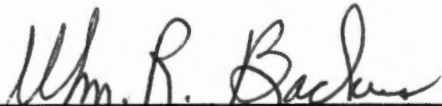


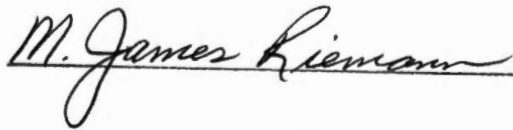
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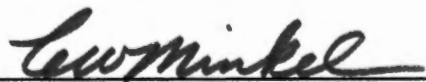

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IMPLICATIONS OF POSSIBLE EFFECTS ON BEEF
COW EFFICIENCY FROM SELECTION FOR MATERNAL
ABILITY, YEARLING WEIGHT, OR A
COMBINATION OF THE TWO

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Billy Wayne Fuller
August 1990

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ABSTRACT

The selection practiced in the beef industry lacks uniformity because breeders are unaware of the potential effects on lifetime productivity when certain traits are emphasized in a selection program. This study involved data collected from 120 Angus and 90 Polled Hereford cows and their progeny (913 calves) over a five year period (1985 to 1989). Data were obtained from the calves at weaning, cows at weaning of calf, calves at a year of age, and from the 1988 calves at slaughter. These data were analyzed, and correlations involving both live-animal and carcass variables were calculated from the error line in an analysis conducted according to SAS (1985). The initial Angus cows were randomly divided into groups: control group in which no selection would be practiced, a group in which increased maternal milk production would be favored by selection (referred to as the "maternal" group), a group in which increased yearling weight would be favored by selection (referred to as the "yearling weight" group), and a group in which both of these criteria of selection would be used (referred to as the "composite" group). The Polled Herefords, because of a smaller number of available cows, were divided into only three groups: control, maternal, yearling weight. Inferences were drawn as to the possible relative effectiveness of using either of these traits or a combination of them as the basis for selection. Changes in cow efficiency, defined as the ratio of adjusted 205-day

weight of calf to actual cow weight at weaning of calf, in these selection systems were compared.

Upon visual evaluation of the means, it was apparent that the most efficient 1989 Angus group was the composite (50.3%). The most efficient 1989 Polled Hereford group was the control (39.5%). No complete comparison between the herds can be made due to absence of a composite group in the Polled Herefords. In both herds, the least efficient group was the maternal (45.7%, Angus and 38.2%, Polled Hereford). Trends toward improved cow efficiency were observed in the Angus herd between 1985 and 1989. Cows that failed to calve were the least efficient and in both herds, were fatter and heavier at time of calf weaning. In visually evaluating the mean adjusted 205-day weight, mean adjusted 365-day, and mean adjusted 550-day weight, there appeared to be some improvement between 1985 and 1989 in the Angus herd and less improvement in the Polled Hereford herd. One major problem when selecting solely for maternal milk production is that heifers tend to become too fat. There was an increase of .2 mm backfat in the Angus herd and .4 mm in the Polled Hereford herd. Carcass data from 1988 steers were analyzed, and the mean yield grade and quality grade of carcasses from the Angus composite group were 2.8 and high Select (11.8), respectively. The analysis of the carcass data was across herds. Yield grade was correlated with fat thickness (.89) and %KPH (.72). Quality grade was correlated with marbling (.7). Percentage cutability was correlated negatively with fat thickness (-.88) and yield grade (-.99).

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CHAPTER I

INTRODUCTION

Improving productivity and efficiency are economically important to the beef cattle producer. The evaluation of progress in improving economic traits is an essential part of successful planning of future breeding schemes and allows documentation of progress from past selection (Nadarajah et al., 1987). Producers must be more aware of today's industry demands and select to improve important traits, including those desired by consumers. Researchers working with beef cattle have been lagging behind in their work during the past few years and are now trying to make changes to increase productivity. Notter and Johnson (1977) reported that the average rate of calf production does not exceed .75 calves weaned per cow exposed to breeding and that the proportion of total feed input that is required for maintenance of the breeding herd is higher for beef cattle than for any other common meat producing species. The primary limitation to increasing efficiency of beef production is the reproductive ability of the cow. Either a physiological problem or poor management or both may be commonly responsible for cows not getting bred. The present study was designed to evaluate selection procedures with emphasis on overall efficiency of the dams. Four groups of Angus and three groups of Polled Herefords were utilized, and several measurements were taken on the

progeny, the dams, and, only most recently, the carcasses. A control group within each herd was used to compare with groups subjected to certain selection procedures. The major objective was to determine how selecting for specific traits affected offspring performance. Performance information is a very useful tool in selection procedures, but subsequent visual appraisal can be used in making the final decision as to whether to keep or to cull. Perhaps Paul Swaffer (1967) put it best when he said, "While the aim of the total performance registry program is to help breeders gain useful information about their cattle and accumulate data which can be invaluable for future research, performance records should not be considered a substitute, but rather as supplementary tools, for sound judgement and good husbandry practices in Hereford production."

CHAPTER II

REVIEW OF LITERATURE

History of the Beef Industry Improvement Association

Since the beginning of time, people have known that changes can be made simply by selection of breeding stock. With careful evaluation one can select for specific traits and cull on specific faults. By simply breeding the "best to the best", one can see genetic improvement being made. As early as the 1930's, researchers began using objective measurements for evaluating beef cattle. It was soon found that traits of economic importance that are heritable could be evaluated, and, through selection, genetic improvement could be made. Thus, with this early work, performance testing was born.

Baker (1986) stated that in order to standardize programs and methodology and to improve the use of performance testing, both state and national organizations must come together, and, on February 1, 1968, the Beef Improvement Federation was formed.

Leading up to this, between 1930 and 1935, the USDA conducted the first research at a Range Livestock Station in Miles City, Montana. The first Beef Cattle Improvement Association was formed in Virginia in 1955. Baker (1986) reported also that the Red Angus Association was the first organization to include performance data in pedigrees, and this began on March 25, 1954, in Fort Worth, Texas. The

American Angus Improvement Conference was held in 1961, sponsored by both the American Society of Animal Science and the American National Cattlemen's Association. The American Hereford Association total Performance Record Program was started in 1964.

The Use of Linear Measurements

Subjective evaluation is the most common method of selection and grouping of animals; however, human error and prejudice on the part of individual visual appraisals play a key role. The use of actual body measurements taken on an animal should give a more accurate prediction of future performance. Touchberry and Lush (1950) conducted a study in which they examined the accuracy of linear body measurements of dairy cattle. Body length, heart girth, paunch girth, wither height, and chest depth were observed at 7 ages: six months, one, two, three, four, five and seven years. Relative accuracies at the different ages were not significantly different. Lush and Copeland (1930) found little or no correlation between the average size of measurements and the random error in taking them. In each study, multiple observations of the same trait made little improvement in the relative accuracy of the measurements.

Much research has been done comparing linear measurements of a live animal with measurements taken from a photograph. Smith et al. (1950) reported slightly higher repeatabilities, in general, from photographs with errors of greatest magnitude occurring in body length of cows and

yearlings. This indicated that either method is similarly accurate, but most measurement studies reported have been of direct animal measurements instead of measurements from photographs.

In a study conducted by Melton et al. (1967), positive relationships between feed intake and measurements of chest depth, width at hooks and body length were found, indicating that if body measurements were included in a regression equation, the prediction of feed requirements of cattle would be improved. Orme et al. (1959) reported that weight alone accounted for 27.7 percent of the variation in daily feed requirements. When the variables of weight, heart girth and body length were considered together, the regression equation explained 55.2 percent of the variation in feed requirements.

In order to evaluate body measurements or other traits as selection criteria, reliable estimates of heritability must be available. Table I summarizes many of the reported estimates of heritability of various linear measurements. Overall, these estimates appear to be "moderate" to "high" as compared to weaning performance traits, and the estimates of heritability of skeletal measures are similar to those of values obtained for post-weaning gain and yearling performance traits.

Busch et al. (1969), and Orme et al. (1959) determined that there exists very low association between linear measurements and percent closely trimmed major retail cuts. Orme et al. (1959) and Lush (1932) found that skeletal

length and skeletal height are positively and highly correlated with weight and with one another. Thus, linear measurements of calves are useful predictors of post-weaning performance and are usually involved in positive, although weak, associations.

Lush (1932) found height at both hips and withers and body length to be highly correlated with final weight but to a much lesser extent with gain (.7 vs .3), and concluded that maximum gains were characteristic of animals with a long body, tall at withers, with a large heart girth but small flank girth and narrow loin. Lush (1928) found height at withers and hip height to be the most useful measurements which increase at a less rapid rate than does weight.

Brown and Shrode (1971) studied six linear body measurements, traits that were indications of performance and body composition. These evaluations were used to assess the usefulness of these measurements in predicting post-weaning average daily gain, lifetime average daily gain and fat thickness. From their research it seemed that body dimensions and fatness could be used to improve the prediction of post-weaning performance and body composition more than by using only calf age and weight.

From tremendous amounts of research, linear measurements have been evaluated for several years. Brown et al. (1956c) stated that evaluation on the basis of measurements has the advantages of being independent of human judgement and of remaining standard over long periods of time in contrast to subjective conformation and type

scores which change considerably over time. Brown et al. (1956a, 1956b) found that beef animals reach maturity earlier with respect to height, depth, width, length and heart girth recorded at earlier ages than with respect to body weight. Guilbert and Gregory (1952) reported that linear skeletal growth increased more rapidly and was completed earlier than was thickness growth, thus, demonstrating that much of the change in body weight of cattle at maturity is due to changes in the amount of fat deposition rather than to differences in true skeletal size.

Brown et al. (1956b) found that Angus calves at 12 months of age had attained 51 percent of their mature weight and from 80 to 89 percent of their mature size, whereas, Hereford calves at similar ages had attained only 46 percent of their mature weight and 71 to 86 percent of their mature size, as indicated by body measurements. This indicates that linear measurements taken at earlier ages may be a means of more accurately predicting mature size and shape than is possible using only weight and gain. Guilbert and Gregory (1952) stated that body measurements are valuable in research and breeding as reference points to assess changes in size and type.

Tallis et al. (1959) suggested that length, height and circumference at the naval are valuable measurements for describing type in cattle and proclaimed that weight-height or weight-length ratios are better carcass indexes for breeding cattle than are single measurements.

Yao et al. (1953) reported that length and height are

skeletal measures of overall size while width, chest depth, paunch girth and heart girth are measures of fleshiness. Tallis et al. (1959) reported no significant difference in the amount of independent variations explained by depth of chest, width of chest and heart girth.

Brown et al. (1972) conducted a study in which they applied a technique called principal-component analysis using linear body measurements and weight. The analysis was applied to data from 267 Hereford and 283 Angus Bulls at the Arkansas Experiment Station. The body measurements recorded were wither height, hip height, shoulder width, pelvic width, loin width, foregirth body depth, flank depth, heart girth and body length from point of shoulder to pins as well as weight at 4, 8 and 12 months of age. Five principal components were used to describe body shape. Component one (PC1) at each of the ages provided an index of size, with nearly equal emphasis on all 10 standardized traits, and, thus, accounted for 56 to 68 percent of the variation. The second component (PC2) contrasted tall, narrow, bulls with short, wide ones and accounted for more than 10 percent of the variation in the total system of variation. Together, nearly 75 percent of the variation in the system was accounted for by these 2 components. It was found that the consistency of importance of shape contrast provided by component two at 4, 8 and 12 months of age indicated that tall, narrow-bodied and short, wide-bodied represent two basic shapes of cattle at pre-yearling ages. The correlations of PC2 values at all ages suggested that bulls

of these two body shapes remained relatively unchanged throughout the age range. The genetic and phenotypic correlations indicated that when equal weighing was given to each of the ten size measures, bulls selected at one age on this single composite value could be different in shape in later ages. Thus, it seems that unrestricted selection based on a composite character, such as weight, size or gain would produce animals of variable dimensions or shape. Contrasting body shapes in which relationships among body dimensions were not always positive explained approximately 40 percent of the variation in the covariance structure of the ten body measurements. As a result, extreme length was offset by decreases in depth and height. Extreme height was accompanied by a decrease in width, and width was frequently attained by sacrifices in depth of body. If an optimal size exists, such compensatory effects are logical. The estimates of heritability of size and shape at different ages in Hereford and Angus bulls obtained by Brown et al. are presented in Table 1.

Table 1. Estimates of heritability of principal components (PC)

BREED	PC No.	Description	Age in Mos.		
			4	8	12
Angus	1	Size	.40	.22	1.00
	2	Shape	.75	.29	.65
Hereford	1	Size	.54	.39	.42
	2	Shape	.38	.45	.33

The use of linear measurements in heifers also must be

considered. Dellmeier et al. (1979) conducted a study on 514 Polled Hereford and 1129 Angus heifer calves to determine if weaning body measurements could be utilized in the selection of replacement females at weaning. Six linear body measurements as well as body weight were used in the total analysis. Three weaning variables were used: S-ratio (S for shape, ratio of body volume to hip height), body volume and heart girth. These variables were determined to have values for predicting yearling weight of 92%, 91%, and 89% respectively, relative to the predictive value of weaning weight for predicting yearling weight. Tests for similarities of corresponding correlations showed homogeneity of gross correlations and pooled within -breed- and- year correlations. Also, homogeneous were the separate correlations calculated from the Polled Hereford and Angus data. Thus, all correlations could be used with equal validity for inferences concerning biological relationships. Furthermore, the gross correlations should be more reliable estimates because they were based on more degrees of freedom. For selection purposes, it is more important to rank the animals as accurately as possible with respect to yearling weight than to predict precisely the yearling weight of each animal. Rank correlations are simply correlations between animals' rank with respect to weaning measurements and their rank with respect to yearling weight. Coefficients of rank correlations of weaning weight, weaning S-ratio, weaning volume and weaning heart girth with yearling weight were:

Weaning Variable	r
Weight	.83
S-Ratio	.75
Volume	.74
Heart Girth	.73

The three weaning variables appear to be almost identical in value for predicting yearling weight and are nearly as valuable as is weaning weight.

Specific Selection

The primary goal in a selection program should be to improve genetic merit of the individuals. Terrill and Lush (1951) reported at a symposium during the 1949 meetings of the American Society of Animal Production information on the economically important traits of sheep. In his study, during the period of 1938 to 1948, Terrill considered the amount of selection practiced and the gains made from selection for certain traits of economic importance in a flock of range Rambouillet sheep. He wanted to determine if selection had been effective in producing genetic improvement in each of the various traits and in overall merit. Terrill found that selection differentials were nearly all positive. Selection differentials for sires generally increased from 1943 to 1948 for staple length, type, face covering, and weanling index, and this was partly due to increased accuracy of selection and decreased generation length for sires. The expected genetic progress,

which is obtained by multiplying selection differential by heritability, generally increased for the lamb crops from 1946 to 1948.

Terrill and Lush (1951) reported that, too often, researchers expect mass selection to cause the mean of the population to increase in each generation by an amount equivalent to the products of the selection differential and the heritability. However, many populations do not actually change this rapidly, and this may be due to several important factors. First, heritability may not be as high as estimated. Second, selection may not have been as intense as it was believed to be. Third, the rate of progress actually is substantially as much as it ordinarily would be. It is highly important that careful measurements of the traits be taken. More work is needed to understand specific selection better, as, until 1951, attempts to measure intensity of the selection actually practiced in whole herds have been few.

Single-trait selection is highly important for animal research due to the limited amount of work that has been done. When selecting for specific traits that are economically important to both the commercial as well as to the purebred producer, one needs to be certain he is making the right decisions. These decisions must be based on practical applied research that facilitates the economic well-being of the cattle industry. Should we be selecting specifically for yearling weight or maternal milk production or a combination of the two? Bourdon (1988) reported that

enough information is still not known to be selecting for extremes and that producers need to take the "middle path" approach in selection. He felt that to make rapid genetic changes, the producers need to be ready at any time to alter their system to adjust to sudden changes in the industry.

Cow Efficiency

In today's beef cattle industry, cattle size is becoming progressively larger. The question that needs to be addressed is "How big is too big". Changes in show-ring standard must take place in the immediate future if they are to be useful in selection of breeding animals. Those producers who continue prospering and thriving in the cattle business will be those whose cattle are most efficient in converting feed into gain. The efficiency we strive for is 50 percent or above, i.e., a calf's adjusted 205-day weaning weight must be 50 percent of its dams actual weight at weaning. Cow efficiency can be used as an indicator of cow producing ability, especially in herds with cows of different frame sizes. Calculations such as these remove some of the effect of different growth potentials in herds of various frame sizes. Klosterman and Parker (1976) suggested that the greatest immediate improvement in efficiency of the total beef industry would be realized by matching different types of cattle with rations or feeding systems to which they are best suited. When cattle of different types are fed for similar periods of time or to

similar weights, there are large differences among them in rate of gain, efficiency of gain and carcass composition. Their results illustrate the importance of using relative gain rather than absolute gain as an indicator of efficiency when comparing cattle of different types. This is the reason for the higher expectations for the exotic breeds, such as Chianina, Charolais, Simmental, etc. With use of exotic bulls, one should expect 50 pounds heavier weaning weight.

Klosterman and Parker (1976) observed that early maturing cattle consumed more feed per unit of body weight than later maturing types. Heifers daily consume more feed per unit of body weight and mature earlier than do steers or bulls, and small types eat more per unit of weight and finish quicker than do larger types. Cattle that produce the greatest carcass weight of the desired grade at the youngest age will be the most efficient cattle.

Garrett et al. (1959) found that maintenance requirements of fat cows per unit of metabolic size were lower than those of thin cows, and an accurate estimate of maintenance should consider differences in condition. Adequate energy supply is a primary consideration in the feeding of any animal. The partial efficiency of feed utilization was found to be independent of body size. Therefore, one relationship between energy intake and energy gain would express the energy requirement of sheep and cattle. One must believe that differences in maintenance requirements which may exist among sizes, breeds and sexes

of cattle are relatively small and that these may be related to physiological age or body composition.

Carcass Composition

The primary concern of the beef cattle industry is to produce a product that is acceptable to and desired by the consumer. A major consideration that the producer must emphasize in order to achieve packer acceptability is that the size of the carcass must "fit the box." Ideal size can, in general, be defined as the largest that will under practical production conditions attain the desired carcass composition at the weight and age demanded by the market." Our whole purpose is to produce a steer or heifer that will have a yield grade between 2 and 3 and a quality grade of Choice. The first beef grading standards were formulated in 1916, and many amendments and changes have been adopted to meet the changing demands (Boggs and Merkel, 1982). In 1925, tentative standards for the marketing of cattle were published. The official standards were amended in 1939 to allow a single standard for the grading and labeling of steer, heifer and cow beef. Later, in 1950, another amendment combined the standards for grades of slaughter steers, heifers and cows into a single standard and set up minimum requirements for each grade. In 1966, another change resulted in the reduction of marbling requirements for Prime, Choice, Good, (Select) and Standard. Also, at this time, the yield grade system was adopted to identify carcasses on the basis of their cutability. The yield

grades were numbered 1 through 5 with 1 representing the highest yield of boneless, closely trimmed retail cuts from the round, loin, rib and chuck, and 5 the lowest yield. The quality grade is a composite evaluation of factors that affect the palatability of meat, i.e., tenderness, juiciness and flavor. Beef carcass quality grade is based upon degree of marbling and degree of maturity.

Through much research, scientists have determined that there are correlations between carcass grade and linear measurements on the live animal. Cook et al. (1951) and Ternan et al. (1959) found significant relationships between linear body measurements and feeder grade, slaughter grade, and carcass quality. Black et al. (1938) reported a negative correlation of -0.74 between carcass grade and body length at slaughter. Yao et al. (1953) and Brown et al. (1956) also reported negative correlations for carcass grade and body length. Black et al. (1938) found also that ratio of body weight to wither height was positively correlated ($r = 0.84$) with slaughter grade. Lush (1928) found that heart girth-to-wither height ratio was positively correlated ($r = 0.56$) with estimated fatness.

Ultimately, we need to determine if single trait selection will or will not improve carcass composition. If selecting for specific traits reduces the quality of the carcass, and, in turn, leads to consumer disapproval, all of the selection is in vain. If, in fact, we see improvement in carcass quality or for that matter, very little change in the carcass, and still learn more efficient ways to produce

beef, our research would be extremely beneficial for today's beef cattle industry.

CHAPTER III

MATERIALS AND METHODS

Experimental Data

Data for this project were collected from progeny of 120 Plateau Experiment Station (PES) Angus and 90 Tobacco Experiment Station (TES) Polled Hereford females over a five-year period. These data were analyzed to evaluate differences in linear measurements when selecting for single traits. The Angus cows were randomly divided into four different groups designated as (1) control (no selection), (2) selection for maternal milk production (maternal), (3) selected for yearling weight, and (4) selection for both milk production and yearling weight (composite). Because of smaller numbers of available cows, the Polled Herefords were separated into only three groups, designated as (1) control, (2) maternal, and (3) yearling weight. Names of the non-control groups were based on the selection trait for that group. Because artificial insemination was used, cattle of different "groups" were co-mingled with all cows on each station for the deliberate reduction of environmental differences between the animals to be compared.

Data collected from the calves included birth weight, weaning weight, hip height, heart girth, body length, hip width, estimated fat thickness, yearling weight, yearling height, and yearling fat thickness. Data obtained from the cows were weight, hip height, and estimated fat thickness.

Cows were bred in April, May, and June to calve in January, February, and March of each year. All females were diagnosed as to pregnancy status in the fall and sold if not pregnant. Replacement females were expected to calve by twenty-four months of age; however, if they performed well but lost a calf for some reason other than poor mothering ability, they were given a second opportunity to prove themselves.

All cattle were managed with respect to nutrition as a typical commercial cattle operation in Tennessee with fescue pasture as the predominant forage source. After the calves were weaned, cows were pastured as long as adequate pasture was available. Wintering and growing rations consisted of hay and corn silage supplemented with energy and protein sources. Heifer calves were developed on a high quality corn silage ration so that they might express their genetic potential for skeletal and muscle growth and to attain ample size to be bred at fifteen months of age. Selected bull calves were tested for 140 days on a moderately high-energy ration so that they might express their genetic potential for growth. The largest steer calves were wintered on silage, backgrounded on rye grass pasture in the spring, and fed for 100 days on a high-energy finishing ration. The smallest steer calves also were wintered on silage, grazed spring and summer on fescue-clover pasture and then fed. When were slaughtered, carcass quality and quantity parameters were determined.

Cow Size and Efficiency

Cow weights were taken in both the PES and the TES herds at weaning. From 1985 to 1989, hip height and estimated fat thickness were recorded and, thus, were considered when evaluating progeny in those years. As previously mentioned, cow size is indicative of producing ability. The formula for calculating overall cow efficiency, EFFIC, is listed below. (BIF, 1986)

$$\text{EFFICIENCY} = \frac{\text{Adjusted 205-day weight of calf}}{\text{Actual cow weight at weaning of calf}} \times 100$$

Statistical Analysis

Statistical analysis was performed on data from cows and calves possessing complete performance records. When cows with incomplete calving data were eliminated, the total number of cows was reduced to 196 cows (both Angus and Polled Herefords) which produced 913 calves during the five year of the study. A major loss occurred in 1986 in which 18 calves died in each herd. Correlations involving data from both live animals and carcasses were calculated from the values in the error line of analyses of all variables collected during the course of the study according to SAS (1985). Thus, the correlations calculated are "within" correlations.

The model used contained as classification variables, year, breed, and group. The dependent variables were birth weight (BWT), weaning height (WNHT), weaning girth (WNGRT),

weaning length (WNLEN), weaning width (WNWID), estimated fat thickness (ESTFAT), group (GRP), adjusted 205-day weight (ADG205), adjusted 550-day weight (ADG550), and in some circumstances, adjusted 365-day weight (ADJ365). Maternal milk production was indicated by the weaning weight of the calf.

The formulas (from BIF 1986) used for calculation of ADJ205, ADJ365, and ADJ550 day weights are listed below:

$$\text{ADJ205} = [(\text{Actual weaning wt.} - \text{birth wt.}) / \text{Age in days at weaning}] (205) + \text{Age-of-dam and sex-of-calf adjustments} + \text{Birth weight of calf}$$

$$\text{ADJ365} = [(\text{Actual final wt.} - \text{actual weaning wt.}) / \text{Days between weights}] (160) + \text{ADJ205}$$

$$\text{ADJ550} = [(\text{Actual final wt.} - \text{actual weaning wt.}) / \text{Days between weights}] (345) + \text{ADJ205}$$

The carcass variables were hot carcass weight (HOTCWT), marbling (MARB), quality grade (QG), fat thickness (FAT), rib-eye-area (REA), percentage kidney, pelvic, and heart fat (KPH), maturity (MAT), yield grade (YG), and percentage cutability (CUT).

The formulas (USDA, 1976) for calculating yield grade and percentage cutability (% boneless, closely-trimmed retail cuts) are listed below:

$$\text{YG} = 2.5 + [(2.5) (\text{Adj. fat thickness, 12th rib}) + (0.2) (\% \text{KPH}) + (0.0038) (\text{hot carc. wt., lbs}) - (0.32) (\text{REA, sq. in.})]$$

$$\begin{aligned}\% \text{ Cutability} &= 51.34 - [(5.78 \times \text{Adj. fat thickness, 12th} \\ &\quad \text{rib}) \\ &\quad - (0.0093) (\text{hot carc. wt., lbs}) \\ &\quad - (0.462) (\% \text{KPH}) \\ &\quad + (0.74) (\text{REA, sq.in.})]\end{aligned}$$

CHAPTER IV

RESULTS AND DISCUSSION

Because the data for this study came from two separate groups of cattle, from the standpoint of physical location, management skills, and measured traits, it was necessary to analyze the data from each herd separately and within each year. The differences are pointed out in the Tables 2-5, which give least square means, and standard deviations calculated from both Angus and Polled Hereford data, respectively, and Tables 6 and 7, which give correlation coefficients calculated from data from each herd. Johnson (1958) defines a genetic correlation as a measure of the correlation between the genetic influences affecting two different traits in the same individual.

The results in each of the analyses and the discussion of them constitute an attempt to present findings regarding the contribution of measures of hip height and ADJ205 to define calf size more accurately. In addition, inferences are drawn as to the possible usefulness of using either yearling weight, maternal milk production, or both for assessing the effectiveness of different kinds of selection.

Cow Efficiency

For today's cattleman, it is highly important to maximize overall efficiency by optimizing cow size and calf production. In the analysis, it was found that ADJ205 calf

Table 2. Least-squares means and standard deviations of selected traits of the 1985 Angus progeny.

	Group 1		Group 2		Group 3		Group 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	70.2	8.0	72.1	7.3	75.3	8.1	74.2	6.1
ADJ205 (lb)	468.2	60.2	455.1	69.2	508.4	79.3	477.1	74.2
WNHT (in)	41.1	4.0	41.4	3.9	42.5	3.8	41.5	2.9
WNGRT (in)	55.9	2.2	56.7	3.1	56.3	4.1	56.4	3.2
WNWID (in)	11.3	1.4	12.4	2.2	12.7	2.3	12.5	2.4
WNLEN (in)	39.0	2.0	38.6	4.3	39.6	3.2	39.3	3.4
ESTFAT (mm)	2.7	.7	2.7	1.3	1.9	2.1	2.4	2.1
ADJ550 (lb)	589.2	56.1	602.2	72.3	604.3	66.4	607.5	49.9
YRHT (in)	43.1	.6	43.9	.9	44.1	1.1	44.0	.8
YRFAT (mm)	5.2	.7	5.3	.8	5.0	1.2	4.6	1.1

Table 3. Least-squares means and standard deviations of selected traits of the 1989 Angus progeny

	Group 1		Group 2		Group 3		Group 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	72.4	7.1	73.6	8.2	78.9	10.4	76.5	8.2
ADJ205 (lb)	500.4	62.4	538.2	69.4	550.7	78.4	551.4	71.5
WNHT (in)	41.4	3.6	41.5	4.2	42.4	5.7	42.8	4.3
WNGRT (in)	56.4	6.4	56.5	4.6	56.2	6.3	57.2	5.1
WNWID (in)	11.5	1.2	12.6	2.4	12.8	2.2	12.9	1.4
WNLEN (in)	40.8	4.3	41.5	4.5	41.9	6.3	42.1	5.8
ESTFAT (mm)	2.8	1.6	2.9	1.4	2.3	1.2	2.5	1.3
ADJ365 (lb)	603.5	74.1	627.4	46.5	641.2	79.6	640.4	66.8
YRHT (in)	44.0	2.3	45.1	2.6	45.2	2.5	46.1	2.3
YRFAT (mm)	5.4	.9	5.6	1.2	5.0	1.1	4.8	.9

Table 4. Least-squares means and standard deviations of selected traits of the 1985 Polled Hereford progeny.

	Group 1		Group 2		Group 3	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	72.6	9.2	74.8	10.3	76.9	11.3
ADJ205 (lb)	396.4	52.1	403.2	59.34	407.1	60.2
WNHT (in)	39.1	2.3	40.2	2.6	41.2	3.4
WNGRT (in)	57.4	3.4	56.8	3.6	58.1	3.2
WNWID (in)	10.9	1.1	11.1	.9	11.2	.8
WNLEN (in)	37.8	2.4	38.2	1.9	38.8	1.6
ESTFAT (mm)	3.1	1.1	3.2	1.4	2.9	.6
ADJ365 (lb)	459.1	58.3	476.6	60.3	479.1	57.8

Table 5. Least-squares means and standard deviations of selected traits of the 1989 Polled Hereford progeny.

	Group 1		Group 2		Group 3	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	74.2	12.3	76.4	10.2	78.1	9.3
ADJ205 (lb)	402.1	56.6	406.3	60.8	415.4	63.9
WNHT (in)	40.1	1.3	41.3	2.4	42.2	1.9
WNGRT (in)	57.9	2.8	56.9	3.1	57.4	2.8
WNWID (in)	11.3	1.2	11.8	1.3	12.0	1.6
WNLEN (in)	38.1	2.2	39.1	2.6	39.9	1.8
ESTFAT (mm)	3.4	1.2	3.6	1.6	3.0	1.3
ADJ365 (lb)	486.2	60.4	476.2	55.2	480.1	59.9
YRHT (in)	42.0	2.1	43.2	2.4	42.5	2.7
YRFAT (mm)	5.0	.4	5.3	.5	5.1	.8

Table 6. Coefficients of correlation (r) and probability (P) of a greater value under the hypothesis that the population correlation is zero (pooled Angus data).

	BWT	WNWT	WNHT	WNGRT	WNLEN	WNWID	ESTFAT	GRP	ADJ205	ADJ550FT
BWT	r 1.00	0.48	0.34	0.32	0.23	0.23	-0.09	0.13	0.49	0.47
	P 0.00	a	0.01	0.01	0.09	0.10	0.50	0.35	a	0.01
WNWT	r	1.00	0.59	0.82	0.67	0.60	0.08	0.08	0.79	0.77
	P	0.00	a	a	a	a	0.56	0.54	a	a
WNHT	r		1.00	0.58	0.61	0.42	-0.07	0.10	0.57	0.53
	P		0.00	a	a	a	0.61	0.45	a	a
WNGRT	r			1.00	0.54	0.63	0.30	0.04	0.56	0.50
	P			0.00	a	a	0.48	0.76	a	a
WNLEN	r				1.00	0.50	-0.09	0.10	0.07	0.09
	P				0.00	a	0.48	0.43	a	0.00
WNWID	r					1.00	0.41	0.00	0.40	0.33
	P					0.00	a	0.99	a	0.01
ESTFAT	r						1.00	-0.17	-0.14	-0.21
	P						0.00	0.21	0.30	0.13
GRP	r							1.00	0.09	0.13
	P							0.00	0.51	0.36
ADJ205	r								1.00	0.97
	P								0.00	a
ADJ550	r									1.00
	P									0.00

a. P is near zero

Table 7. Coefficients of correlation (r) and probability (P) of a greater value under the hypothesis that the population correlation is zero (pooled Polled Hereford data).

	BWT	WNWT	WNHT	WNGRT	WNLEN	WNWID	ESTFAT	GRP	ADJ205	ADJ365
BWT	r	1.00	0.35	0.42	0.24	0.30	0.09	0.11	0.39	0.35
	P	0.00	a	0.02	0.03	a	0.43	0.32	a	0.11
WNWT	r		1.00	0.56	0.55	0.57	0.30	0.09	0.82	0.39
	P		0.00	a	a	a	a	0.51	a	0.07
WNHT	r			1.00	0.63	0.36	-0.01	0.09	0.55	0.50
	P			0.00	a	a	0.60	0.42	a	a
WNGRT	r				0.00	0.00	0.00	0.04	0.00	0.22
	P				0.00	0.00	0.00	0.69	0.00	0.21
WNLEN	r				1.00	0.50	0.12	0.10	0.28	0.02
	P				0.00	a	0.16	0.41	0.01	0.92
WNWID	r					1.00	a	0.02	0.23	0.20
	P					0.00	0.00	0.86	0.04	0.36
ESTFAT	r						1.00	-0.12	0.20	0.25
	P						0.00	0.20	0.08	0.25
GRP	r							1.00	0.12	0.10
	P							0.00	0.47	0.35
ADJ205	r								1.00	0.65
	P								0.00	a
ADJ365	r									1.00
	P									0.00

a. P is near zero

weaning weight, Table 8, was highly correlated with overall cow efficiency (.6) and the most efficient Angus group was the composite. Initially, due to random selection of the individuals for the project, there were very small differences among the groups. The means, Tables 9 and 10, indicate that the least efficient group was the maternal group in both herds, but group differences were small. Efficiency was defined as the ratio of adjusted 205-day weight of calf to cow weight at calf weaning. Table 8 shows that ADJ205 is highly correlated with efficiency in both herds. In the control group, there is a high correlation between efficiency and ADJ205, but when comparing ADJ205 in the control groups with groups two, three, and four, the ADJ205 is considerably higher. The maternal group and the yearling weight groups are similar, but efficiency is less in them than in the composite.

The Polled Hereford data gave similar results with increasing efficiency means; however, the control is slightly more efficient. The maternal group is the least efficient, but in all three groups, ADJ205 did not reach the level attained in the Angus herd. No complete comparison between the herds can be made because the Polled Hereford herd no composite group. No breed comparison is possible because of complete confounding of breed, location, and management regime. The PES is primarily concerned with forage and livestock production while the TES's primary emphasis is on tobacco and cattle are secondary. Fewer

Table 8. Coefficients of correlation (r) calculated from Angus and Polled Hereford data where the probability (P) is a greater value under the hypothesis that the population is zero.

Angus Data				
	COWWT	ADJ-205 WT	EFFIC.	
COWWT	r	1.00	0.04	-0.68
	P	0.00	0.82	a
ADJ205	r	1.00	1.00	0.64
	P	0.00	0.00	a
EFFIC	r			1.00
	P			0.00
Polled Hereford				
COWWT	r	1.00	0.03	-0.57
	P	0.00	0.86	a
ADJ205	r		1.00	0.61
	P		0.00	a
EFFIC	r			1.00
	P			a

a. P is near zero.

Table 9. Least-squares means and standard deviations both Angus and Polled Hereford 1985 data by group.

	Group 1		Group 2		Group 3		Group 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Angus								
COWWT (lb)	978.3	68.4	1001.3	59.4	1027.2	64.3	1018.1	58.3
ADJ205 (lb)	437.2	56.3	444.2	59.5	463.4	63.9	470.2	64.4
EFFIC (%)	45.3	7.9	44.1	8.3	45.1	7.3	46.3	6.7
Polled Hereford								
COWWT (lb)	965.2	66.3	987.3	56.2	1001.6	54.1	-	-
ADJ205 (lb)	396.2	56.3	401.2	59.5	403.4	64.9	-	-
EFFIC (%)	39.1	5.7	37.3	8.9	38.4	7.1	-	-

Table 10. Least-squares means and standard deviations both Angus and Polled Hereford 1989 data by group.

	Group 1		Group 2		Group 3		Group 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Angus Data								
COWWT (lb)	992.2	64.8	1031.1	69.2	1079.4	74.8	1067.3	78.1
ADJ205 (lb)	468.2	60.2	455.1	69.2	508.4	79.3	477.1	74.2
EFFIC (%)	48.3	7.4	45.7	8.9	49.2	6.8	50.3	7.9
Polled Hereford Data								
COWWT (lb)	987.1	86.2	1009.4	73.1	1013.6	64.4	-	-
ADJ205 (lb)	404.8	63.2	418.3	57.4	433.3	64.8	-	-
EFFIC (%)	39.5	5.2	38.2	9.4	39.3	8.1	-	-

Polled Hereford calves than Angus calves were produced by artificial insemination in 1989 (49 vs. 93). Hence, less genetic progress would be expected in the TES herd.

The least efficient group of cows, of course, consists of those that failed to calve or whose calves died early. In both herds, these cattle were fatter (PES, 12 mm; TES, 14 mm) and heavier PES, 1187; TES, 1202, thus requiring more forage. Cows open in the fall are culled. Cows that loose a calf at birth are generally given a second opportunity. One of the major problems in most commercial operations is lack of culling standards. Too often, a cow that does not conceive is given second, third, fourth, etc., chances, and not sold. Such cows are not efficient and are an economic burden.

Linear Measurements

When looking at the least-squares means of the various linear measurements, one can interpolate how these offspring will perform. Tables 5 and 6 display all correlations, and lists the probabilities. Some consideration must be taken since not all measurements were taken every year.

Birth weight is highly correlated with WNWT, WNHT, WNLEN, WNWID, ADJ205, and adjusted yearling weight (either ADJ365 or ADJ550). This was true in both herds. The heavier the birth weight, the heavier the calves were at weaning, and therefore they possessed larger skeletal size. This tended to be true in all groups except the control groups.

Weaning weight was highly correlated with WNHT, WNGRT, WNLEN, ADJ205, and yearling weight. This was especially true in the Angus data as changes between ADJ205 and ADJ550 (ADJ365 in 1989) were considerable. However, the ADJ365 in all of the Polled Hereford groups were rather small: 486.2 lb, 491.4 lb, 493.1 lb in groups 1, 2, and 3 respectively. This was the largest difference between the two herds as very little change between weaning and yearling weights occurred in the TES herd. The yearling weight group improved in weight as expected, but the PES composite group out-performed all groups and the ranking on ADJ205 of the other three groups in each herd was: yearling weight (2nd), maternal (3rd), and control (4th).

Estimated fat was least correlated with all other traits except in the maternal group. In this group in both herds, the calves consistently carried more condition. This is reasonable since selecting for maternal milk (weaning weight of calf), backfat tends to increase. This was especially true in the TES herd as the Polled Hereford cows tend to get too fat.

Also, the calves in the control group tended to be short-bodied, have large heart girths and generally be fatter and finish sooner than the longer-bodied, trimmer type of cattle of the other groups. The control group calves in both herds were typical of the type of cattle favored by selection in the past and are now being discounted. Cattle in the maternal groups and the control groups are types being discriminated against in the industry

because of the fatness of the carcass and the type of progeny produced. Both carcass information and subsequent generations will be discussed later. Individual producers must become more aware of the industry situation when making decisions as to selection programs.

Individual Groups

A. Group One

Results of the analyses of these data at both locations conformed closely to expectations. Very little improvement occurred between the years of 1985 and 1989. The matings were planned so that comparisons could be made of the changes produced in the control, maternal, yearling weight, and composite groups. There was only slight improvement in ADJ205 in the Angus herd and non-significant change in the Polled Hereford herds. The experiment was designed to utilize the control group as a simulation of most commercial type of cattle in the beef industry today. Carcass data from the control group shows that control cattle had shorter, smaller carcasses with more external fat. The least squares means for yield grade was 2.9 (std. dev. = .4) and average quality grade was 12.9 (choice). Table 11 contains combined information from both herds.

B. Group Two

Selection in these groups was based on dam's milk production as indicated by weaning weight of calf in both the PES herd and the TES. Tables 1-4 show that progress

Table 11. Least-squares means and standard deviations of carcass variables of 1988 steers.

	Group 1		Group 2		Group 3		Group 4 (PES only)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
HOTCWT(1b)	633.5	87.2	633.9	74.3	638.7	86.5	681.0	51.3
MARB ^a	18.1	1.4	18.7	3.2	18.4	3.7	18.2	1.9
QG	12.9	2.7	13.0	2.3	11.9	1.7	11.8	.4
FAT (mm)	11.4	2.2	13.9	3.1	11.1	1.2	12.6	2.3
REA (sq in)	11.4	1.9	11.6	2.1	11.8	1.8	12.2	2.2
KPH (%)	1.8	.9	2.0	.6	1.9	.8	1.8	.9
MAT ^b	13.1	1.4	13.2	1.5	13.6	2.1	13.8	2.3
YG ^c	2.9	.4	3.0	.3	2.6	.2	2.8	.3
CUT (%)	50.4	2.2	49.6	1.7	50.6	.9	50.2	1.5

^aSmall minus = 18, Small average = 19.

^bA plus maturity = 13, A average maturity = 14.

^cGood plus = 11, Choice minus = 12, Choice average = 13, Choice plus = 14.

appears to have been made with respect to ADJ205. Again, more improvement appears have been made in the PES herd than in the TES herd. The mean in the PES herd was 538 lb with a standard deviation of 69 lb, and in the TES herd was 410 lb with a standard deviation of 60 lb. The means of estimated fat were 2.9 mm in the PES herd and 3.6 mm in the TES herd. Selection groups were slightly fatter as compared to their respective control groups. This is the major problem in selecting solely for calf weaning weight, namely, that offspring tend to be fatter and produce carcasses with more fat trim. The heritability of maternal milk production is substantial (.42) and must be remembered when selecting replacement females solely on the basis of dam's milk production (as indicated by calf weaning weight). In the carcass information, a yield grade of 3.0 and a quality grade of choice (13.0) was calculated from data from this group. Once again, fatter, wastier carcasses are undesirable in today's society, and this information further justifies not selecting only for maternal milk production. Of course, in certain special situations, one might reasonably justify selecting replacement females on this basis, but in beef cattle, in general, selection for only one trait is probably economically impractical.

C. Group Three

Yearling weight is an extremely important trait that all producers must consider. Within this group in each herd at both locations, improvement in growth appears to have

been made as expected. However, it is not valid to compare yearling weight of heifers across herds since there is considerable difference besides breed differences between the PES and the TES herd (Tables 2 and 4). The mean ADJ365 in the PES herd was 641 lb with a standard deviation of 79 lb and the ADJ365 in the TES herd was 491 lb with a standard deviation of 55 lb. Similar estimated fat measurements were found, but there were slight differences in hip height and body length. Similar results were obtained with respect to yield grade and quality grade in the two herds. It appears that selecting for yearling weight is more likely to result in the type of cattle the industry needs than is no selection or selection based on maternal ability alone. Selecting for yearling weight alone might ultimately result in "too large" cattle being selected for tomorrow's "reduced-size" industry. Selecting solely for this trait might sometimes involve detrimental neglect of other important traits. The desirability of selecting for yearling weight alone is uncertain; however, in both herds improvement in weaning weight was realized. The ranking of the groups with respect to carcass traits is similar to that with respect to live-animal variables.

D. Group Four

This group combines selection for yearling weight with selection for maternal milk production. It is unfortunate that because of the small number of available females in the TES herd, this group could not be included. In the PES herd

there was an ADJ205 mean of 551 lb and a standard deviation of 71 lb. The ADJ365 mean was 640 lb and a standard deviation of 66 lb. There was greater improvement in this group as compared to the control, maternal, and the yearling weight groups. From Table 5, as expected, the correlation between ADJ205 and ADJ550, a part whole correlation, is high (.97). The least-squares mean of hip height in the yearling weight group was 46.1 in. with a standard deviation of 2 in., which again was very similar to the values in the yearling weight group and the maternal group. The carcass information indicates that this group produced carcasses, having a least-squares mean yield grade of 2.8 with a standard deviation of .3 and quality grade 11.8 (high select). These figures indicate that selection should be based on more than one trait in beef cattle production. For today's beef cattle industry, a more "balanced" female should be selected in order to meet the demands of the industry. With females such as these, it is likely that more rapid changes can be made to stay abreast of trends which may shift in either direction toward the extremes. With this type of selection, a producer could make slight changes in his/her program in order to meet changing demands of the consumer. Hohenboken (1988) suggested that tomorrow's beef cow must be above average in all traits subjected to selection, efficiently maintained, and no longer a result of extreme selection.

Initial Generation

In the data from this study, changes from the offspring of the initial randomly taken females can be seen. Overall, similar results were obtained (Tables 12 and 13) with only slight improvements in the control groups and continual genetic improvement in the other groups. The use of bulls each year which are superior with respect to each specific trait was effective in bringing about improvement. In 1989, the heifers selected in the composite group (1987) continued to excel in that there was a 10-lb improvement in weaning weight, and a 15-lb improvement in yearling weight, and a .2 mm improvement in estimate of yearling fat. Within the yearling weight group, there was an 8-lb improvement in ADJ365 in the PES herd and a 4 lb improvement in the TES herd. Within the maternal group, there was a 6-lb improvement and a 3 lb improvement in ADJ205 and ADJ365, respectively. Examination of the means shows that there is considerable change within the TES herd. Koger et al. (1979) stated that genetic adaptability to local environmental conditions is of paramount importance in beef cattle production and that measurable improvement in genetic adaptation to new environmental situations can be achieved through appropriate selection and culling.

Table 12. Least-squares means and standard deviations of variables recorded from progeny of cows providing the data presented in Table 2 (Angus herd).

	Group 1		Group 2		Group 3		Group 4	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	72.4	8.7	74.3	7.7	77.5	9.2	76.1	7.6
ADJ205 (lb)	503.2	62.6	544.1	59.3	560.2	69.5	561.4	74.7
WNHT (in)	41.91	4.7	42.5	3.7	42.8	4.3	43.0	3.9
WNGRT (in)	56.5	2.9	57.4	3.6	58.2	4.3	57.8	3.5
WNWID (in)	11.9	1.6	12.6	2.1	13.0	2.8	12.9	2.2
WNLEN (in)	40.1	2.5	41.5	4.1	42.8	3.9	43.5	3.3
EST.FAT (mm)	2.9	.6	3.0	1.5	2.1	1.8	2.5	2.1
ADJ550 (lb)	607.2	57.6	630.2	71.5	649.4	69.5	655.6	52.9
YRHT (in)	43.9	.8	44.5	1.5	44.9	1.6	45.0	1.2
YRFAT (mm)	5.7	.9	6.1	.8	5.2	1.1	4.6	.9

Table 13. Least-squares means and standard deviations of variables recorded from progeny of cows providing the data presented in Table 4 (Polled Hereford).

	Group 1		Group 2		Group 3	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
BWT (lb)	73.5	9.4	75.8	11.0	77.9	10.1
ADJ205 (lb)	402.5	51.2	409.2	49.4	414.1	57.0
WNHT (in)	39.9	2.5	41.2	2.3	42.1	3.1
WNGRT (in)	57.5	3.0	55.8	3.9	58.9	3.0
WNWID (in)	11.2	1.7	12.0	1.2	12.3	.9
WNLEN (in)	38.5	2.2	39.3	2.0	40.1	1.6
ESTFAT (mm)	3.5	1.2	3.7	1.1	3.0	.9
ADJ365 (lb)	462.1	56.8	480.7	62.0	482.1	54.7

Carcass Characteristics

In only one year was carcass information recorded. Table 7 lists the means obtained from data from each group. Producers need to be more conscious of the changes that occur once a weaned calf is sold because regardless of the selection program, the end product must be a carcass that is acceptable to the consumer. From the data analysis, the composite group from the Angus herd yielded a least-squares mean yield grade of 2.8 and a mean quality grade of 11.8 (high Select). The analysis of carcass data included data from both the PES and the TES herds; hence, the analysis is across herds because all steer calves were maintained at the same location after weaning and grazed and finished together. Table 14 lists the correlations of the traits measured. Yield grade is highly correlated with FAT, KPH, REA, and HOTCWT. This is quite reasonable in view of the fact that fat is the key factor determining yield grade. Quality grade is highly correlated with marbling (.7). The factors which are highly correlated for cutability are YG (-.99), FAT (-.88), KPH (-.69), and MAT (-.54) .

Table 14. Coefficients of correlation (r) and probability (P) of a greater value under the hypothesis that the population correlation is zero (PES and TES steers).

		HOTCWT	MARB	QG	FAT	REA	KPH	MAT	YG	CUT
HOTCWT	r	1.00	0.12	0.22	0.05	0.64	0.23	0.03	0.11	-0.13
	P	0.00	0.67	0.43	0.86	0.01	0.42	0.93	0.70	0.64
MARB	r		1.00	0.70	0.05	0.02	0.06	-0.30	0.09	-0.08
	P		0.00	a	0.85	0.93	0.84	0.28	0.76	0.77
QG	r			1.00	-0.06	0.35	-0.01	-0.12	-0.17	0.17
	P			0.00	0.84	0.21	0.96	0.66	0.57	0.56
FAT	r				1.00	0.04	0.78	0.69	0.89	-0.88
	P				0.00	0.87	a	0.01	a	a
REA	r					1.00	0.30	0.17	-0.24	0.25
	P					0.00	0.30	0.56	0.41	0.38
KPH	r						1.00	0.68	0.72	-0.69
	P						0.00	a	a	a
MAT	r							1.00	0.55	-0.54
	P							0.00	0.04	0.05
YG	r								1.00	-0.99
	P								0.00	a
CUT	r									1.00
	P									0.00

a. P is near zero.

CHAPTER V

SUMMARY

The selection practiced in the beef industry lacks uniformity because breeders are unaware of the potential effects on lifetime productivity when certain traits are emphasized in a selection program. This study involved data collected from 120 Angus and 90 Polled Hereford cows and their progeny (913 calves) over a five year period (1985 to 1989). Data were obtained from the calves at weaning, cows at weaning of calf, calves at a year of age, and from the 1988 calves at slaughter. These data were analyzed, and correlations involving both live-animal and carcass variables were calculated from the error line in an analysis conducted according to SAS (1985). The initial Angus cows were randomly divided into groups: control group in which no selection would be practiced, a group in which increased maternal milk production would be favored by selection (referred to as the "maternal" group), a group in which increased yearling weight would be favored by selection (referred to as the "yearling weight" group), and a group in which both of these criteria of selection would be used (referred to as the "composite" group). The Polled Herefords, because of a smaller number of available cows, were divided into only three groups: control, maternal, yearling weight. Inferences were drawn as to the possible relative effectiveness of using either of these traits or a

combination of them as the basis for selection. Changes in cow efficiency, defined as the ratio of adjusted 205-day weight of calf to actual cow weight at weaning of calf, in these selection systems were compared.

Upon visual evaluation of the means, it was apparent that the most efficient 1989 Angus group was the composite (50.3%). The most efficient 1989 Polled Hereford group was the control (39.5%). No complete comparison between the herds can be made due to absence of a composite group in the Polled Herefords. In both herds, the least efficient group was the maternal (45.7%, Angus and 38.2%, Polled Hereford). Trends toward improved cow efficiency were observed in the Angus herd between 1985 and 1989. Cows that failed to calve were the least efficient and in both herds, were fatter and heavier at time of calf weaning. In visually evaluating the mean adjusted 205-day weight, mean adjusted 365-day, and mean adjusted 550-day weight, there appeared to be some improvement between 1985 and 1989 in the Angus herd and less improvement in the Polled Hereford herd. One major problem when selecting solely for maternal milk production is that heifers tend to become too fat. There was an increase of .2 mm backfat in the Angus herd and .4 mm in the Polled Hereford herd. Carcass data from 1988 steers were analyzed, and the mean yield grade and quality grade of carcasses from the Angus composite group were 2.8 and high Select (11.8), respectively. The analysis of the carcass data was across herds. Yield grade was correlated with fat thickness (.89) and %KPH (.72). Quality grade was correlated with marbling

(.7). Percentage cutability was correlated negatively with fat thickness (-.88) and yield grade (-.99).

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VITA

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