put on gain test. Along with this ranking, the cows that just weaned a calf could be ranked on their record, the average record of their paternal and maternal half-sibs, and the average record of their progeny. The MPPA uses only progeny information. Then the selection worksheet could be used as an aid in culling the cow herd. After the yearling test, the procedure could be repeated using yearling weight. This selection worksheet would be useful in selecting young bulls and, if one were made on all sires, in comparing the young bulls with current herd sires. The estimated breeding values are numbers adjusted such that breeding values of animals with differing amounts of

information can be fairly compared. The selection worksheet as opposed to the performance pedigree puts the data together for use when selections must be made. To get value from the selection worksheet a breeder needs to have the majority of his calf crop contemporary and must have a reasonably consistent management and record system over the several years from which the data comes. Such a service by a performance program can be offered as optional or additional to those breeders interested.

10. HONESTY AND ACCURACY OF RECORDS. Our beef industry is built on the honesty and accuracy of the cowman in keeping records. Although certification of weights by a disinterested party helps verify a breeding stock program, it is not essential. The breeder sells breeding values and that is how the calves of his stock performs for the buyer. When his stock fails to perform for others, free enterprise solves the problem.

11. PERFORMANCE PEDIGREES. The purpose of performance pedigrees is promotion primarily especially if selection worksheets are being used. Problems arise with performance pedigrees when breeding stock is transferred from one owner to another. Performance data from one herd is difficult to combine with that from another. Also, the relevant information contained in a pedigree should be combined using multiple regression techniques into estimated breeding values. This helps eliminate undue emphasis to remote ancestors with superior records. In general performance pedigrees should contain only individual performance data of the ancestors. Estimated breeding values should be shown for relevant traits. These should be based on the progeny tests of the sire and dam (paternal and maternal half-sibs to the individual), the individuals' own record to date, and his progeny, if any. When an individual is sold the buyer gets a performance pedigree having the current information available in the herd of the seller. When the buyer requests an updated pedigree, the individual performance data of those in the pedigree and only the new data generated in the herd of the buyer will be used to recompute the estimated breeding values. This is the breeding value of importance anyway. All records should be expressed as ratios and absolute values.

All performance programs that also are involved with pedigrees should merge the ancestry records and performance data such that all pedigrees contain whatever performance data that are available.

12. SIRE EVALUATION. All performance programs need the capability to search their herd files and retrieve information on progeny from sires used in numerous herds. Such sire evaluation can be useful in determining how sires evaluated previously in a breed wide sire evaluation program to the carcass are doing in the breed. Also information generated from a breed wide sire evaluation program needs to be incorporated into herd data sets where the particular sires are being used. The progeny test of a sire is a sib test of his sons so would be useful especially for the carcass data where sons are being produced. Organizations developing sire evaluation programs must have the capability to randomize cow herds, conduct the relevant performance program for the progeny test, and analyze the data periodically into EXPECTED PROGENY DIFFERENCES for each bull tested to date as well as furnish each breeder with EPD's when his test is completed. Sire evaluation data needs to be published in its entirety from the start of such programs.

13. RECORD UTILIZATION. To become acquainted with a set of records and what they can be used for, would be a significant aid in interesting new participants in a performance program. While obtaining enough records to

be useful, is the time a lot of breeders quit. If they could practice on a dummy set of records already computed for them, they could see selection operate (learn genetic principles) as well as become better acquainted with the forms and procedures. Such a tool is available in the computer cow game. It could be played in groups of new breeders just enrolling. They could be asked to participate in the game over several calf crops to see just how a performance program can be made to work. Also breeders already keeping records might want to try out several selection schemes to decide which would be the most successful before starting a near lifetime program.

14. BREEDING EDUCATION. Educational material on how to design and conduct sound breeding programs using the particular system of records must be developed. Both the novice and the experienced record breeder must be challenged. No breeder today is utilizing his records for selection or for promotion of his product at near maximum potential.

15. ABBREVIATED PERFORMANCE PROGRAMS. A need exists for performance programs to develop and conduct simple abbreviated programs for commercial cow-calf producers, stockers, and feeders. Opportunities range from simple weaning programs and rate of gain evaluations to a sampling procedure (quality control) in which a sample of calves (the product offered for sale) is fed out and carcass evaluation made on the sample. Breeds could well develop specific commercial programs for crossbred heifer production where both maternal potential of the heifers and the growth potential of their calves needs to be specified.

REPORT OF THE NATIONAL SIRE EVALUATION COORDINATING COMMITTEE

The National Sire Evaluation Coordinating Committee met on April 27, 1972. Committee members present included Lytle Tom, Jr., Bernard Jones, Paul Miller, Richard Willham and Everett Warwick. Approximately 25 others also attended.

Representatives of four breed associations gave brief reports of activities to date in the sire evaluation area.

Drs. Miller and Willham discussed procedures for analyzing and summarizing data involving reference sires used in many herds. Procedures can be flexible depending upon the nature and extent of the data.

Dr. Willham initiated discussion on the subjects of testing for genetic defects and custom progeny testing. Lively discussions followed on each subject. Opinions differed widely on the amount of testing which could be justified for genetic defects. All were agreed on the desirability of greater use of commercial herds for custom progeny testing if national sire evaluation programs are to be fully effective. Alternative uses of suitable herds which may return greater profit to the owners were mentioned as difficulties in securing enough herds.

The chairman asked for discussion on modification of the guidelines for sire evaluation adopted in 1971. Mr. Tom raised a question of providing for the reporting of data on the actual fertility of bulls being progeny tested. Others pointed out the many environmental influences affecting this. These include quality of semen processing, maturity of the bulls, etc.

No changes were adopted in the 1971 guidelines.

E. J. Warwick
Chairman

LOOKING AHEAD IN BEEF IMPROVEMENT

D. D. Bennett

I would first like to express my appreciation to BIF for the opportunity to serve as President these past two years. It has been both an extreme pleasure and valuable experience for me to work with the Federation and particularly the Secretary, Frank Baker, The Board of Directors, Committee Chairmen and others in BIF.

Prices, although not necessarily margin received by cattle producers, in 1972 have improved. Our statisticians report an approximate 10% rise from the best year, 1951 to 1972, yet it has been pointed out that in 1951 one hour's wage would purchase 1.7 lbs. of beef and 1972 the same hour's wage would purchase 3.3 lbs. of higher quality beef. Further 20 years ago 25¢ out of every household dollar went for food while today only 16¢ of the household dollar goes for food. Work in our state carcass contest shows that not only has the wage-beef ratio improved for the retailer and consumer over the past 20 years but improved cutability also favors the retailer and consumer simultaneously. The recent publicity accompanying this rise has caused concern to the entire industry. This tends to emphasize the need for continued improvement of production efficiency. In beef improvement work like any other industry research and product testing must be ahead of the industry for progress. A margin of profit is essential for research and development to produce cattle that will truly improve all segments of the beef industry and result in the most efficient, most desirable, highest quality end product.

Tonight I wish to discuss four or five activities of BIF that have come to the forefront in the past two years.

The Beef Improvement Federation has provided the climate wherein representatives of the cattle industry from universities, government, state improvement associations, and breed associations could come together and brainstorm concerning the concept of a National Sire Evaluation Program. The development of this concept required more than two years of dialogue among these groups. On April 9, 1971, the Federation adopted Guidelines for the National Sire Evaluation Program. During the past year a large number of symposia and other types of meetings have been held to create a higher level of understanding of the concept presented in the National Sire Evaluation Program. Dr. Warwick reports that the program is being implemented by at least two of the largest breed organizations. Other breed organizations have the program under consideration and will be taking action in regard to it sometime in the future.

The recent announcement by the American Angus Association of an open A.I. policy may have some bearing on what many breed associations will want to do regarding sire evaluation programs of all types.

One thing is certain; all breed associations will develop a sire evaluation program or try to compete without one. Attempting to compete without a program may put them to a decided disadvantage.

In the last year the Federation has been active with the Sire Evaluation Program. We do not anticipate the Federation's interest in this program will decrease, but, at this point our standing committee on the program will handle sire evaluation as an ongoing activity and the primary thrust on the Federation will be directed toward other activities.

A second area of interest received special attention at the BIF Symposium in 1971. This was the introduction of growth curves in the planning of beef improvement activities. It is still early to say how much impact the research on growth curves, as conducted by Drs. James Brown and C. J. Brown at the Arkansas Station, will really have. The work of these people has no doubt stimulated research by other scientists and has stimulated a great deal of interest among breeders of registered cattle. Today we see the greatest array of genetic material available for use of the American beef industry in its entire history. Striking differences in body size and perhaps in growth rate do exist within breeds and between breeds. This fact in itself makes the attentions given to growth curves at the 1971 Research Symposium highly significant.

Another area of importance that has moved into the forefront in BIF activities recently, is the National Carcass Data Service Program. Two years ago, at the Beef Improvement Federation Meeting, the Illinois Department of Agriculture called to the Federation's attention the fact that a pilot program would be initiated. Last year in Kansas City, the USDA workers reported on the procedures being used in the four-state pilot project. Since that time, we have been quite active with other organizations in developing the plan for making this a national program. Organizations in each state have been contacted to act as local distributors of tags. A meeting was held here this morning to finalize the mechanics of this program. This program offers great potential for assisting commercial cattlemen in (1) establishing the genetic potential of their cattle for purposes of determining bull requirements and (2) for planning merchandising and sales programs for their feeder cattle through a sound performance reputation.

Similarly, the data available from this program would be especially useful in assessing and planning crossbreeding programs for commercial production. The genetic potential of the cow herd helps determine which breed of bulls should be used in order to maximize the returns in a commercial operation.

A fifth area that deserves special attention is the 1972 Research Symposium regarding reproduction in beef cattle, particularly the idea of incorporating more complete fertility and reproduction information into performance programs.

A recently announced grade standard for young slaughter bulls might have some impact on beef improvement programs. For example, under such a program all male calves in the calf crop could be retained as bulls until they were approximately a year of age and yearling data were recorded. Those that were culled on the basis of yearling data could go to slaughter for full market value through this grading system.

I think that the aforementioned items emphasize a point: That the Beef Improvement Federation is somewhat of a think-tank for the industry. It is from this think-tank that the performance recording programs and beef improvement programs of the 80's and 90's will be developed. Frank Baker, 3 years ago at a PRI meeting, suggested the concept that record keeping systems could be developed in a way that information inputs be made by telephone to the association office with performance pedigrees and other pertinent information printed back for the breeder at the ranch instantaneously by an electronic device attached to his telephone in the ranch office. Although it hasn't been adapted for use in performance programs yet, this type of technical capability exists in communication systems at the present time.

The use of Dr. Willham's highly successful computer cow game has been encouraged by the Federation as a means of familiarizing producers with the handling of computerized data. Our Computer Utilization Committee has its work cut out in the development and wider application of these sophisticated computer techniques.

I certainly want to take this opportunity to recognize the BIF Awards Program because the first set of awards are being made at this year's Beef Improvement Federation Meeting. The purpose of the Awards Program is to recognize past excellence of people and organizations in beef improvement programs and motivate the membership to a higher level of future excellence.

THE BEEF IMPROVEMENT FEDERATION

Conception - Gestation - Birth - Infancy: What Next?

by

Frank H. Baker, BIF Secretary & Chairman, Animal Science Department
University of Nebraska

Secretary's Report to BIF--April 28, 1972

The Beef Improvement Federation (BIF) idea was born in the late 60's amid the ferment which developed at the end of a decade of controversy on performance recording programs. That decade of controversy opened with only a few state Beef Cattle Improvement Association (BCIA) programs and the national Performance Registry International (PRI) program in existence. The decade closed with (1) most states having a BCIA program, (2) most breed associations having a performance recording program, (3) the PRI program continuing and (4) artificial insemination (AI) studs actively promoting performance tested bulls. Some breeders and organizations were scarred, battered and perhaps frustrated from the "in-fighting" resulting from having pioneered and crusaded for the basic performance testing concept that had gained acceptance in the industry.

The development of U.S. Beef Records Committee report on performance testing program standardization had provided a setting wherein some of the groups with interest in performance programs had worked together in solving problems. This committee was "self-appointed" with representatives of PRI, breed associations, Agricultural Research Service and the State and Federal Extension Services. This past experience of working across the lines of the so-called special interest groups was probably a key to the creation of an atmosphere in which the plan for BIF could be developed. F. R. Carpenter, Hayden, Colorado facilitated the birth of BIF by taking the initiative under the sponsorship of PRI to call a national meeting in Denver in January, 1967. This National Beef Improvement meeting served the "conception" process very effectively for BIF. The "gestation" period for BIF was 12 months in length and included many periods when loss of the "fetus" seemed inevitable. These periods of crisis resulted from differences in philosophy as to the purpose of such an organization and as to how it would function. BIF was born in January, 1968 and is slowly emerging from a newborn infant "stage". Hopefully, this "emerging process" is a normal coordinated growth.

BIF, as it is today, includes "genetic material" or ideas from many ancestors. Some of these BIF ancestors view it as the "master coordinator" of the beef seedstock industry of the future. Other BIF ancestors expect it to "capture" the beef seedstock industry and as the "victor" to move with dispatch in implementing new approaches for "improvement" of the beef seedstock industry. As one who has been involved with this "area of work" for quite sometime, I doubt that either role will be truly fulfilled by BIF. One significant truism is that the BIF charter and by-laws does not prohibit either of these roles for the organization or any other role that the constituents choose for the "body".

The "checks and balances" involved in the forming of organizations gave it the following purposes:

1. Uniformity. To work for establishment of accurate and uniform procedures for measuring and recording data concerning the performance of beef cattle which may be used by participating organizations.

2. Development. To assist member organizations and/or their affiliates in developing their individual programs consistent with the needs of their members and the common goal of all record-keeping programs.

3. Cooperation. To develop cooperation among all segments of the beef industry in compilation and utilization of performance records to improve efficiency in the production of beef.

4. Education. To encourage members to develop educational programs emphasizing the use of and interpretation of performance data in improving the efficiency of beef production.

5. Confidence. To develop increased confidence of the beef industry in the economic potential of performance testing.

These "checks and balances" also assigned the "balance of power" in the executive board to the state beef cattle improvement associations and to PRI. In the 17-member board, PRI holds one seat and the state BCIA's hold 8 seats.

The current role of BIF seems to be that of pursuing the aforementioned objectives through a "coordinator's approach" plus stimulating the constituent members of BIF to do some "hard thinking and planning" for the future of the beef seedstock industry and to provide a setting for public examination of ideas concerning the future beef industry that might be "no, no ideas" in any other setting.

The work of BIF to date has been through technical and educational committees working on key questions of the performance recording programs.

In its short life to date, BIF has been involved in focusing attention on new ideas in the beef industry. These include:

1. performance pedigrees;
2. most probable producing ability calculations;
3. breeding value calculations;
4. computer selection exercises as educational tools;
5. sire evaluation programs for the industry.

A quick review of BIF activities of the past year show the following projects receiving special attention.

1. Announcement of National Sire Evaluation Program at the close of the 1971 Annual Meeting. A series of 12 symposia and lectures were planned and conducted to assist the industry in understanding the program. Leaflets giving dates and locations of the symposia and lectures were prepared and distributed.

2. Announcement of the beginning of the Recognition Program. The awards banquet Wednesday evening completed the first year of this program. Leaflets on the recognition program were prepared and distributed.

3. Continued the production of a publication entitled "Report of Member Activities."

4. Revision of the publication entitled "Guidelines for Uniform Beef Improvement Programs." A preliminary printing was released this week.

5. Co-sponsored the revision and publication of the American Meat Science Association recommended guides for beef carcass evaluation. The first copies were released this week.

6. Activated a more extensive distribution of news releases and feature stories on a nationwide basis.

7. Initiated a Beef Carcass Data Service Committee. This committee is assisting USDA in expanding the 4-state pilot project to a national program to begin later this year.

The Research Symposium, the program planning conference and this annual meeting focused on concepts and questions that are relevant to the future of the Beef Industry. Some of these were:

1. Reproductive efficiency and how to incorporate it in performance record programs.

2. Will marketing through performance records enhance and/or perhaps replace other marketing programs?

3. Can cattlemen and industry firms cooperate nationally in gathering carcass data?

4. Can performance record utilization be improved?

5. Does the rapidly changing picture of artificial insemination rules for registered cattle breeders present special opportunities in performance testing programs.

What Next?

It depends largely on cattle breeders and on us as representatives of organizations and institutions concerned with cattle breeding and production.

Resources unequalled in the world exist in the USA for cattle breeding and production.

Genetic material from throughout the world is rapidly becoming available for cattle breeding and production in this country.

Will the ideas for full use of technology and for full development of new beef improvement concepts be freed of the fetters and encumbrances that have been typical of the past? Will we be able to change the N to G so that the No - No's can be revised to Go - Go's?

We will through vigorous activity at the local, state and national level. More than 50 organizations working together in a dynamic manner at the national level and driving forward vigorously on individual programs at all levels will create a wave of progress previously unequalled in the beef industry.

MINUTES OF THE BIF BOARD OF DIRECTORS MEETING

September 22, 1971

Rapid City, South Dakota

The Directors present were: Everett Warwick, Max Hammond, Glen Butts for Clarence Burch, Dave Nichols, Martin Jorgensen, Harry Herman, Bob deBaca, Lou Chesnut, Pete Swaffar, Bill Durfey, Art Linton, Doug Bennett, Waldo Forbes, Stan Anderson, Frank Baker and guests Dale Neumeyer and Jim Gosey.

Frank Baker reported on action taken since the Annual Meeting. There have been two leaflets prepared--one on National Sire Evaluation Programs and the other on the Recognitions Program. Requests for renewal of memberships have been circulated and Baker pointed out that failure to pay dues will result in inactive status for member organizations.

In the report on sire evaluation by Everett Warwick, he reported that a series of meetings as planned at the Annual Meeting in April, 1971 have been undertaken and that a number of breed associations are now adopting National Sire Evaluation programs. He also reported that a National Sire Evaluation Program Coordinating Committee has been worked on by Dixon Hubbard and himself and that the functions of this committee would be four-fold.

1. To review and update recommendations.
2. To review programs for soundness and adequacy.
3. To council with member organizations.
4. To designate BIF approved sire evaluation programs.

Warwick recommended that the Coordinating Committee be composed of first one chairman with a three-year term, two geneticists representing state universities, two representatives of beef breed associations to be named by the President of the Beef Breeds Council. One representative of the National Association of Animal Breeders, one representative of Performance Registry International and one representative from a state beef cattle improvement association. Discussion followed.

Swaffar reported recommendations by the Beef Breeds Council for their two representatives on the Coordinating Committee for National Sire Evaluation programs were these two men: Jack Richey and Lyle Springer. Recommended for the post from the National Association of Animal Breeders was Bernard Jones. From PRI, their representative is Glen Butts. The BCIA people decided to caucus to select their representative for the Coordinating Committee. A vote was taken among the four men nominated for the two geneticist posts. Men nominated were Richard Willham, Paul Miller, Everett Warwick and Jim Brinks. A vote was taken and Willham and Miller were selected for the committee.

It was moved by Dave Nichols and seconded by Stan Anderson that Everett Warwick be elected Chairman of this Coordinating Committee. Motion carried.

Glen Butts moved that we should designate three people to one-year terms with the possibility of revision after a year's review. Max Hammond seconded this motion. Nichols moved and Linton seconded to amend the original motion to a one-year term. This motion carried. Also the two technical positions should be one-year terms.

Bob deBaca reported that the Promotion Committee has distributed several feature stories to about 1,000 different media across the country. Articles have been distributed on farm and ranch testing, on central bull testing and on the recognitions program.

Pete Swaffar reported on the Annual Meeting in 1972 and stated that it would be April 26, 27 and 28 at the New Tower Inn in Omaha, Nebraska. The New Tower Inn is located at 78th and Dodge Streets. The Vice-President of BIF will be actively involved in planning of this program in Omaha.

Baker briefly indicated that Jim Brinks, Will Butts, Everett Warwick, Dick Willham and Chairman Larry Cundiff are actively planning the program at the present time. Basically there will be two areas of discussion. Number one would be incorporating fertility data in record of performance programs. Also this would involve fertility on a lifetime production basis as well as selection for fertility traits and management to maintain the highest possible fertility. The second area of discussion would be recommendations for proper recording and processing of fertility trait data.

A discussion of the Beef Carcass Data Service indicated that the BIF has posted a letter to endorse the program. John Pierce had indicated to Secretary Baker a need for a meeting of the minds concerning all phases of the industry to discuss the Beef Carcass Data Service. So a need for a committee was indicated. Burton Eller was selected to chair a committee to be appointed.

.Meeting adjourned.

MINUTES OF THE BIF BOARD OF DIRECTORS MEETING

April 26 and April 28, 1972

President Doug Bennett called the meeting to order at 7:30 a.m., April 26 and the Secretary read the minutes of the midyear meeting at South Dakota. The minutes were approved. The Secretary also presented the financial statement for discussion. The financial report was approved.

The plans for the Annual Meeting were reviewed and discussed. Dixon Hubbard reported on the current status of committee activities and outlined his plan to gain some new names for committee membership and to revise the committee memberships sometime soon after the Annual Meeting.

The Board discussed the selection of an awardee for the first Beef Improvement Federation Service Award. The Board voted to serve as a committee as a whole to handle the question. The committee recommended the selection of the candidate who had received the majority of the votes from a secret ballot to receive the first Service Award. This recommendation was passed unanimously. The candidate selected was Clarence Burch, Mill Creek, Oklahoma.

The meeting recessed until Friday, April 28.

The meeting reconvened at 8:00 a.m., April 28. Those present were: Burch, Maples, Warwick, Vaniman, Durfey, Swaffar, Francis, Herman, Mast, Meyer, Forbes, Jorgenson, Nichols, deBaca, Chesnut, Baker, Bennett, Hubbard, Ludwig and Olson sat in for Hemingson.

The Board reviewed the committee reports that had been made in the general meeting and took the following action.

Baker moved and Chesnut seconded that the Board direct the committee coordinator to follow through and designate a committee on Reproduction Records of Performance and ask that committee to prepare a report for next year's meeting. Motion passed.

Baker moved that the Board direct the committee coordinator to appoint a study committee to assemble a status report on performance requirements for registration of beef breeds for reporting at next year's Annual Meeting. The committee to be called the Registration Requirements Committee. Motion was seconded by Chesnut.

Swaffar amended the motion to direct this report to be developed by the Performance Pedigree Committee. Herman seconded the motion, and the amended motion passed.

Forbes moved and Meyer seconded that the original resolution as stated in the committee report of the Farm and Ranch Testing Committee recommending that all breed associations require performance data to be available on animals to be registered be passed. Durfey moved that the motion be tabled. Swaffar seconded. The motion passed.

Baker moved that the Marketing Committee pursue the direction which they recommended in their report to contact the National Live Stock & Meat Board in regard to the development of a new method of marketing to bring about greater returns to feeders and producers. Maples seconded. Motion passed.

Baker moved that the Board authorize BIF to function in implementing the Beef Carcass Data Service Program nationally and that BIF claim a thousand or more tags to service member organizations who need less than a thousand tags. Member organizations would sign a special agreement absolving BIF of financial responsibility for these tags. The tags would be sold C.O.D. to the member organizations. Motion was seconded by Francis and passed.

Baker moved that the Beef Carcass Data Service Committee be encouraged to work cooperatively with USDA and BIF members and other industry organizations in a national educational program on the beef carcass data service project. Durfey seconded. The motion was passed.

Martin Jorgenson moved that the Central Bull Testing Station Committee chairman be asked to compile a complete up-to-date list of test stations to provide this to the Secretary in order that the Secretary could send a copy of the new Guidelines with a special letter recommending the use of these Guidelines in planning an operation of the test stations. The motion was seconded by Swaffar and passed.

Burch moved that the annual dues for the Beef Improvement Federation be set at $100 for members and $50 for associate members. It was seconded by Swaffar and passed.

Baker moved that the Record Utilization Committee be encouraged to move ahead with the planned educational program to publish a brochure. The motion was seconded by Nichols and passed.

Baker moved that Bob deBaca's request for relief as Information Director be accepted effective August 31 and that Bob be commended for excellence in his work in this capacity and that C. C. Mast be appointed Information Director effective September 1, 1972. Chesnut seconded. The motion passed.

Baker moved that the 1973 Annual Meeting be held in the New Tower Motel in Omaha, Nebraska the middle 10 days of April and that a two-day program format be investigated. It was seconded by Nichols and passed. Tentative dates of April 11 and 12 have been reserved at the New Tower Motel.

Maples suggested that the midyear Board of Directors Meeting serve as a regional meeting and would move around the country to create interest in other areas of the country. Burch moved that the officers give special consideration to this suggestion. Ludwig seconded. Motion passed.

Herman moved and Burch seconded that the Board offer a special resolution of commendation to Baker and Swaffar for the excellence of the arrangements for the meeting. Motion passed.

Nichols moved and Burch seconded that we extend a special resolution to Doug Bennett thanking him for his excellent service as President of the Beef Improvement Federation Board for the past two years.

The election of officers was held. Dave Nichols was elected President; Ray Meyer was elected Vice-President; Frank Baker was elected Secretary; and C. D. Swaffar was elected Treasurer.

The meeting adjourned at 9:30 a.m.

MINUTES OF GENERAL MEETING

April 27, 1972 -- 8:00 p.m.

The Secretary's report was presented by Frank Baker. The Reports of the caucuses on the election of Directors were given. William Gray, Falkland Farms, Schellsburg, Pennsylvania was elected as the Director of the Northeast Region. D. D. Bennett was re-elected as the Director of the Western Region. The breed association Directors' positions were filled by Craig Ludwig, Kansas City; Don Vaniman, Bozeman, Montana; Fred Francis, St. Joseph, Missouri; Jim Hemingson, Iowa; and C. D. Swaffar, Omaha, Nebr.

Dixon Hubbard moderated the committee reports as printed elsewhere in the proceedings. Reports presented included: Utilization Committee by Richard Willham; the Farm and Ranch Testing Committee by Ray Meyer; the Marketing Committee by Mack Patton; the Central Test Committee by Bob Rankin; the Sire Evaluation Committee by Everett Warwick; the Carcass Data Service Committee by Keith Zoellner and the Youth Educational Activities Committee by Charles Christians.

Following the committee reports Henry Matthiessen raised a question as to the financial needs of the Beef Improvement Federation. He pointed out that improved and increased numbers of publications cost more money than are available in the existing Beef Improvement Federation budget. Secondly, that annual meetings that draw national attention of key people in the entire industry require special contacts and promotions in the form of personalized letters which are more expensive than methods that have been used in the past. He also called attention to the fact that the Federation has paid no expenses for travel to any individual who has served as a speaker in the Research Symposium. He suggested that it would be desirable for BIF to have some money available to use for this type of purpose. This question was discussed by several members from the floor. Mrs. Forbes moved and Harry Herman seconded that the Board give consideration to increasing the membership to $100 for those organizations that have over 50 members and those with less than 50 members remain at the same level. Motion passed.

Burch commented that the Beef Improvement Federation should try to keep its perspective as an organization that has a special role of leadership in the industry and that special efforts should be made to keep the committee projects relevant to the needs of the beef industry as has been the case in the past. He pointed out that the committee chairmen and officers are due praise of the beef industry for the things that have been done in the past.

Bob deBaca called attention to the need for a continued information and publicity program. He pointed out that this required newsworthy information from all the BIF member organizations and for individuals within the organizations. He asked the continued cooperation of the members and the organizations in having this type of information available.

The meeting adjourned.

BEEF IMPROVEMENT FEDERATION

Financial Statement

July 1, 1970 to March 31, 1972

Date	Description	Expenditures	Deposit	Balance
7/1/70				$2,117.30
7/28/70	Stamps	$ 20.00		2,097.30
7/28/70	Materials for Conf. Proceed.	23.00		2,074.30
7/28/70	Reproduction for Conference Proceedings	45.00		2,029.30
8/6/70	Gift for Secretarial Assist.	30.16		1,999.14
8/21/70	Attorney Fee	5.00		1,994.14
9/17/70	Membership Dues		$ 275.00	2,269.14
9/18/70	Conference Room	19.33		2,249.81
9/24/70	Membership Dues		1,100.00	3,349.81
10/7/70	Expenses of Directors' Mtg.	58.51		3,291.30
10/8/70	Membership Dues		300.00	3,591.30
12/1/70	Office Supplies	305.92		3,285.38
1/20/71	Stamps	25.00		3,260.38
2/2/71	Membership Dues		450.00	3,710.38
2/18/71	Stamps	50.00		3,660.38
3/1/71	Duplication of Membership Activities Report	89.00		3,571.38
3/18/71	Stamps	18.00		3,553.38
3/22/71	Office Materials & Secretarial Assistance	300.00		3,253.38
3/23/71	Printing Conference Programs, Name Tags & Leaflets	248.85		3,004.53
3/25/71	Printing	7.47		2,997.06
4/2/71	Convention Expense	100.00		2,897.06
4/9/71	Convention Expense	441.84		2,455.22
4/15/71	Secretarial Service	132.98		2,322.24
4/23/71	Publicity Expenses	250.00		2,072.24
4/23/71	Filing Fee, State of Colo.	5.00		2,067.24
4/29/71	Envelopes	7.15		2,060.09
5/3/71	Mimeograph Paper	34.00		2,026.09
5/4/71	Stamps	40.00		1,986.09
5/7/71	Secretarial Service	51.00		1,935.09
5/7/71	Secretarial Service	84.50		1,850.59
5/8/71	Materials for Conf. Proceed.	48.93		1,801.66
6/15/71	Printing Sire Eval. Leaflet	162.74		1,638.92
6/15/71	Legal Fee	5.00		1,633.92
	Balance June 30, 1971			$1,633.92
7/1/71	Stamps	19.00		1,614.92
8/18/71	Printing Recognition Leaflet	198.17		1,416.75
9/7/71	Postage	43.00		1,373.75
9/7/71	Office Expenses & Secretarial Assistance	75.00		1,298.75
9/16/71	Membership Dues		1,650.00	2,948.75
9/22/71	Expenses for Board Meeting	68.45		2,880.30
12/30/71	Duplicating Service	47.85		2,832.45
1/21/72	Stamps & Postage	30.00		2,802.45
1/28/72	Duplicating Service	59.40		2,743.05
3/8/72	Membership Dues		250.00	2,993.05
3/9/72	Meeting Expenses BCDS	10.23		2,982.82
3/15/72	Stamps	50.00		2,932.82
	Balance March 31, 1972			$2,932.82

ELECTION OF BOARD OF DIRECTORS

Vacancies of the Board of Directors were filled by election in accordance with the by-laws i.e. representatives of breed associations caucus and elect members to represent them; state BCIA representatives elect regional directors in regional caucuses and at-large directors in a caucus of all BCIA's.

Director	Address	Representing	Term Expiration
Breed Associations			
Fred Francis	3201 Frederick Blvd. St. Joseph, Mo. 64506	Am. Angus Assn.	1974
James Hemingson	Newell, Ia. 50568	Am. Polled Heref. Assn.	1973
Craig Ludwig	Hereford Drive Kansas City, Mo. 64105	Am. Heref. Assn.	1975
Raymond Meyer	Sorum, S.D. 57654	Red Angus Assn. of Am.	1973
C. D. Swaffar	8288 Hascall St. Omaha, Ne. 68124	Am. Shorthorn Assn.	1975
Don Vaniman	Box 24 Bozeman, Mt. 59715	Am. Simmental Assn.	1975
State BCIA's & PRI			
D. D. Bennett	Box 352 Hermiston, Or. 97838	BCIA Western Region	1975
J. Dave Nichols	Anita, Ia. 50020	BCIA North Central Region	1973
Mack Maples	Elkmont, Al. 35620	BCIA Southern Region	1973
William Gray	Folkland Farms Schellsburg, Pa. 15559	BCIA Northeast Region	1975
Louis C. Chesnut	4314 Scott Spokane, Wash. 99200	BCIA-at-Large	1974
Waldo Forbes	Beckton Stock Farm Sheridan, Wy. 82801	BCIA-at-Large	1973
Martin Jorgenson	Ideal, S.D. 57541	BCIA-at-Large	1974
Max Hammond	Barton, Fla. 33830	BCIA-at-Large	1974
Clarence Burch	Mill Creek, Ok. 74856	PRI	Continuing
Other Organizations			
Burton Eller	1540 Emerson St. Denver, Co. 80218	Am. Natl. Cattlemens Assn.	Continuing
Harry Herman	512 Cherry St. Columbia, Mo. 65201	Natl. Assn. of Ani. Brdrs.	Continuing

Ex Officio

Dixon Hubbard	Extension Service, USDA, Washington, D.C. 20250.
Everett Warwick	Agricultural Research Service, Beltsville, Md. 20705
Don Nicholson	Livestock Div., Dept. of Ag. of Canada, Ottawa, Canada
Robert deBaca	Animal Sci. Dept., Iowa State Univ., Ames, Io. 50010
C. C. Mast	Animal Sci. Dept., VPI, Blacksburg, Va. 24061
Frank H. Baker	Animal Sci. Dept., Univ. of Nebr., Lincoln, Ne. 68503

BEEF IMPROVEMENT EVENTS
SPONSORED BY MEMBER ORGANIZATIONS

1972

MAY 31 & JUNE 1	-	Minnesota Beef Improvement Field Day and Bull Test Station Sale. Lake Benton, Minnesota Sponsored by Minn. BCIA & Univ. of Minn. Extension Service. Contact: C. J. Christians University of Minn. Animal Science Dept. St. Paul, Minn.
JUNE 6	-	Beef Cattle Evaluation Conference Univ. of Minn., St. Paul Sponsored by Minn. BCIA & Univ. of Minn. Extension Service. Contact: C. J. Christians University of Minn. Animal Science Dept. St. Paul, Minn.
JULY 9-10	-	PRI Annual Meeting Camelot Inn, Tulsa Sponsored by PRI Box 133 Joplin, Mo. 64801
JULY 17-18	-	American Cattlemans Conference Colo. State Univ, Ft. Collins Sponsored by Am. Polled Hereford Assn., Amer. Natl. Cattlemans Assn. & Colorado State Univ.
JULY 21-22	-	Bonsma Field Day Still House Hollow Farm, Hume, Va. Slide lectures in the evening. Dialogue with Bonsma --2nd Day. Sponsored by Va. Jr. Hereford Assn., Va. Hereford Assn., & Still House Hollow Farm.
JULY 24-25	-	Missouri Cow-Calf Clinic Univ. of Mo. Livestock Center, Columbia Sponsored by Extension Division MBCIA & Mo. Cattlemans Assn.

AUGUST 20-23 - 1972 Annual Convention
Arlington Heights, Ill.
Sponsored by Natl. Assn. of Animal Breeders
P. O. Box 1033
Columbia, Mo. 65201

AUGUST 25 - Cow-Calf Field Day
Highmore, S. D.
Sponsored by S.D.S.U. Ext. Service

NOVEMBER 8 - State Performance Tested Bull Sale
Univ. of Mo. Livestock Center, Columbia
Sponsored by Extension Div.
Mo. BCIA & Mo. Cattlemans Assn.

NOVEMBER 15 - NBCIA Annual Meeting
Ainsworth, Nebraska
Sponsored by NBCIA

DECEMBER 12 - Annual Meeting
Location TBA
Sponsored by S.D. Production Recds., Inc.

1973

JANUARY 13 - Seventh NAAB Conference on Beef Cattle A.I.
Brown Palace Hotel, Denver
Sponsored by Natl. Assn. of Animal Breeders
P. O. Box 1033
Columbia, Mo. 65201

JANUARY 23-27 - 76th Annual Convention & 3rd Annual Trade Show
San Antonio, Tx.
Sponsored by American Natl. Cattlemen's Association.

APRIL 24
APRIL 25 - Washington Beef Improvement Day
Lacrosse Performance Sale
Lacrosse, Washington
Sponsored by Wash. BCIA & Washington State Univ.

MAY 15 - Field Day & Private Treaty Bull Sale
Location TBA
Sponsored by S.D. Livestock Production Records.

OCTOBER 1-4 - World Angus Forum
Kansas City, Mo.
Sponsored by Am. Angus Assn.

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