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Use of growth parameters of feeder steers to predict finishing performance

Teri L. Ingle

To the Graduate Council:

I am submitting herewith a thesis written by Teri L. Ingle entitled "Use of growth parameters of feeder steers to predict finishing performance." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Science.

J.C. Waller, Major Professor

We have read this thesis and recommend its acceptance:

J.B. McLaren, M.J. Riemann

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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Date May 31, 1988

USE OF GROWTH PARAMETERS OF FEEDER STEERS TO PREDICT FINISHING PERFORMANCE

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Teri L. Ingle

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This thesis is dedicated to the memory of K. D. (Buster) Ingle.

ABSTRACT

The objective of this experiment was to determine the feasibility of utilizing certain feeder calf characteristics to predict subsequent feedlot performance and carcass value. Data from 144 steers (72 Angus and 72 Angus-Hereford cross) in Trial I (1984-85) and 144 steers (same distribution of breeds) in Trial II (1985-86), purchased by an order buyer from East Tennessee and the surrounding area, formed the basis of this study. Animals were considered to be representative of the predominate breeds preferred by buyers of Tennessee feeder steers. Initial and final linear body measurements, subcutaneous fat thickness and weights were recorded for the growth phase in each Trial. Carcass traits and days on feed needed to reach 12 mm fat thickness were recorded for the finish phase of Trials I and II.

In Trial I, initial width ($P < .001$) and average daily gain during the growth phase ($P < .01$) significantly effected subsequent carcass value. These variables were therefore utilized to allot the steers on Trial II to feedlot pens. These allotment systems proved to be effective in predicting days on feed needed to reach optimal slaughter endpoint of 12 mm fat thickness ($P < .01$). However, no differences in the effectiveness of predicting days on feed were found between the two allotment systems.

The results of analysis of variance on the combined data set from Trials I and II indicated that an increase in final height, initial length, initial width and total weight gain during the growth phase significantly increased subsequent carcass value ($P < .001$). An

increase in final fat thickness at the end of the growth phase also increased carcass value ($P < .0001$). Neither initial height, final shoulder width, final length or initial fat thickness had any effect on carcass value.

An increase in initial and final fat thickness significantly decreased the number of days on feed needed to reach optimal slaughter endpoint ($P < .0001$). An increase in final shoulder width also decreased days on feed ($P < .01$). However, initial and final height, initial and final length, initial shoulder width and total weight gain during the growth phase had no significant effect on days on feed.

By grouping the animals in Trials I and II by net worth, it was determined that animals with higher linear body measurements and weight gains during the growth phase yielded higher carcass values due to the increase in carcass weight. The animals with lower linear body measurements and total weight gains during the growth phase required fewer average days on feed to reach optimal slaughter endpoint, however they yielded carcasses of lower values due to lower carcass weights.

Initial shoulder width and weight gains during the growth phase can be an accurate predictors of subsequent feedlot performance and carcass value. Initial length and final height may be utilized as predictors of carcass value, also, after further study.

Initial width and/or weight gain during the growth phase could be useful to the feedlot operator in predicting feedlot performance and carcass value of feeder steers of British breeds. Linear body measurements and weight gains might also be useful to the beef producer in selecting management techniques and marketing strategies to increase net revenue.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Beef feedlot operators obtain feeder calves from a variety of growing or backgrounding systems resulting in calves of various weights, size, shape and rate of maturing. Present slaughter cattle pricing systems favor slaughter groups which are relatively homogeneous in weight range and degree of fatness. Therefore, to achieve maximum net returns these animals should be allotted or penned so that they reach their optimal slaughter points at approximately the same number of days on feed, thus reducing the variance in carcass quality and yield.

Allotting animals to pens so that they reach their optimum slaughter points at similar days on feed could also increase the number of animals managed and fed in the feedlot. Selecting individual animals to go to slaughter often leaves feedlot pens occupied by only a few animals, as the operator waits for these animals to reach their optimum slaughter weight. This practice decreases the total number of animals managed by the feedlot during a given period, and thus decreases the maximum net revenues to the feedlot operator.

In past research feeder calf characteristics such as height, length, depth, width of shoulder, and average daily gain have been correlated with certain carcass characteristics, such as rib-eye area, marbling, yield grade, quality grade and dressing percentage. The relationships found between carcass characteristics and feeder calf characteristics could be used to develop prediction equations for use by feedlot managers in allotment of cattle to finish groups. Research is needed in this area to determine which feeder calf characteristics best predict the performance of steers on a finishing diet, and their net revenue returns to the producer.

The objectives of this study were:

1. To establish relationships among measurable characteristics of feeder calves, days on feed to reach common endpoint and carcass value.

2. To establish the feasibility of using prediction equations when allotting steers to feedlot pens to reduce the variance of slaughter groups.

CHAPTER II

REVIEW OF LITERATURE

1. PREDICTION OF FEEDER CALF PERFORMANCE

Researchers have studied many methods of predicting feeder calf performance in the feedlot. Much of this work has dealt with subjective evaluations of the feeder animal. Crouse et al. (1974) analyzed visual appraisal of 14 feeder calf traits as predictors of average daily gain and subsequent carcass characteristics. Although correlations among appraisers were high for most characteristics, no combination of feeder calf traits accurately estimated carcass quality grades.

Knapp and Clark (1951) found that score at weaning time is not an index of subsequent gains in the feedlot. Durham and Knox (1953) also found no correlation between initial feeder cattle grade and carcass grade. However, over the years beef cattle breeds have changed due to selection by producers for more efficient animals. A more recent analysis of data from a serial slaughter of 324 steers similar in age, but from twenty different breeds showed that feeder cattle frame-size score was a good indicator of differences in absolute growth rate and slaughter weight at a specified level of fatness (Tatum et al. 1986). Gilbert et al. (1982) found that the number of days on feed needed to reach a desired fat percentage increased as initial feeder cattle frame size increased.

In a study utilizing both subjective and objective measures of feeder cattle characteristics, Butts et al. (1980) determined that frame and fat scores were less effective in predicting carcass weight than were objective measurements of initial height, fat and body depth. McLemore and Butts (1982) simulated the feeding of a diverse group of 350 feeder cattle utilizing nine different allotment systems. Their simulation was based on a data set consisting of biweekly weight and ultrasonic fat measurements from the 350 feeder calf steers. These animals were fed either a traditional concentrate or silage and concentrate diet. The first allotment was by diet only. The 1964 USDA feeder cattle grades were utilized for the second allotment system. The 1979 USDA feeder cattle grades, based on frame size, muscle and fat thickness, were also utilized. Two different allotment systems using frame score and muscle thickness were developed, as were two different using frame score combined with fat thickness. Fat thickness was evaluated subjectively in one allotment system and measured ultrasonically in the second. A prediction equation developed to predict days on feed to reach 12 mm fat thickness was the basis for an allotment system. The final allotment system allowed individual animals to be fed and slaughtered at their optimum level of fat thickness with no grouping. The net revenue performance of allotment systems based on frame size, muscling, and fatness was found to be superior to no allotment at slaughter points above 12 mm fat level. However, the frame-fat system of grades was determined to be a more accurate predictor of days on feed required to reach optimum slaughter points.

There are several different methods of producing and marketing beef animals in the Southeast. These methods range from finishing cattle on all forage diets to the more conventional method of feeding high energy concentrate diets in the feedlot. Also, the producer may wish to sell his calves at weaning or retain ownership throughout the feedlot period.

Brown et al. (1987) evaluated three different management regimes to produce slaughter animals. The heaviest and fattest steers at weaning were selected for Regime I. These animals went directly to the feedlot and were fed a concentrate ration ad libitum for a 105 day period. The remaining steers were allotted to Regime II and Regime III, matching weights and breed composition. Regime II animals were placed on wheat and rye grass pasture for a 105 day period and were then placed on a 105 day feedlot ration. Regime III animals were also placed on wheat and rye grass pasture for 105 days. For the next 105 day period they were supplemented with hay and grain (while still on pasture), before being placed on the feedlot diet for the remaining 105 day period. Although Regime I produced the most economical carcasses, Regime II and Regime III were also found to be economically acceptable methods of producing slaughter animals.

The effects of breed type and management system on net revenue were studied by Dikeman et al. (1985). Angus-Hereford-cross steers and Simmental-sired crossbred steers were allotted to one of two production systems. The accelerated system consisted of a finishing phase only. The conventional system consisted of backgrounding and finishing phases. It was found that the larger Simmental-sired steers were fed more economically on the accelerated system due to their potential for rapid growth. However, the Angus-Hereford-cross steers did not have potential for rapid growth, and carcass weights were unacceptably light on the accelerated management system.

The ability to predict feeder calf performance could greatly enhance the producers ability to chose which marketing and management systems best fit his or her needs, as well as the capacity to increase net revenue to the feedlot operator.

2. LINEAR BODY MEASUREMENTS

The most common method of selecting and grouping feeder animals for the feedlot has been subjective evaluation. However, this method is subject to human error and prejudice on the part of the individual visual appraisers. A more accurate method of predicting future performance of feeder calves may be the use of actual body measurements taken on the animal. Buric (1966) stated that "linear measurements, used as a selection tool, will make the conformation of the beef animal a matter of record and will afford an opportunity to compare facts with impressions."

Accuracy and Repeatability

Numerous techniques for determining linear body measurements and the repeatability and accuracy associated with them have been studied. The techniques most commonly used include measurements obtained from photographs, actual measurements taken on the live animal or a combination of these techniques.

Twenty-five different body measurements on Jersey cows and yearling heifers were obtained by Lush and Copeland (1930). Close general agreement for repeatability in the two groups of cattle was reported, although the error was larger for larger animals. The error associated with obtaining the 25 measurements compares favorably with the error associated with live weighing where the standard error was found to be near 1% of the mean weight.

Touchberry and Lush (1950) measured wither height, chest depth, body length and paunch girth of Holstein cattle three times at each of the ages of 6 months, 1, 2, 3, 4, 5 and 7 years. It was concluded that a single measurement of each characteristic, with exception of body length, is accurate enough for use. Age had no significant effect on the adequacy of single measurements.

To determine the accuracy of live animal measurements compared with photographic measurements, Smith et al. (1950) analyzed the data taken from 10 cows, 10 calves and 23 yearlings. Photographic measurements produced slightly higher estimates of repeatability. Differences in repeatability for the three groups ranged from .546 to .898 for live animal length, .726 to .844 for photographic body length, .784 to .914 for live animal wither height, and .807 to .908 for photographic wither height. Live animal chest depth and photographic chest depth repeatabilities were very similar. Variation due to time during the day measured, operator and size of animal measured were negligible.

Relation to Performance

Black et al. (1938) stated that if ratios of linear body measurements are to be used to predict performance and carcass traits, corrections must be made for fat, weight and age. Much of the variance on performance resulted from the fact that some of the cattle in the study were fed to a more homogeneous for content while others varied widely in composition. Performance and carcass trait measures tend to become similar when different types of cattle are fed to a constant fat composition.

Hawkins (1979) described two groups of linear body measurements utilized to characterize performance and carcass measurements. The first group includes those that increase with fattening more rapidly than weight, such as chest width, loin width, heart girth and flank girth. These measure fat in a positive way. Those that increase with weight more rapidly than fattening are included in the second group, such as pelvis, head and trunk measurements, and measure fat in a negative way.

Research results have shown varying degrees of correlation between animal height and performance. In a study conducted by Lush (1928) height at withers and height at hooks were found to be equal in terms of repeatability and almost a duplicate of each other. Kidwell (1955) reported that height at hooks appeared to be more highly related to carcass variables than height at withers. However, height at hooks had little relation with performance traits in Kidwell's study. Kohli et al. (1951) found nonsignificant correlation between height at withers and feed efficiency. Height at withers was found to be negatively correlated to performance traits by Hultz (1927) and by Black et al. (1938). However, Lush (1932) found height at withers was associated with higher gains based on linear body measurements made on steers at weaning. Reports by Lush (1932), Black et al. (1938) and Yao et al. (1953) all agreed that height at withers was the best measure of height.

Length and depth and their relationship with performance traits have also been studied. Cook et al. (1951), Kidwell (1955) and Ternan et al. (1959) observed no correlation between body length and performance traits. Kidwell et al. (1959) found no significant increase in body length during the last 60 days animals were on feed. Negative correlations between body length and average daily gain and feed efficiency were reported by Black et al. (1938) and Kohli et al. (1951). However, Lush (1932) found gains were positively associated with longer-bodied steers. Shallow-bodied animals had better feed efficiency and produced more edible beef when compared with deeper-bodied steers according to Lush (1932) and Black et al. (1938).

Yao et al. (1953) stated that length and height are skeletal measures of overall size while width, chest depth, paunch girth and heart girth are measures of thickness and fleshiness. Tallis et al. (1959) reported no significant difference in the amount of independent variation explained by depth of chest, width of chest and heart girth.

<u>Relationship to Feeder, Slaughter and Carcass Quality Grade</u>

Past research has attempted to define the relationships between linear body measurements and feeder grade, slaughter grade and carcass quality. Cook et al. (1951) and Ternan et al. (1959) found that significant relationships exist between certain linear measurements and feeder grade, slaughter grade and carcass quality. However, both authors agreed that most of these correlations were too low to be of predictive value.

A negative correlation (r = -.74) between carcass grade and body length at slaughter was reported by Black et al. (1938). Yao et al. (1953) and Brown et al. (1956) also reported negative correlations between body length at slaughter and carcass grade. Lush (1928), Cook et al. (1951) and Kidwell (1955), however, found no correlation between body length and carcass grade.

Kidwell et al. (1959) stated that a body measurement or combination of body measurements might be found that would reasonably predict carcass grade. He submitted that the ratio of wither height to heart girth circumference is highly related to carcass traits. Klosterman et al. (1968) stated that ratios of weight to height were useful in describing the condition of cows of various size and type. Correlation coefficients (r = .84) between the ratio of body weight of wither height and slaughter grade were reported by Black et al. (1938). Lush (1928) found that heart girth to wither height ratio was positively correlated (r = .56) to estimated fatness. Gregory (1933) suggested the ratio of round measurements to wither height as an index of beef type. Guilbert and Gregory (1952) found this ratio to be highly correlated with carcass grade. Tallis et al. (1959) found that ratios of weight to height and weight to length were positively correlated with dressing percentage and area of rib eye.

3. REPEATABILITY OF ULTRASONIC TECHNIQUE FOR ESTIMATING SUBCUTANEOUS FAT THICKNESS

The correlations between ultrasonic fat thickness taken over the *longissimus dorsi* and actual carcass measurements of *l. dorsi* fat thickness have been extensively researched in the past. McReynolds and Arthaud (1970) concluded that fat thickness can accurately be measured by using ultrasonic techniques. Davis, Temple and McCormick (1966) compared two operators with two different pieces of ultrasonic equipment and reported a high degree of repeatability in the ultrasonic measurement of fat thickness.

Hedrick et al. (1962) found that ultrasonic measurements of fat thickness in live animals just prior to slaughter were highly related to carcass measurements of fat thickness. Davis et al. (1964) also reported highly significant correlations between ultrasonic measurements and carcass measurements of the *l. dorsi* area ($r = 0.87$ and $r = 0.67$). On data collected from 39 Hereford and 13 Charolais-Hereford-cross steers, Brinks et al. (1962) reported that ultrasonic measures of fatness appeared to be more accurate than rib-eye area for predicting carcass traits. While Butts et al. (1980) found that ultrasonic fat measurements were more accurate in predicting carcass traits than subjective fat scores.

Kempster and Owen (1981) reported that by using ultrasonic measurements of fat thickness on live animals they could satisfactorily predict slaughter point on different breeds. McLemore and Butts (1982) found that allotment of feeder animals based on ultrasonic measurements produced slightly larger net revenues than allotment using subjective estimation of fatness in allotment systems based on frame score combined with measured fat thickness (ultrasonically) or condition (fat) score.

CHAPTER III

EXPERIMENTAL PROCEDURE

Data for Trial I were collected from October 1984 through July 1985, while data for Trial II were collected from October 1985 through June 1986, from experiments conducted at Blount Farm on the Knoxville Experiment Station, Knoxville, Tennessee.

1. EXPERIMENTAL ANIMALS

One hundred forty-four steers (72 Angus and 72 Angus-Hereford-cross) were purchased by an order buyer from eastern Tennessee and the surrounding states during the fall of 1984. Weights ranged from 214 kg to 330 kg and averaged 272 kg. For Trial II an additional 144 steers (72 Angus and 72 Angus-Hereford-cross) were purchased by the same order buyer. Weights ranged from 218 kg to 327 kg and averaged 278 kg. Animals were considered to be a representative sample of the predominate type of steers currently preferred by feedlot operators that feed Tennessee cattle.

2. MANAGEMENT AND FEEDING

Upon arrival at the experiment facility the calves on Trial I were allowed an adjustment period of 14 days while on a diet of corm silage ad libitum and decreasing amounts of hay. At the end of this 14 day period all calves were implanted with 36 mg of zeranol, weighed, temperatured, photographed, measured for shoulder width and sonorayed for fat thickness. The cattle were randomly allotted to 24 pens of 6 steers each. Cattle were then weighed and measured for fat thickness every 21 days for approximately 105 days. While on this growth phase, all animals were fed a diet consisting of corm silage ad libitum plus .68 kg soybean meal per calf per day plus a free choice mineral and salt mix (Table 1).

At the end of the growth phase all animals were weighed, photographed, measured for shoulder width and measured for fat thickness. They were then placed on an adjustment diet for 14 days. At the end of this 14 day period, cattle were weighed and measured for fat thickness, reallotted to 24 pens of 6 steers each, and placed on the finishing diet. The finishing diet was composed of a standard bull feed formulated for the University of Tennessee Beef Facilities, Knoxville and a free choice mineral and salt mix (Table 1). Throughout the finishing phase all cattle were weighed and measured for fat thickness every 28 days until individuals reached the desirable market conditioning of 12mm fat thickness.

Calves on Trial II were managed and fed the same as Trial I.

3. OBJECTIVE MEASURES

In Trial I photographs of each animal were made in a specially designed grid chute. Prior to entering the chute the individual animal was paint branded on the point of the shoulder, ilium and ischium. Linear body measurements were calculated at a later date from life-size projections of 35 mm slides. Height measurements were taken from the base of the grid chute to the ilium. Length

TABLE 1

COMPOSITION OF FEED RATIONS OF TRIAL I AND II (DRY MATTER BASIS)

Constituent	Dry Matter,%	Crude Protein,%	Crude Fiber,%	Ether Ext.,%
<u>Trial</u> <u>I</u>				
Growth Ration:				
Corn Silage	30.24	10.32	7.85	0.68
Soybean Meal	92.83	48.26	8.16	8.06
Finish Ration:				
Bullfeed	89.72	14.09	13.03	5.11
<u>Trial</u> <u>II</u>				
Growth Ration:				
Corn Silage	28.76	10.56	7.48	0.72
Soybean Meal	93.92	48.45	8.47	7.95
Finish Ration:				
Bullfeed	88.26	14.18	11.78	6.30

measurements were taken from the point of the shoulder to the ischium. Shoulder width measurements were obtained using body calipers to measure from point of shoulder to point of shoulder. These linear measurements were recorded in centimeters.

Fat thickness was ultrasonically measured over the longissimus muscle between the 12th and 13th rib three-fourths the distance between the dorsal midline and the distal edge of the longissimus muscle, using a Model 12 Sonoray calibrated on an oscilloscope. All fat thickness measurements were obtained by one technician experienced in the use of ultrasonic equipment. Fat thickness measurements were recorded in millimeters.

The same measurements, using the same procedures, were taken for Trial II.

4. CARCASS MEASUREMENTS

In Trials I and II live animal numbers were recorded immediately following stunning, prior to going on the slaughter house line. Hot carcass weights were taken immediately after slaughter. After a 48 hour chilling period the left side of the carcass was ribbed between the twelfth and thirteenth rib. Rib-eye area was measured using the plastic overlay grid. Yield grade and carcass quality were obtained from the USDA grader. Live weights at slaughter were calculated using hot carcass weights and an assumed dressing percentage of 61.5%.

5. NET VALUE

The preliminary estimated value (PEV) of each steer carcass in

Trials I and II was calculated using equations developed by Ferguson (1986). These equations were based upon weekly average price data for Omaha and Los Angeles markets for 1983 and 1984. Multiple regression was used to provide an index of price (PEV) for carcasses of the i^{th} quality grade, j^{th} yield grade and k^{th} weight class based upon the price of Choice, Yield Grade 3, 600-699 lb. steer carcasses (Table 2).

The PEV of each carcass was then multiplied by its hot carcass weight (HCW) to determine estimated value (EV):

$$EV = HCW * PEV$$

The non feed cost (NFC) was calculated using days on feed (DOF) and the assumed price of $.50 per animal per day:

$$NFC = DOF * .50$$

The resulting net worth of each individual was determined using the following equation:

$$NET\ WORTH = EV - NFC$$

6. ALLOTMENT SYSTEMS

Of the one hundred forty-four steers on Trial I, 36 steers (18 Angus and 18 Angus-Hereford-cross)were randomly allotted to two blocks of 18 steers each and placed on the finishing diet with 6 steers per pen (3 Angus and 3 Angus-Hereford-cross) to serve as the control group. The remaining 108 steers were allotted to groups of high, medium or low on the basis of their lean growth during the growth

TABLE 2

PRELIMINARY ESTIMATED VALUES (PEV) OF STEER CARCASSES*

Quality Grade[a]	Yield Grade	Carcass weight(kg) Range	PEV
>9	2	227-272	1.00892342
>9	2	272-317	1.00912461
>9	2	317-362	1.00908424
>9	2	>362	1.00799326
<10	2	227-272	0.97599927
<10	2	272-317	0.97620048
<10	2	317-362	0.97494955
<10	2	>362	0.97506913
>9	3	227-272	1.00272047
>9	3	272-317	1.00292168
>9	3	317-362	1.00167075
>9	3	>362	1.00179033
<10	3	227-272	0.96979634
<10	3	272-317	0.96999755
<10	3	317-362	0.96874662
<10	3	>362	0.96886622
>9	4	227-272	0.90286291
>9	4	272-317	0.90306412
>9	4	317-362	0.90181319
>9	4	>362	0.90193277
<10	4	227-272	0.86993878
<10	4	272-317	0.87013999
<10	4	317-362	0.86888906
<10	4	>362	0.86900864

*(Ferguson, 1986)

[a] 9 = Good+, 10 = Choice-

phase:

$$LG = W - F$$

where

LG = coefficient for lean growth

W = regression coefficient for weight = day

F = regression coefficient for fat = day

Each group consisted of 36 steers allotted to 6 pens of 6 steers each (Table 3).

The data from the Trial I was analyzed and used to allot the one hundred forty-four steers in the Trial II (1985-86). Prior to this analysis 33 animals were dropped from the data set of Trial I due to inadequate data. The following regression equation was used to determine the growth phase characteristics most highly correlated to days on feed during the finishing phase and net worth of carcass:

$$CV = ADG + ILM + FLM + WGAIN + FGAIN$$

where

CV = carcass value

ADG = average daily gain during growth phase

ILM = initial linear measurements during growth phase

FLM = final linear measurements during growth phase

WGAIN = total weight gain during growth phase

FGAIN = total fat gain during growth phase

Average daily gain and initial width of the animals during the growth phase proved to have the most significant effect on net worth

TABLE 3

TRIAL I EXPERIMENTAL DESIGN OF FINISH PHASE

	Lean Growth *			
Rep.	High	Medium	Low	Control
1	6	6	6	6
2	6	6	6	6
3	6	6	6	6
4	6	6	6	6
5	6	6	6	6
6	6	6	6	6

*Based on Lean growth during growth phase

(Table 4). Steers in Trial II were then allotted to pens based on either their initial width or average daily gain (Table 5).

7. STATISTICAL ANALYSIS

Data from Trials I and II were analyzed using the Statistical Analysis System (SAS, 1979). The analysis were used to evaluate the allotment systems used in this study, and to determine relationships among measurable feeder calf characteristics, days on feed to reach common slaughter endpoint and carcass value.

Evaluation of Allotment Systems

In Trial I the following factorial model was used to determine the effect of the allotment system and breed on net worth and days on feed:

NET WORTH = ALLOTMENT-CRITERIUM BREED ALLOTMENT-CRITERIUM*BREED

where

NET WORTH = net value of animal

ALLOTMENT-CRITERIUM = High lean growth, medium lean growth, low lean growth or control lean growth

BREED = Angus or Angus-Hereford-cross

DOF replaced NET WORTH in the model to determine the effects of grouping on days on feed.

In Trial II the same model above was used, however, the allotment criterium were high ADG, medium ADG, low ADG, control ADG, high initial width, medium initial width, low initial width and control

TABLE 4

TRIAL I ANALYSIS OF VARIANCE FOR THE EFFECTS OF FEEDER CALF CHARACTERISTICS DURING THE GROWTH PHASE ON NET WORTH

Source	df	Mean Square
ADG	1	15950.7350 *
Fat Gain	1	2946.3372
Initial Height	1	282.8238
Initial Length	1	4787.1884
Initial Width	1	19805.2668 **
Final Height	1	9095.4048
Final Length	1	8220.6995
Final Width	1	445.3072
Residual	102	1617.1478

r-square = 0.48

*P < .01

**P < .001

TABLE 5

TRIAL II EXPERIMENTAL DESIGN OF FINISH PHASE

Allotment Criterium	REP. 1	REP. 2	REP.3
High Width	6	6	6
Med. Width	6	6	6
Low Width	6	6	6
Control Width	6	6	6
High ADG	6	6	6
Med. ADG	6	6	6
Low ADG	6	6	6
Control ADG	6	6	6

initial width. When a variable proved to have a significant effect on the dependent variable, means were separated using the Student-Newman-Keuls test.

Multiple Regression Analysis

The combined data collected during Trials I and II were analyzed using regression models. To determine the effect of feeder calf characteristics on net value of the carcass the following model was used:

NET WORTH=IHT ILG IWD FHT FLG FWD WTGAIN FATGAIN

where

NET WORTH = net value of carcass

IHT = initial height during growth phase

ILG = initial length during growth phase

IWD = initial width during growth phase

FHT = final height during growth phase

FLG = final length during growth phase

FWD = final width during growth phase

WTGAIN = total weight gain during growth phase

FATGAIN= total fat gain during growth phase

To determine the effect of feeder calf characteristics of days on feed, DOF replaced NET WORTH in the above model.

Description of Feeder Calf Characteristics

Trial I and Trial II data sets were combined and divided into groups according to the net worth of the animals. Group I represented those animals in the top 25% of net returns. Group 4 represented those animals in the bottom 25% of net returns. Group 3 and Group 4 represented the remaining 50% of animals (25% respectively). The number of animals, means and standard deviations for the variables were calculated for each Group. Pearson Correlation Coefficients were calculated to determine the relationships among variables in the data set.

CHAPTER IV

RESULTS AND DISCUSSION

1. EVALUATION OF ALLOTMENT SYSTEMS

The allotment system utilized for Trial I was based on the coefficient for lean growth of animals during the growth phase. The results from analysis of variance indicated that this allotment system had no significant effect on either net worth or days on feed needed to reach an optimal slaughter endpoint (Table 6). Also, the model that was used accounted for only a small fraction of the variation in net worth and in days on feed.

Animals of a related breed type (British breeds) gain weight with similar muscle to fat ratios. Therefore, allotment systems based on lean growth during the growth phase are of little value in predicting subsequent carcass worth and decreasing the variation in days on feed to reach optimal slaughter endpoint for animals of similar genotypes.

The data from Trial I was regressed to develop the allotment systems used to allot steers in Trial II. The results from regression analysis indicated that net worth was significantly increased by an increase in initial width and average daily gain during the growth phase, with a r-square value of 0.48 for the model used (Table 4). Therefore, steers on Trial II were penned according to either initial shoulder width or average daily gain during the growth phase.

Table 7 shows that days on feed (Trial II) were significantly effected by allotment group ($P < .01$). The groups high gain and high

TABLE 6

TRIAL I ANALYSIS OF VARIANCE FOR THE EFFECTS OF ALLOTMENT SYSTEM AND BREED ON DAYS ON FEED AND NET WORTH

		Mean Squares	
Source	df	DOF	NET WORTH
Allotment	3	41.1106	22276.7464
Breed	1	625.6665	1393.2703
Allotment x Breed	3	1181.6885	819.1727
Residual	110	119.9409	2853.4130

r-squared = 0.13 and 0.08

TABLE 7

TRIAL II ANALYSIS OF VARIANCE FOR THE EFFECTS OF ALLOTMENT SYSTEM AND BREED ON DAYS ON FEED AND NET WORTH

		MEAN SQUARES	
Source	df	DOF	NET WORTH
Allotment	7	4782.4084*	46288.4470
Breed	1	18.0488	11559.4908
Allotment x Breed	7	2511.1044	10855.4577
Residual		253.2262	2455.7191

r-squared = 0.18 and 0.11

*P < .01

width were significantly different from low width (Table 8). However, when contrast statements were used to determine significant differences between the two allotment systems (average daily gain vs. initial shoulder width) no difference was found. Due to the correlation of regression value reported by this model (r^2 = .18), it is apparent that initial shoulder width and average daily gain during the growth phase do not adequately explain the variation in days on feed needed to reach optimal slaughter endpoint. More accurate means of predicting days on feed need to be developed from further research.

The results from analysis of variance for net worth of carcasses during Trial II indicated no significant effect by allotment systems (Table 7). This lack of a significant effect on net worth during Trial II was expected. Individual animals were taken to their optimum slaughter endpoint of 12 mm fat thickness in this study, and were from similar breed types, which would result in little variation in net worth of the carcasses.

2. REGRESSION ANALYSIS

Regression analysis was performed on the combined data from Trial I and Trial II to determine the relationship between certain feeder calf characteristics and subsequent feedlot performance and carcass value. The results from the preliminary regression model used to evaluate the effects of growth phase parameters such as linear body measurements, fat thickness and weight gain on carcass value indicated that initial height, final width, final length and initial fat measurements had no effect on net worth. Therefore, these variables

TABLE 8

TRIAL II STUDENT-NEWMAN-KEULS SEPARATION OF MEANS FOR ALLOTMENT SYSTEM'S EFFECT ON DAYS ON FEED

Allotment	N	MEAN
Low Width	18	79.4 [a]
Control Width	18	77.9 [a,b]
Low Gain	18	74.0 [a,b]
Medium Width	18	72.4 [a,b]
Medium Gain	18	71.7 [a,b]
Control Gain	18	71.7 [a,b]
High Gain	18	63.1 [b]
High Width	18	62.3 [b]

[a,b]Means with different superscripts are different ($P<.05$)

were dropped from the model. The results from the subsequent model indicated that fat thickness taken at the end of the growth phase had the most significant effect on net worth (Table 9). An increase in final height, initial length, initial shoulder width and total weight gain during the growth phase also significantly increased net worth.

After preliminary analysis for the effects on days on feed, the variables initial height, initial length, initial shoulder width and total weight gain during the growth phase were dropped from the model due to these variables lack of effect on days on feed to reach optimal slaughter endpoint. From the results of the subsequent model (Table 10), it is apparent that higher initial and final fat thickness measurements result in fewer days on feed needed to reach optimal slaughter endpoint. An increase in final width during the growth phase also significantly decreased days on feed.

Final shoulder width, initial fat thickness and final fat thickness measurements effect on days on feed may be the result of differences in maturity of steers. The animals which were more mature coming on to Trials I and II finished in fewer days on feed during the finish phase. Final shoulder width and initial fat thickness lack of effect on net worth supports the explanation of different levels of maturity. Although these animals finished on fewer days on feed, there were no significant differences in their reported carcass value.

Initial shoulder width, initial length, final height and total weight gain during the growth phase had no significant effect on days on feed. However, these variables had a significant effect on net worth. This may best be explained by either superior genetic

TABLE 9

TRIAL I AND II ANALYSIS OF VARIANCE FOR THE EFFECTS OF FEEDER CALF CHARACTERISTICS MEASURED DURING THE GROWTH PHASE ON NET WORTH

Source	df	Mean Square
Final Height	1	49915.6593*
Initial Width	1	31803.2655*
Initial Length	1	29739.0303*
Weight Gain	1	30638.1583*
Final Fat	1	25512.7284**
Residual	249	1866.4870

r-square = 0.36

*P < .001

**P < .0001

TABLE 10

TRIAL I AND II ANALYSIS OF VARIANCE FOR THE EFFECTS OF FEEDER CALF CHARACTERISTICS MEASURED DURING THE GROWTH PHASE ON DAYS ON FEED

Source	df	Mean Square
Final Height	1	11283.3296
Final Width	1	2112.7698*
Final Length	1	1372.4636
Initial Fat	1	4497.8497**
Final Fat	1	17506.4714**
Residual	249	219.2962

r-square = .36

*P < .01

**P < .0001

background of the animal or the different backgrounding systems these animals came from. The larger-framed animals coming on to Trials I and II resulted in larger carcasses of greater value. Also, the animals with higher total weight gains during the growth phase resulted in higher carcass values.

Although this study found significant differences among the calculated carcass values of these animals, there were no significant differences found in the quality grades or yield grades reported for the carcasses from Trials I and II. These animals were of similar breed types (British breeds) and were taken to their optimal slaughter endpoint of 12 mm fat thickness, therefore no differences were expected among quality grades or yield grades. The differences found among the calculated net worth values were due to the significant differences among carcass weights. The larger-framed animals produced heavier carcasses at slaughter, subsequently increasing carcass value when expressed as dollars per steer. If carcass values were expressed in dollars per kilogram, then steers were of equal value.

The significance of final fat thickness on net worth is most likely the result of a decrease in the number of days on feed to reach optimal slaughter endpoint. The animals most highly conditioned at the end of the growth phase would finish on fewer days on feed. This is supported by the significant effect of final fat thickness measurement on days on feed, and would result in a lower cost of maintaining the animal and thus a higher net worth with carcasses of similar value.

3. DESCRIPTION OF CALVES

Steers in Trials I and II were divided into four groups by their net worth value (Table 11). Net worth was significantly different for each Group. The higher net worth values were due to increases in carcass weights and not to differences in quality grades or yield grades. The animals in the top 25 percentile of net returns were placed in Group 1. These animals had significantly higher initial and final heights, initial and final lengths, initial and final weights and greater total weight gains during the growth phase than any of the other three groups. Although the average number of days on feed was significantly greater for Group 1 animals, the standard error for days on feed was lower than for the other groups. These animals reached their optimal slaughter endpoint at similar days on feed and yielded higher net returns per carcass.

Although Group 2 animals had significantly higher final weights during the growth phase than Group 3 animals, Groups 2 and 3 were very similar. There were no other significant differences found between these groups for the variables measured during the growth phase.

Group 4 represented those animals in the low 25 percentile of net returns. Of the four groups, these animals had the lowest initial and final heights, initial and final lengths, final shoulder widths, initial and final weights, and the lowest total weight gains during the growth phase ($P < .05$). Although nonsignificant, final fat thickness was slightly higher for Group 4 animals than for any other group. These smaller-framed animals had less potential for lean

TABLE 11

MEANS AND STANDARD ERRORS OF CHARACTERISTICS OF FEEDER STEERS - GROUPS 1, 2, 3 AND 4

	Group 1 n = 64		Group 2 n = 63		Group 3 n = 64		Group 4 n = 64	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Height, cm								
Initial	102.84^{a}	4.09	101.07^{b}	3.33	$100.56^{b,c}$	3.10	99.52^{c}	2.87
Final	108.41^{a}	4.47	105.99^{b}	3.96	105.71^{b}	3.30	104.17^{c}	3.84
Length, cm								
Initial	108.69^{a}	4.24	107.14^{b}	3.61	106.81^{b}	3.81	104.72^{c}	4.06
Final	116.81^{a}	4.67	114.25^{b}	4.22	114.73^{b}	4.88	111.79^{c}	4.50
Width, cm								
Initial	37.06	2.11	36.45	2.56	36.02	1.98	36.12	2.59
Final	42.72^{a}	1.96	$42.24^{a,b}$	2.54	$42.27^{a,b}$	2.34	41.53^{b}	2.64
Fat, mm								
Initial	2.41	0.77	2.40	0.71	2.12	0.68	2.25	0.76
Final	5.11	1.27	5.27	1.36	5.22	1.17	5.56	1.36
Weight, kg								
Initial	288.35^{a}	16.65	278.87^{b}	20.57	271.57^{b}	25.92	263.22^{c}	26.49
Final	369.39^{a}	19.01	354.34^{b}	26.80	344.06^{c}	30.69	331.97^{d}	31.18
Gain	81.04^{a}	14.40	75.47^{b}	16.03	$72.49^{b,c}$	15.31	68.75^{c}	14.95
DOF, days	88.34^{a}	14.01	81.49^{b}	18.33	80.70^{b}	20.55	75.17^{b}	18.11
Net Worth $	682.12^{a}	28.87	629.31^{b}	9.98	592.58^{c}	10.30	547.68^{d}	23.64

^{a,b,c,d}Means with different superscripts differ ($P < .05$).

n = Number of observations in group.

growth and therefore, on a high energy corn silage diet, increased fat thickness sooner than the larger-framed animals. Although their average number of days on feed was lower than for Group 1 animals, their net returns per carcass were also significantly lower.

CHAPTER V

CONCLUSIONS

The purpose of this study was to evaluate the effects of measurable feeder calf characteristics on subsequent feedlot performance and carcass value, and to evaluate the feasibility of using prediction equations when allotting steers to feedlot pens to reduce the variance of slaughter groups. The results of this study led to the following conclusions:

1. Allotment systems based on initial shoulder width of the feeder steer and average daily gain during the growth phase can accurately predict the subsequent days on feed needed to reach optimal slaughter endpoint for animals of British-breed type.

2. Within British-breed types, animals with greater linear body measurements and total weight gains during the growth phase produce carcasses of greater value.

3. Initial and final fat thickness and final shoulder width measurements taken during the growth phase are related to the average days on feed needed to reach optimal slaughter endpoint.

4. Initial shoulder width, initial length and final height measurements taken during the growth phase are related to subsequent carcass value.

CHAPTER VI

SUMMARY

The objective of this experiment was to determine the feasibility of utilizing certain feeder calf characteristics to predict subsequent feedlot performance and carcass value. Data from 144 steers (72 Angus and 72 Angus-Hereford cross) in Trial I (1984-85) and 144 steers (same distribution of breeds) in Trial II (1985-86), purchased by an order buyer from East Tennessee and the surrounding area, formed the basis of this study. Animals were considered to be representative of the predominate breeds preferred by buyers of Tennessee feeder steers. Initial and final linear body measurements, subcutaneous fat thickness and weights were recorded for the growth phase in each Trial. Carcass traits and days on feed needed to reach 12 mm fat thickness were recorded for the finishing phase of Trials I and II.

In Trial I, initial shoulder width ($P < .001$) and average daily gain during the growth phase ($P < .01$) significantly effected subsequent carcass value. These variables were therefore utilized to allot the steers on Trial II to feedlot pens. These allotment systems proved to be effective in predicting days on feed needed to reach optimal slaughter endpoint of 12 mm fat thickness ($P < .01$). However, no differences in the effectiveness of predicting days on feed were found between the two allotment systems.

The results of analysis of variance on the combined data set from Trials I and II indicated that an increase in initial length, initial width, final height and total weight gain during the growth phase

significantly increased subsequent carcass value (P < .001). An increase in final fat thickness at the end of the growth phase also increased carcass value (P < .0001). Neither initial height, final shoulder width, final length or initial fat thickness had any effect on carcass value.

An increase in initial and final fat thickness significantly decreased the number of days on feed needed to reach optimal slaughter endpoint (P < .0001). An increase in final shoulder width also decreased days on feed (P < .01). However, initial and final height, initial and final length, initial shoulder width and total weight gain during the growth phase had no significant effect on days on feed.

By grouping the animals in Trials I and II by networth, it was determined that animals with higher linear body measurements and weight gains during the growth phase yielded higher carcass values due to the increase in carcass weight. The animals with lower linear body measurements and total weight gains during the growth phase required fewer average days on feed to reach optimal slaughter endpoint, however they yielded carcasses of lower values due to lower carcass weights.

Initial shoulder width and weight gains during the growth phase can be accurate predictors of subsequent feedlot performance and carcass value. Initial length and final height may be utilized as predictors of carcass value, also, after further study.

Initial width and/or weight gain during the growth phase could be useful to the feedlot operator in predicting feedlot performance and carcass value of feeder steers of British breeds. Linear body measurements and weight gains might also be useful to the beef producer in selecting management techniques and marketing strategies to increase net revenue.

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APPENDIX

TABLE A-1

TRIAL I ANALYSIS OF VARIANCE FOR THE EFFECTS OF FEEDER CALF CHARACTERISTICS MEASURED DURING THE GROWTH PHASE ON DAYS ON FEED

Source	df	Mean Square
ADG	1	33.8151
Fat Gain	1	1068.1895*
Initial Width	1	204.3821
Initial Height	1	379.8182
Initial Length	1	241.1209
Final Width	1	236.6682
Final Height	1	325.0225
Final Length	1	26.1618
Residual	102	101.8396

r-square = 0.26

*P < .01

TABLE A-2

PEARSON CORRELATION COEFFICIENTS FOR FEEDER CALF CHARACTERISTICS MEASURED DURING THE GROWTH PHASE ON DAYS ON FEED AND NET WORTH

	HT2	WD1	WC2	LG1	LG2	WTI	WTF	Net Worth	DOF	WTGAIN	ADG
Height 1	0.77[a]	0.10	0.01	0.36[a]	0.43[a]	0.30[a]	0.36[a]	0.39[a]	0.05	0.23[b]	0.23[b]
Height 2		0.14	0.02	0.31[a]	0.45[a]	0.20[b]	0.28[a]	0.41[a]	0.13	0.23[b]	0.23[b]
Width 1			0.44[a]	0.28[a]	0.17[c]	0.47[a]	0.42[a]	0.21[b]	-0.20[b]	0.09	0.09
Width 2				0.20[c]	0.23[b]	0.52[a]	0.60[a]	0.22[b]	-0.34[a]	0.34[a]	0.34
Length 1					0.53[a]	0.49[a]	0.51[a]	0.41[a]	0.00	0.22[b]	0.22[b]
Length 2						0.46[a]	0.51[a]	0.40[a]	-0.14	0.28[a]	0.27[a]
WTI							0.86[a]	0.44[a]	-0.36[a]	0.11	0.10
WTF								0.52[a]	-0.36[a]	0.60[a]	0.60[a]
Net Worth									0.27[a]	0.32[a]	0.33[a]
DOF										-0.14	-0.13
WTGAIN											0.99[a]
ADG											

[a]Prob > R under HO: RHO = 0, P < .0001

[b]Prob > R under HO: RHO = 0, P < .001

[c]Prob > R under HO: RHO = 0, P < .01

VITA

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