INVESTIGATION OF FACTORS INFLUENCING FEEDLOT

PERFORMANCE AND PROFITABILITY IN THE 2001-2002 TEXAS

A&M RANCH TO RAIL PROGRAM-SOUTH

A Thesis

by

KARL WALTER HARBORTH

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2003

Major Subject: Animal Science

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ABSTRACT

Investigation of Factors Influencing Feedlot Performance and Profitability in the 2001-

2002 Texas A&M Ranch to Rail Program- South.

(December 2003)

Karl Walter Harborth, B.S., Texas A&M University

Co-Chairs of Advisory Committee: Dr. A. D. Herring
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Data from the 2001-2002 Texas A&M University Ranch to Rail Program-South were used to determine factors that influence cattle feedlot performance and profitability. Steers (n=860) were classified according to sire (SBIO) and dam (DBIO) biological groups, kill groups (KILL), and entry month (ENTRYMON). Biological groups were determined by predominant genetic make up of the sire or dam. Traits evaluated included net income (NI), feedlot average daily gain (ADG), slaughter weight (OUTWT), carcass weight (CW), fat thickness (FT), longissimus muscle area (LMA), marbling score (MS), yield grade, (YG), medicine costs (TOTMED), and carcass value (CVL). Analyses of covariance were performed to determine differences between SBIO and DBIO, KILL, and ENTRYMON, and the influence of initial feedlot weight (INWT). Sire biological type had a significant effect on NI, ADG, FT, LMA, MS, YG, and CVL. Dam biological type and KILL had significant effects on all traits excluding TOTMED. Entry month accounted for no differences. Among SBIO groups, British-sired steers exhibited greatest values for ADG (1.39 kg/d), MS (457), FT (1.45 cm), CVL ($891),

and NI ($25.62). Continental-sired steers exhibited the largest LMA (97.65 cm) and lowest YG (2.51). Brahman-sired steers exhibited the lowest ADG (1.32kg/d), MS (405), CVL ($859), and NI ($-17.80).

Multiple regression was performed to determine which traits had the greatest effect on CVL and NI. Independent categorical effects were SBIO, DBIO, KILL and ENTRYMON, while independent continuous effects were INWT, ADG, FT, LMA, MS and TOTMED. Both CVL and NI were influenced by CW, FT, LMA, and MS, but not by ADG, INWT, or TOTMED.

Phenotypic correlation coefficients were determined among all traits. Highest correlations were present between CVL: and NI, CW, ADG, and LMA (0.80, 0.81, 0.54, and 0.49, respectively). Strong correlations were seen between ADG and CW (0.63), FT and YG (0.87) and YG and LMA (-0.51). Marbling score was moderately correlated to CVL (0.30) and NI (0.30). This study indicates that a wide variety of traits interact to determine CVL and NI in retained ownership programs, and that maximizing carcass value does not ensure increased profitability.

DEDICATION

This thesis is dedicated to my family. To my beautiful wife, Sondra, without your love, understanding, and continuous support this would not have been possible. To my parents, Kermit and Dorothy, I would like to thank you both for every opportunity you have given me to succeed at accomplishing my goals throughout my life. My father, Kermit has also taught me to never stop believing in my dreams even when others don't believe they are possible. To my brother, Chris, I hope that I have inspired you to not only do your best but also reach for your goals. I wish you the best of luck in fulfilling your dreams because I know you can. To my father and mother in-law, Jim and Jeanette Long, their support over the past three years has been greatly appreciated. Last but not least I would also like to thank my grandfathers, Raymond and Percy. They have taught me lessons of life, which only one can experience through the many years of learning, growing, and experiencing. As I have grown physically and mentally, I have learned from the words of wisdom which they have shared.

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I would also like to thank Dr. Andy Herring for his guidance, patience, and friendship during my master's program. Dr. Jim Sanders and Dr. Danny Klinefelter, thank you both for serving on my committee but more importantly, for your insight and encouragement during the course of my project.

To Dr. Joe Paschal, thank you for providing me the Ranch to Rail program data used in my project and your assistance in understanding of the programs entirety.

Finally, I would like to thank all of my fellow beef cattle graduate students for their support and friendship over the past two years. You have not only made my experiences in graduate school enjoyable but also memorable. I wish each of you the best of luck in the game of life.

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INTRODUCTION

There are approximately 1,000 breeds of cattle recognized around the world (Porter, 1992). Eighty of these breeds are available to United States producers, but only 20% of these actually contribute to the majority of the genetic make-up of the United States cattle population (Taylor and Field, 2003). Cattle are generally placed into two major biological groups *Bos indicus* (humped) and *Bos taurus* (non-humped) (Taylor and Field, 2003). An example of *Bos indicus* commonly utilized in the United States would include the Red and Grey Brahman. *Bos indicus* composites would include Beefmaster, Santa Gertrudis, Simbrah, and Brangus. Typical *Bos taurus* breeds used in the United States include Angus, Hereford, Red Angus, Charolais, Gelbvieh, Limousin, and Simmental. Beef cattle producers are faced with the challenge of using these diverse genetic resources to produce cattle that are acceptable to all segments of the industry. The cow-calf producers' breeding decisions influence the marketability of their cattle the day they select their breeding stock (McKissick et al., 2001). These decisions vary greatly depending on the geographical region in which the cattle are raised. A rancher from the northern regions may choose cattle with only *Bos taurus* influence such as a British x Continental cross or straightbred British or Continental. A rancher from the south may choose to utilize the heat tolerance traits found in the more tropically adapted cattle made up predominantly of *Bos indicus* bloodlines, for example Brahman,

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or combine the traits found across biological types and use composite breeds such as Beefmaster, Simbrah, or Santa Gertrudis. There are many avenues for cow-calf producers to market their cattle; for example, cow-calf producers can sell their cattle at a local auction, directly through video or private treaty, consignment, forward contract, or by retaining ownership through any particular sector of the industry (Taylor and Field, 2003). To maximize potential profit, producers need information on breed differences and genetic parameters for a variety of traits as well as economic data to develop effective breeding schemes. The influence of *Bos indicus* cattle has been strong for many decades due to their heat tolerance, pest resistance, and heterosis when crossed with Bos *taurus* breeds. While their use has increased, *Bos indicus* influenced cattle have gained an unfavorable reputation for the quality and consistency of their carcass characteristics; specifically marbling and tenderness (Paschal et al., 1995; West et al., 1995).

The Texas A&M Ranch to Rail Program was developed to be an information feed back system to allow cow-calf producers to learn more about the cattle they are raising and what factors affect profitability beyond weaning (Paschal et al., 1995). In order for cow-calf producers to maximize profits through a retained ownership scenario such as this, they must determine what factors influence performance and the potential value of their cattle in the feedlot and at the packing plant. The objective of this study is to elucidate the factors influencing feedlot performance and carcass profitability from the 2001-2002 Texas A&M University Ranch to Rail-south program.

LITERATURE REVIEW

Effects of Biological Type on Feedlot Performance and Carcass Composition

There have been numerous studies on the effects of biological type of cattle on carcass composition. Wheeler et al. (2001) stated no single breed excels in all traits that are of importance to beef production. Many studies have shown that particular breeds do excel in specific traits such as longissimus muscle area, fat thickness, marbling score, yield grade, dressing percentage, days on feed, hot carcass weight, or average daily gain, but do not excel in an optimum combination of the value determining traits. The following are brief descriptions of the studies that will be referenced throughout this review.

Damon et al. (1960) reported on data from 275 steers produced by mating Angus, Brahman, Brangus, Charolais, Hereford, and Shorthorn bulls to Angus, Brahman, Brangus, and Hereford cows. A new bull of each breed was used and placed with a different cowherd every year. The study described results on slaughter weight, slaughter grade, carcass grade, cold dressing percentage, longissimus muscle area, fat thickness, and marbling score.

A study conducted in subtropical Florida by Crockett et al. (1979) reported on 207 steers produced by mating Brahman, Brangus, Beefmaster, Limousin, Simmental, and Maine-Anjou sires to Angus, Brangus, and Hereford females. The study spanned a four year period (1972-76) and evaluated marbling score, fat thickness, longissimus muscle area, quality grade, and yield grade. Other pre-harvest traits measured in this

study included feedlot average daily gain, initial feedlot weight, final weight, birth weight, 205-d weight, type score, and condition score.

A study designed to evaluate steers from Simmental, Limousin, Brahman, and Polled Hereford bulls was conducted by Comerford et al. (1988). The steers were produced by using a diallel mating design over a five year period. Traits reported in the study include carcass weight, dressing percentage, longissimus muscle area, fat thickness, kidney, pelvic and heart fat percentage, yield grade, and marbling score.

Urick et al. (1991) evaluated 259 steers produced over a four year period by mating Angus, Red Poll, Pinzgauer, Simmental and Tarentaise (utilized only during the fourth year) to Hereford females. These breeds were utilized because of their popularity to the northern Great Plains region. Each year of the study, the castrated male offspring were assigned randomly into three feeding groups. The groups were killed at three different intervals beginning at 196 d for 1976, 184 d for 1977, 177 d for 1978, and 218 d for 1979. Pre-slaughter traits evaluated include average daily gain, 382 d wt., feed intake, and feed conversion. Post slaughter traits recorded include slaughter weight, carcass weight, longissimus muscle area, fat depth, kidney, pelvic, and heart fat, muscle score, and percent retail product.

Paschal et al. (1995) evaluated F_1 calves sired by Gray Brahman, Gir, Indu-Brazil, Nellore, Red Brahman and Angus bulls out of Hereford cows that were born over a four year period. The steer calves produced from these matings were all raised until weaning at the Blacklands Conservation Research Center at the Riesel center. The steers were fed in different locations, those born in 1982 and 1983 were fed in Riesel, TX and

those born in 1984 and 1985 were fed at the Texas A&M University Agricultural Research Center at McGregor, TX. Pre-slaughter traits recorded in this study included feedlot initial weight, final weight, and average daily gain. Carcass traits reported include skeletal, lean, and overall maturity, marbling score, longissimus muscle area, adjusted fat thickness, percent kidney pelvic and heart fat, and yield grade.

The Germplasm Evaluation (GPE) (Cycle IV) conducted at the Roman L. Hruska Meat Animal Research Center (MARC) Clay Center, NE as reported by Wheeler et al. (1996) utilized Hereford and Angus dams mated artificially (AI) to Angus, Hereford, Longhorn, Piedmontese, Charolais, Salers, Galloway, Nellore, and Shorthorn, and by natural service (NS) to Hereford (H), Angus (A), Charolais (C), Gelbvieh (G), and Pinzgauer to produce 888 steer calves. Cycle IV utilized five breeds from previous GPE cycles and six additional breeds to represent the diverse U.S. cattle population. Steer calves were born in the spring each year from 1986 through 1990. They were fed in pens by sire breed for an average of 272 d. Live weight, hot carcass weight, dressing percentage, adjusted fat thickness, longissimus muscle area, yield grade, marbling score, and other palatability traits were reported by Wheeler et al. (1996).

The GPE (Cycle V) reported by Wheeler et al. (2001) utilized 854 steers born between March 1992 to 1994. Hereford and Angus, Boran, Tuli, Brahman, Piedmontese, and Belgian Blue sires were mated to Hereford (HH), Angus (AN) and MARC III (¼ Angus, ¼ Hereford, ¼ Pinzguaer, ¼ Red Poll) cows to produce these offspring. Live weight, hot carcass weight (HCW), dressing percentage, adjusted fat thickness,

longissimus muscle area, percent kidney, pelvic, and heart fat, yield grade, marbling score, and other palatability traits were reported by Wheeler et al. (2001).

A preliminary report by Cundiff et al. (2001a) of the GPE Evaluation Cycle VI results utilized calves by Hereford, Angus, and MARC III (¼ Angus, ¼ Hereford, ¼ Pinzgauer, ¼ Red Poll) cows mated to Hereford, Angus, Norwegian Red, Swedish Red & White, Friesian, and Wagyu sires. Preweaning traits reviewed included gestation length, calving difficulty score, birth weight, calf survival rate, and 200 day weight. Feedlot and carcass traits discussed included average daily gain, final weight, carcass weight, dressing percentage, marbling score, yield grade, fat thickness, ribeye area, percent retail product, percent fat trim, and percent bone. Meat tenderness and sensory characteristics including Warner-Bratzler Shear force, tenderness score, flavor score, and juiciness score were also evaluated but did not pertain to the this study and will not be discussed.

Data from 1,351 weaned calves sired by Hereford, Angus, Red Angus, Charolais, Limousin, Simmental, and Gelbvieh bulls mated to Hereford, Angus, and MARC III (¼ Angus, ¼ Hereford, ¼ Pinzguaer, ¼ Red Poll) cows were produced in the GPE Evaluation Cycle VII (Cundiff et al., 2001b). The preliminary results by Cundiff et al. (2001b) reported preweaning traits including gestation length, calving difficulty score, birth weight, calf survival rate, and 200 day weight. Feedlot and carcass traits were also reported including average daily gain, final weight, carcass weight, dressing percentage, marbling score, yield grade, fat thickness, longissimus muscle area, percent retail product, percent fat trim, and percent bone. Meat tenderness and sensory characteristics

including Warner-Bratzler Shear force, tenderness score, flavor score, and juiciness score were also evaluated, but since they did not impact this study they will not be discussed.

DeRouen et al. (2002) mated Brahman-Hereford (F_1) cows to Angus, Brangus, Gelbvieh, and Gelbray bulls to produce 231 steers over a 4 yr period (1993-1996) at the Hill farm Research Station of the Louisiana Agricultural Experiment Station (Homer, LA). The steers born in 1993 and 1994 were fed at the Iberia Research Station of the Louisiana Agricultural Experiment Station (Jeanerette, LA). Steers born in 1995 and 1996 were feed in a commercial feedlot in Guymon, OK. Feedlot traits evaluated in this study included initial weight, average daily gain, and final feedlot weight. The carcass traits evaluated included hot carcass weight, dressing percentage, longissimus muscle area, fat thickness at the 12th rib, marbling score, yield grade, and Warner-Bratzler shear force.

Wyatt et al. (2002) evaluated Brangus, Beefmaster, Gelbray, and Simbrah sires in a study that produced purebred and crossbred calves (out of purebred and Brahman X Hereford F_1 cows). Over a five year (1988-1992) period 209 steers were evaluated for economically important traits including postweaning ADG, weaning weight, hip height, days on feed, and feedlot ADG.

During the rest of this section individual traits will be discussed in detail from the research reports.

Days on Feed (DOF). There are many factors that affect the number days cattle

are kept on feed. These factors include age at feedlot entry (calf fed vs. yearling fed),

postweaning management (direct feedlot entry vs. backgrounding), and feeding endpoint

(days vs. fat thickness). A summary of results from several sources relating age and

feeding end point are presented in Table 1. The average of days on feed varies from

study to study and within each study. Damon et al. (1960) used steers that were placed

on feed at an average age of 254 d, and fed approximately 168-d in 20 hectare pastures

of wheat and rye grass. In conjunction with the available forage, the steers were limit fed

seven and one-half pounds of concentrate per day. Crockett et al. (1979) followed a

different slaughter schedule each of the four years of the study due to shipping and

slaughter schedules. Steers were placed on feed at an average age of 258 d and were fed

for 178, 168, 170, and 180 d for 1973, 1974, 1975, and 1976, respectively. Comerford et

al. (1988) evaluated two different slaughter groups over each year for a five year period.

Steers entered the feeding process at an average age of 236 d. The feeding period for the

first group was 209, 195, 195, 184, 185 d, while the feeding period for the second group

were 251, 211, 223, 219, and 216 d. Urick et al. (1991) processed three groups of steers

at 28 d intervals. The first groups of steers were slaughtered after 196, 184, 177, and 218

d for 1976, 1977, 1978, and 1979, respectively. Paschal et al. (1995) reported days on

feed, for yearling fed steers (365 d), for the years of 1982, 1983, 1984, and 1985 of 135,

122, 120, and 129 d, respectively. Wheeler et al. (1996) fed the steers by sire breed, and

slaughtered them serially each year. On average, steers were placed on feed at an age of

155 d, and fed for 272 d (240 – 302 d range). Steers fed in the Wheeler et al. (2001)

study were placed on feed at an average age of 184 d, and spent an average of 260 d on

feed with a range of 225 to 293 d. Cundiff et al. (2001a) allowed a postweaning

adjustment period of 30 d and then placed the steers on feed (average age 216 d), for an

average of 255 d, sorted by sire breed. Cundiff et al. (2001b) also utilized a 30-d

postweaning adjustment period, but placed steers on feed at an average age of 209 d, and

fed them for an average of 239 d. The steers fed in LA by DeRouen et al. (2002) were

yearling fed and slaughtered serially after 84 d once they measured 10 mm of

subcutaneous fat at the 13th rib. This measurement was taken using real-time ultrasound

every 28 d. Steers that did not obtain the 10 mm measurement were slaughtered at three

subsequent 28 d intervals (168, 196 and 224 d), those with the most subcutaneous fat in

the first third. The steers fed in OK, during the third and fourth years of the study, were

harvested when the average backfat was subjectively determined to be 10 mm. The

Angus-, Brangus-, Gelbvieh-, and Gelbray-sired steers fed in LA had the DOF of 167,

162, 183, and 195, respectively. No data specified for DOF the steers fed in OK. Wyatt

et al. (2002) reported on steers that had an initial feedlot age of 443 d and spent an

average DOF by sire breed for Angus-, Brangus-, Beefmaster-, Gelbvieh-, and

Simmental-sired steers of 140, 181, 185, 203.5, and 211, respectively, harvesting all

steers when they obtained a fat thickness of 10 mm.

Table 1. Summary of sire breeds in carcass studies with respect to initial feedlot age, days on feed, and feeding endpoint

Study	Sire breeds evaluated	Age at feedlot entry (avg. approx.)	Feeding end point	Days on feed (avg.)
Damon et al. (1960)	Angus, Brahman, Brangus, Charolais, Hereford, Shorthorn	254 d	Days	168 d
Crockett et al. (1979)	Beefmaster, Brahman, Brangus, Limousin, Maine-Anjou, Simmental	258 d	Days	139 d
Comerford et al. (1988)	Brahman, Limousin, Polled Hereford, Simmental	236 d	Days	209 d
Urick et al. (1990)	Angus, Pinzgauer, Red Poll, Simmental, Tartentaise	204 d	Days	155 d
Paschal et al. (1995)	Angus, Gray Brahman, Gir, Indu-Brazil, Nellore, Red Brahman	365 d	Days	125 d
Wheeler et al. (1996)	Angus, Charolais, Gelbvieh, Galloway, Hereford, Longhorn, Nellore, Piedmontese, Pinzgauer, Salers, Shorthorn	155 d	Days	271 d
Wheeler et al. (2001)	Angus, Belgian Blue, Boran, Brahman, Hereford, Piedmontese, Tuli,	184 d	Days	260 d
Cundiff et al. (2001a)	Angus, Friesian, Hereford, Norwegian Red, Swedish Red & White, Wagyu	216 d	Days	255 d
Cundiff et al. (2001b)	Angus, Charolais, Gelbvieh, Hereford, Limousin, Red Angus, Simmental	209 d	Days	239 d
DeRouen et al. (2002)	Angus, Brangus, Gelbray, Gelbvieh	365 d	Fat Thickness	196 d
Wyatt et al. (2002)	Brangus, Beefmaster, Gelbvieh, Simmental	443 d	Fat Thickness	188 d

Post Weaning Average Daily Gain. Crockett et al. (1979) showed Maine-Anjou and Brahman-sired steers to exhibit the highest average daily gain (ADG) (1.36 and 1.29 kg/d, respectively) while Brangus-sired steers exhibited the lowest average daily gain (1.15 kg/d). Paschal et al. (1995) reported little variation in ADG showing a range from 1.47 kg/d (Gir-sired) to 1.60 kg/d (Indu-Brazil- and Gray Brahman-sired) for F_1 Bos *indicus*-sired steers. The preliminary results from The GPE Cycle VI study as reported by Cundiff et al. (2001a) showed Hereford- and Angus-sired steers to have higher average daily gains (1.42 kg/d) compared to Norwegian Red-, Swedish Red & White-, Friesian-, and Wagyu-sired steers (1.34, 1.31, 1.31, and 1.22 kg/d, respectively). Cundiff et al. (2001b) showed little variation among the sire breeds used in this study; the range in average daily gain was 1.50 to 1.57 kg/d. DeRouen et al. (2002) compared steers fed in two different regions of the U.S. (Louisiana and Oklahoma). Steers fed in OK exhibited higher average daily gains than steers fed in LA (1.61 compared to 1.08 kg/d, respectively). DeRouren et al. (2002) stated compensatory gain can be attributed to the difference in ADG from the two locations. OK fed steers lost additional weight in the trip from LA to OK, compared to the steers fed in LA. Wyatt et al. (2002) observed relatively similar average daily gains ranging from 1.17 kg/d (Angus) to 1.30 kg/d (Beefmaster).

Slaughter Weight. Many factors affect the slaughter weight of steers. These factors include genetics, post weaning management practices, the number of days on feed in the feedlot, the mature size of the breed during the era the study was conducted, the diet fed, and the region where the study was conducted. The study by Damon et al.

(1960) reported on steers fed in the 1950's. The mature size of cattle during this era was considerably smaller than the average modern cow herd today. They reported slaughter weights of Angus-, Brahman-, Brangus-, Charolais-, Hereford-, and Shorthorn-sired steers of 320, 332, 325, 363, 351, and 340 kg, respectively. Crockett et al. (1979) evaluated steers fed in the 1970's, and reported slaughter weights for Beefmaster-, Brahman-, Brangus-, Limousin-, Maine-Anjou-, and Simmental-sired steers of 488, 524, 477, 489, 524, and 506 kg, respectively. Slaughter weights reported by Comerford et al. (1988) for Simmental-, Limousin-, Hereford- , and Brahman-sired steers were 458, 437, 448, and 429 kg, respectively. Slaughter weights for Angus-, Red Poll-, Pinzgauer-, Simmental-, and Tarentaise- sired steers as reported by Urick et al. (1991) were 428, 419, 434, 460, and 439 kg, respectively. Paschal et al. (1995) reported on F_1 steers fed in TX during the 1980's. Angus-, Gray Brahman-, Gir-, Indu-Brazil-, Nellore-, and Red Brahman-sired steers were harvested at weights of 468, 500, 472, 492, 480, and 511 kg, respectively. Wheeler et al. (1996) reported slaughter weights of cycle IV steers adjusted to a constant age of 426 d. The weights across sire breeds ranged from 283 kg (Longhorn) to 355 kg (Charolais). Slaughter weights reported by Wheeler et al. (2001) for cycle V steers were also adjusted to a constant age of 444 d. Hereford-sired steers exhibited the heaviest final weight (591 kg) and Tuli-sired steers exhibited the lowest weight (511 kg). The preliminary report by Cundiff et al. (2001a) discussing the GPE Cycle VI showed slaughter weights for Hereford-, Angus-, Norwegian Red-, Swedish Red & White-, Friesian-, and Wagyu-sired steers to be 614, 609, 589, 582, 575, and 542 kg, respectively. In addition, Cundiff et al. (2001b) also reported the results of the GPE

Cycled VII study. They showed Simmental-sired steers to have the heaviest slaughter weight (630 kg), and Limousin-sired steers to have the lowest (593 kg). Slaughter weights as reported by DeRouen et al. (2002) for Angus- Brangus-, Gelbvieh-, Gelbray-sired steers in LA were 577, 551, 603, and 527 kg, respectively, while the results from OK were 562, 557, 544, and 549 kg, respectively. Wyatt et al. (2002) reported Simmental-sired steers exhibited the heaviest slaughter weights (600 kg) when compared to Angus-, Brangus-, Beefmaster-, and Gelbvieh-sired steers (469, 534, 533, and 544 kg, respectively).

Carcass Weight. There is a high degree of variability from study to study in carcass weight due to many reasons. These reasons include the age the steers were placed in to the feedlot, the numbers of days they were fed, the years in which the study was conducted, and pre-feedlot management. Comerford et al. (1988) reported carcass weights from highest to lowest for Simmental-, Limousin-, Hereford-, and Brahman-sired calves (283, 278, 275, and 269 kg, respectively). Urick et al. (1990) reported very little variation in carcass weights as the range was Red Poll (252 kg) to Simmental (274 kg). Red Brahman- and Brahman-sired calves exhibited the heaviest carcass weight (307 and 300 kg, respectively) while Angus-sired steers exhibited the lowest carcass weight (276 kg) in the study reported by Paschal et al. (1995). Wheeler et al. (1996) shows that Charolais-sired steers exhibited the heaviest carcass weights (355 kg) and Longhorn–sired steers exhibited the lightest carcass weight (283 kg), reported at a constant age from GPE cycle IV. Wheeler et al. (2001) showed that when adjusted to 444 d, Angus- and Belgian Blue-sired steers exhibited the heaviest carcass weights (352 and 351 kg,

respectively) when compared to Hereford-, HX/AX-, Brahman-, Piedmontese-, Boran-, and Tuli-sired steers (345, 349, 332, 330, 310, and 308 kg, respectively) from GPE cycle V. Cundiff et al. (2001a) reported that Angus- and Hereford-sired steers exhibited the heaviest carcass weights (377 and 374 kg, respectively) when compared to Norwegian Red-, Swedish Red & White-, Friesian-, and Wagyu-sired steer calves (357, 352, 355, 351, and 333 kg, respectively) from GPE cycle VI. Cundiff et al. (2001b) reported little variation in GPE cycle VII . Carcass weights were (heaviest to lightest) for sire breeds Simmental, Angus, Charolais, Red Angus, Hereford, Gelbvieh, and Limousin (387, 383, 382, 381, 377, 375, and 370 kg, respectively). DeRouen et al. (2002) reported Gelbvieh-sired steers to have the heaviest carcass weights (371 kg) of the steers fed in LA. Angus- and Brangus-sired steers exhibited the heaviest carcass weights of the steers slaughtered in OK (358 kg.).

Dressing Percentage. Damon et al. (1960) observed dressing percentages (DP) that ranged from 56 to 57.7 percent. Brahman-sired steers exhibited the highest, while Hereford-sired steers exhibited the lowest dressing percentage. Comerford et al. (1988) noted a range of dressing percentage scores from 61.2 to 63.3 percent. They ranked (from highest to lowest) by sire breed Limousin, Hereford, Brahman, and Simmental (63.3, 61.9, 61.7 and 61.2 percent, respectively). Preliminary reports by the Cundiff et al. (2001a) of GPE Cycle VI showed a range in dressing percentage of 60.6 to 61.5 percent. Cundiff et al. (2001b) reported the preliminary results showed Limousin (62.3) to have the highest dressing percentage and Hereford to have the lowest (60.7). DeRouen et al. (2002) reported on steers fed in two different locations (LA and OK) over a four year

period. Of the steers fed in LA, Gelbray exhibited the highest dressing percentage (62.9) and Gelbvieh exhibited the lowest (61.8). In contrast, results from the steers fed in OK were the exact opposite; Gelbvieh-sired steers exhibited the highest DP (65.1), and Gelbray exhibited the lowest DP (62.8).

Longissimus Muscle Area. Wheeler et al. (1996) observed that Piedmontese-sired steers had the largest longissimus muscle area (85.8 cm^2) followed by AI Charolais (81.6 cm^2). Naturally serviced Hereford/Angus-, Longhorn-, Shorthorn-, and AI Hereford/Angus-sired calves tended to have the lowest LMA (70.9, 70.0, 72.0, and 72.8 cm^2, respectively). Wheeler et al. (2001) also showed in GPE cycle V that Piedmontese-sired steers along with Belgian Blue-sired steers exhibited the largest longissimus muscle areas (84. 8 and 85.9 cm^2, respectively), and Hereford-, Tuli-, and Brahman-sired calves all exhibited smaller LMA (73.6, 73.6 and 72.9 cm^2, respectively). In comparison, Paschal et al. (1995), reported that Indu-Brazil, Gir, and Red Brahman steers exhibited the largest LMA (77.5, 77.1, and 77.0 cm^2, respectively) while Angus, Grey Brahman, and Nellore exhibited the smallest LMA (76.6, 75.5, and 75.5 cm^2, respectively).

Although little difference existed between breeds of GPE Cycle VI, Cundiff et al. (2001a) reported Angus- and Hereford-sired steers tended to have the largest LMA (82.58 and 81.16 cm^2, respectively), and Wagyu-, Friesian-, Norwegian Red-, and Swedish Red and White-sired steers appeared to have the smallest LMA (80.97, 80.32, 80.26, and 79.74 cm^2, respectively). From GPE Cycle VII, Cundiff et al. (2001b) stated Charolais- and Limousin-sired calves exhibited the largest LMA (90.45 and 90.39 cm^2,

respectively) and Hereford- and Red Angus-sired steers exhibited the smallest LMA (82.19 and 78.77 cm^2, respectively).

DeRouen et al. (2002) reported steers harvested in Louisiana (LA) and Oklahoma (OK) had similar trends across breeds even though steers fed in OK had noticeably higher means for LMA. Gelbvieh steers exhibited the largest LMA (88.4 and 87.5 cm^2, respectively) for both the LA and OK feedlots. Brangus- and Gelbray-sired steers exhibited the lowest LMA for LA (73.2 and 72.3 cm^2, respectively) and OK (79.9 and 80.0 cm^2, respectively) (DeRouen et al., 2002). Crockett et al. (1979) found Limousin and Maine-Anjou sire steers exhibited the largest LMA (83 and 82 cm^2, respectively) when compared with Brangus-, Brahman-, Beefmaster-, and Simmental-sired steers (68, 75, 76, and 78 cm^2, respectively). In the four-breed diallel study reported by Comerford et al. (1988), the sire breed means for LMA, from largest to smallest, were Limousin, Simmental, Polled Hereford, and Brahman (82.8, 81.7, 74.9, and 70.7 cm^2, respectively).

Fat Thickness. As reported by Damon et al. (1960), Angus-, Hereford-, and Shorthorn-sired steers measured with greater external fat thickness (1.03, 1.02, and 1.11 cm, respectively), while Brahman-, Brangus-, and Charolais-sired steers exhibited the smallest fat thickness (.85, .83, and .73 cm, respectively). Crockett et al. (1979) found Beefmaster-, Brahman-, and Brangus-sired steers to have the thickest fat measurements (1.45, 1.50, and 1.24 cm, respectively) while Limousin-, Maine-Anjou-, and Simmental-sired steers tended to have the thinnest external fat measurements (.78, .86, and .86 cm, respectively). Comerford et al. (1988) showed Simmental-, Limousin-, Polled Hereford-, and Brahman-sired steers exhibited mean fat thicknesses of 1.24, .73, 1.6, and .87 cm,

respectively. Angus-sired steers exhibited the largest amount of external fat thickness (1.73 cm) when compared to Red Poll-, Pinzgauer-, Simmental-, and Tarentaise-sired steers (1.43, 11.4, 1.14, and 1.10 cm, respectively) as reported by Urick et al. (1991). Wheeler et al. (1996) reported at a constant age Hereford/Angus-, Shorthorn-, and Nellore-sired calves exhibited the highest adjusted fat thickness measurements (1.56, 1.21, and 1.23 cm, respectively). They also reported Piedmontese-, Longhorn-, AI and NS Charolais-, Gelbvieh-, and Pinzgauer-sired steers had lower adjusted fat thickness measurements (.77, .93, .89 and 1.05,.94, and 1.05 cm, respectively). In the GPE Cycle V study Angus-, Hereford-, and HX/AX-sired steers exhibited the highest adjusted fat thickness measurements at a constant age (1.23, 1.18, and 1.20 cm, respectively). Piedmontese- and Belgian Blue- sired steers exhibited the lowest adjusted fat thickness measurements (.54 and .64, respectively), while Brahman-, Tuli-, and Boran- sired steers fat measurements (1.00, 1.00, and 1.11 cm, respectively) were comparatively in the intermediate range (Wheeler et al., 2001).

The preliminary report of the GPE Cycle VI by Cundiff et al. (2001a) reconfirmed Angus- and Hereford-sired steers had the thickest back fat measurements (1.14 and 1.35, respectively). In the same study Norwegian Red-, Swedish Red & White-, Friesian-, and Wagyu-sired calves exhibited the smallest back fat measurements (.78, .78, .86, and .91 cm, respectively). Cundiff et al. (2001b) noted that Hereford-, Angus-, and Red Angus- sired steers possessed the most fat thickness (1.40, 1.47, and 1.52 cm, respectively). Gelbvieh-, Limousin-, Simmental-, and Charolais- sired steers measured relatively similar with the smallest fat thickness (.99, 1.04, 1.07, and 1.09 cm,

respectively). Paschal et al. (1995) observed little difference in adjusted fat thickness of

Angus-, Gray Brahman-, Gir-, Indu-Brazil-, Nellore-, and Red Brahman-sired F_1 steers

(1.2, 1.2, 1.3, 1.0, 1.2, and 1.2 cm, respectively). DeRouen et al. (2002) reported that

Angus- and Brangus- sired steers fed in LA and OK measured the largest fat thickness

(1.02 and 1.19, 1.04 and 1.06 cm, respectively). They also concluded Gelbvieh- and

Gelbray-sired steers measured the least amount of back fat thickness (.86 and .86, .79

and .99 cm, respectively).

Marbling Score. Crockett et al. (1979) showed the highest marbling scores were

exhibited by the steers out of *Bos indicus* influenced sires which included Brahman,

Beefmaster, and Brangus (11.2, 10.9, and 10.7, respectively) compared to the larger

continental European breeds Limousin, Maine-Anjou, and Simmental (9.1, 10.1, and 9.6,

respectively) (9 = Slight+, 10 = Small-, 11= Small Average). Urick et al. (1991) reported

Angus sired steers to have the highest marbling score (12.0), while Pinzguaer and

Simmental-sired steers had the lowest marbling score (9.6; 9 = slight, 11 = small-, 12 =

small, 13 = small+). Comerford et al. (1988) reported Hereford- and Simmental-sired

calves had the highest marbling scores (13.6 and 13.3, respectively) and Brahman-sired

steers had the lowest mean marbling score (11.3) (Traces = 7, 8, 9; Slight = 10, 11, 12;

Small = 13, 14, 15). Paschal et al. (1995) showed Angus-sired steers to have the highest

marbling score (410) when compared to the steers sired by Gray Brahman, Gir, Indu-

Brazil, Nellore, and Red Brahman (348, 350, 345, 359, and 345, respectively) (300 =

Sl^{00}; 400 = Sm^{00}; etc.). The GPE Cycle IV results as reported by Wheeler et al. (1996)

observed that at a constant age, Shorthorn- and NS Hereford/Angus-sired steers

exhibited the highest marbling scores (527.4 and 540.6, respectively), while NS

Charolais-, Nellore- and Piedmontese-sired steers had the lowest marbling scores (490,

490, and 496, respectively) (400 = Sl^{00}, 500 = Sm^{00}, etc.). Angus-sired steers also had

the highest marbling score (553) in GPE Cycle IV as reported by Wheeler et al. (2001),

with Belgian Blue-, Piedmontese- and Brahman-sired steers possessing the lowest

marbling scores (464, 470, and 473, respectively) (400 = Sl^{00}, 500 = Sm^{00}, etc.). The

preliminary results of the Cycle VI GPE project as reported by Cundiff et al. (2001a)

showed Angus-and Wagyu-sired steers exhibited the highest marbling scores (578 and

562, respectively), while Hereford-, Friesian-, and Swedish Red & White-sired steers

collectively had the lowest marbling scores (506, 514, and 517, respectively) (500 =

Sm^{00}). Cundiff et al. (2001b) showed in GPE Cycle VII that Red Angus- and Angus-

sired steers exhibited the highest marbling scores (589 and 577, respectively), while

Limousin-, Gelbvieh-, and Charolais-sired steers all had the lowest marbling scores

(507, 514, and 517, respectively). DeRouen et al. (2002) also found Angus-sired steers

to have the highest marbling scores from both feed yards (LA and OK) (503 and 522,

respectively), when compared to Brangus-, Gelbray-, and Gelbvieh-sired steers from the

same feeding locations (435 and 497, 443 and 460, and 443 and 456, respectively)

(Slight = 400-499, Small = 500-599).

 Yield Grade. The results from Crockett et al. (1979) reported that *Bos indicus*

influence sired steers had higher numerical yield grades (Beefmaster, 3.2; Brahman, 3.6;

Brangus, 3.4) when compared to Continental-sired steers (Limousin, 2.4; Maine-Anjou,

2.5; Simmental, 2.7). Comerford et al. (1988) noted the following results for yield grade

(listed from highest numerical yield grade to lowest) Hereford, Brahman, Simmental, and Limousin (2.9, 2.6, 2.1, and 2.1, respectively). Although, there were no major differences reported in yield grade, Paschal et al. (1995) showed that Indu–Brazil-sired steers exhibited the lowest numerical yield grade and Gray Brahman-sired had the highest (2.3 and 2.8, respectively). The results from Wheeler et al. (1996) from GPE Cycle IV classified steers into different levels of yield (High, Medium, and Low). Piedmontese-, Longhorn-, NS Gelbvieh-, and AI Charolais-sired steers were considered high yielding (2.29, 2.93, 2.91, and 2.90, respectively), NS Charolais-, Pinzgauer-, Galloway-, and Salers-sired steers were in the medium yield range (3.16, 3.18, 3.16, and 3.07, respectively), and AI Hereford/Angus-, NS Hereford/Angus-, Shorthorn-, and Nellore-sired steers were the low yielding group (3.84, 3.58, 3.56, and 3.48, respectively). As reported by Wheeler et al. (2001) for GPE Cycle V, Piedmontese- and Belgian Blue-sired steers exhibited the lowest numerical yield grades (2.13 and 2.35, respectively) while Hereford- and Angus-sired steers exhibited the highest numerical yield grades (3.44 and 3.47, respectively). The preliminary report from GPE Cycle VI by Cundiff et al. (2001a) showed Angus- and Hereford- sired steers had higher numerical yield grades (3.5 and 3.2, respectively), when compared to Wagyu-, Friesian-, Norwegian Red-, and Swedish Red & White-sired steers (2.7, 2.8, 2.8, and 2.8, respectively). Cundiff et al. (2001b) in GPE Cycle VII also showed that Angus-, Hereford-, and Red Angus-sired steers possesed higher numerical yield grades when compared with Simmental-, Gelbvieh-, Limousin-, and Charolais-sired steers (2.95, 2.80, 2.63 and 2.7, respectively). Yield grade differences found by DeRouen et al.

(2002) revealed that Angus- and Brangus-sired steers (3.33 and 3.07, 3.35 and 3.00, respectively) were higher when compared to Gelbvieh- and Gelbray-sired Steers (2.77 and 2.36, 2.92 and 2.78, respectively) from both feeding locations (LA and OK).

The Effect of Morbidity on Feedlot Performance

Another major factor that influences profitability in the feed lot is animal health. Edwards (1996) stated that a one percent death loss costs $5 to $10 loss per animal marketed and $2 an animal for medication costs across the industry. Edwards (1996) concluded that respiratory morbidity reduced the performance of beef steers in the feedlot by reducing carcass weight, fat deposition, and longissimus muscle area. Gardner et al. (1999) evaluated average daily gain, longissimus muscle area, carcass traits and longissimus tenderness on 204 steers in a 150-d feedlot finishing study. The study demonstrated steers treated once and those treated one or more times had lower final weights (512.9 and 497.9 kg, respectively), average daily gain (1.49 and 1.35 kg/d), hot carcass weight (326.6 and 311.8 kg), fat thicknesses (1.09 and .76 cm), and longissimus muscle areas (85 and 82.5 cm^2) compared to steers not requiring treatment treated (523.3 kg final wt., 1.53 average daily gain, 332.2 kg hot carcass weight, 1.17 mm fat thickness, and 86 cm, respectively). Marbling scores were noticeably different in steers treated more than one time compared to steers only treated once or not at all (317.7, 336.0, and 337.5, respectively).

McNeill et al. (1996) evaluated 7,723 steers from the Texas A&M Ranch to Rail program over a four year period (1991-1995). They concluded sick animals had a disadvantage in ADG (1.26 kg/d) compared to healthy steers (1.33 kg/d). Healthy steers

also averaged $92.26 more profit per animal than sick steers. Only $31.00 of the difference in profit could be attributed to medication cost. The remaining $61.26 was attributed to performance losses in ADG and lowered carcass value (McNeill et. al., 1996).

Limited research has been conducted to study bovine respiratory disease (BRD) across breed types. Muggli-Cockett et al. (1992) evaluated 10,142 animals from the Germ Plasm Utilization project at the Roman L. Hruska U.S. Meat Animal Research Center (MARC). The cattle were born in the spring calving seasons (March to May) of 1983 through 1988. Nine purebred breeds including Hereford, Angus, Red Poll, Braunvieh, Limousin, Charolais, Simmental, and Gelbvieh and three composites MARC I (¼ Braunvieh, ¼ Charolais, ¼ Limousin, 1/8 Hereford, 1/8 Angus), MARC II (¼ Gelbvieh, ¼ Simmental, ¼ Hereford, ¼ Angus), MARC III (¼ Angus, ¼ Hereford, ¼ Pinzguaer, ¼ Red Poll) were evaluated in the study. The calves were administered a killed – virus three way vaccine (IBR, BVD, and PI-3) 30 d prior and 30 d post weaning from 1983 to 1987. In 1988, a modified live virus vaccine of IBR and BVD was administered on the same schedule. Of the 10,142 calves evaluated, 2,420 were treated at least once for BRD during the first year of life. The breeds with the highest occurrence of BRD postweaning included Pinzgauer, Hereford, and Braunvieh (24.6, 19.5, and 19.7 percent, respectively). The breeds with the lowest incidence of BRD during the postweaning period included Angus, Limousin, and MARC I (11.8, 12.4, and 12.0 percent, respectively).

Summary of Texas A&M Ranch to Rail Program Results

The Texas A&M Ranch to Rail Program has been in place for over ten years. It was developed to be an information feed back system; it was not established to be a best of breeds contest. Cattle producers should continue to learn more about the cattle they are raising and what factors affect profitability beyond weaning. In order for cow-calf producers to maximize profits through a retained ownership scenario such as this, they must determine what factors influence performance and the value of their cattle in the feedlot and at the packing plant. The number of cattle nominated and ranches involved have varied over the years. The following is a review of the past nine summary reports of the ranch to rail program (Table 2) There were 152, 380, 250, 258, 186, 166, 101, 111, and 74 ranches participating in 1992-93, 1993-94, 1994-95, 1995-96, 1996-97, 1997-98, 1998-99, 1999-2000, and 2000-01, respectively. Over the nine year period 17,833 steers have been nominated to the program with an average of 1,981 steers per year.

The mean average daily gain for the nine years was 1.33 kg/d with a range of 1.25 kg/d to 1.38 kg/d. The average medicine cost for the nine year period was $6.35 per steer with a range of $2.85 to $12.19. The percentage of steers that graded choice was 36.7, until the last two years at which it had risen to 52 percent. The percent of steers with a numerical yield grade of 1 and 2 range from a low of 58 percent (1999-2000) to a high of 82 percent (1998-1999). Average income per steer over the course of the program has ranged from low of $709.37 to a high of $952.96, while the average net profit/loss has ranged from $-54.44 to $142.09. These incomes were affected by the

variability in the cattle and grain markets, medicine costs, feedyard costs, and percent death loss for each respective year (Table 2).

Throughout all of the studies discussed in this review there are many different breeds that excel in various individual traits. This supports the fact that there is no one perfect breed of cattle that meets the need of all producers. There were few differences shown between breeds in average daily gain, slaughter weight, and carcass weight in the studies discussed. Continental-sired steers tended to have higher dressing percentages, larger longissimus muscle areas, smaller fat thicknesses, and lower numerical yield grades when compared to their British- and *Bos indicus*-sired counterparts. British-sired steers were generally exhibited the highest marbling scores and the largest fat thickness measurements. The purpose of this study is to determine which factors have the greatest bearing on net profit or loss for the producer when there cattle are placed in a retained ownership program.

Table 2. Summary of Texas A&M University Ranch to Rail projects 1992- 2001[1]

	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001
no. ranches	152	380	250	258	186	166	101	111	74
no. cattle	1582	3268	2873	2911	2072	1904	1137	1311	775
In value ($)	486.16	486.38	419.04	345.03	353.47	469.21	384.96	464.03	462.28
Mean ADG (kg/d)	1.30	1.31	1.38	1.35	1.34	1.26	1.38	1.37	1.25
% Ch	37.5	33.0	38.0	36.0	38.0	36.0	39.0	51.0	53.0
% St	3.5	7.0	3.0	9.0	6.0	9.0	6.0	4.0	3.0
% YG 1 & 2	73.0	71.0	68.0	68.0	77.0	81.0	82.0	58.0	75.0
% YG 4 & 5	2.0	2.0	5.0	4.0	6.0	1.0	2.0	10.0	2.0
Medicine ($)	5.80	12.19	4.76	9.44	3.02	5.82	2.85	4.47	8.82
% Sick	21.9	34.1	23.2	29.4	14.4	26.6	13.9	16.6	22.5
% Death Loss	1.0	1.3	0.7	1.3	1.6	1.5	2.3	1.4	2.2
Feedyard costs ($)	290.73	345.01	301.21	353.29	337.68	339.14	278.48	311.37	348.59
Cost of gain ($)	49.53	60.12	51.70	68.88	61.52	62.71	53.11	50.91	61.39
Income ($)	932.45	803.92	784.91	709.37	787.43	753.91	734.54	902.04	952.96
Net Profit/Loss ($)	155.56	(27.47)	64.66	(28.32)	96.28	(54.44)	71.10	124.64	142.09
Range net/hd/ranch ($)	(0.21) 307.03	(310.01) 174.64	(112.34) 209.61	(307.91) 137.04	(286.72) 208.07	(268.36) 99.45	(104.04) 181.93	(167.00) 276.93	(248.29) 279.06

[1]McNeill, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001

MATERIALS AND METHODS

The data for this study were obtained from the 2001-2002 Texas A&M University Ranch Rail Program South, and included 1,083 steers. The cattle were processed in two separate groups at the Hondo Creek Cattle Company, Edroy, TX, with 584 received in October and 483 received in November of 2001. Steers were weighed, eartagged, and implanted during initial processing. Steers with a temperature above 40°C were automatically administered an antibiotic regimen to prevent or minimize the time off feed due to bovine respiratory disease.

The steers were assigned a market value on a per hundred weight basis based on current local markets, frame and muscle scores, and then placed into pens at the feedlot by groups based upon weight, frame, flesh condition, and biological type. During the entire feedlot period, the cattle were fed and managed under the normal feedlot regimens.

The steers spent an average of 226 days on feed. Each individual was marketed when it reached the desirable market weight and condition. The cattle were sold on a carcass basis (weight, quality grade, and yield grade) with premiums and discounts given accordingly. The feed, processing and medicine expenses were deducted from the carcass value with the differences being sent to producers.

During harvest, each carcass was electrically stimulated with a high voltage system to increase carcass tenderness and marbling. The quality and yield grades that determined carcass value were determined by the USDA grader at the plant, and the

component traits of quality and yield grades were recorded by Texas A&M university personnel.

There were many steps taken to modify the data set for analysis. All steers were assigned breed abbreviations from the Beef Improvement Federation Guidelines (2002) (Table 3). The original set had 1,083 steers; seventeen steers were removed because of incomplete data (death). Due to the large number of sire (Table 4) and dam (Table 5) breeds used by producers, each sire and dam was placed into a biological group based upon the predominant breed(s) identified by producers. These biological type frequencies were analyzed and steers were placed into fewer groups to reduce number of categories for a more meaningful analysis (Table 6). Steers that were sired by dairy bulls or those classified as specialty breeds (i.e. Texas Longhorn, Senepol, and Hotlander) were removed from the data set due to small number of steers. There were 860 steers evaluated during the final analysis.

The General Linear Model Procedure of the SAS (1999-2000) statistical package and SPSS 11.0 were used to analyze the data. The independent class variables used in each analysis were sire biological group (SBIO), dam biological group (DBIO), kill group (KILL), and Entry month (ENTRYMON). Dependent variables included net income (NET), average daily gain (ADG), carcass weight (HCW), longissimus muscle area (LMA), yield grade (YG), marbling score (MARB), total medication costs (TOTMED), and carcass value (CVL). The above groups were analyzed with three different covariates: initial weight, fat thickness, and carcass weight. The results from

the initial weight analysis are used in the discussion, and the remaining covariate analyses are attached in the appendix.

Multiple regression was performed to determine which traits had the greatest effect on CVL and NI. Independent categorical effects were SBIO, DBIO, KILL and ENTRYMON, while independent continuous effects were INWT, ADG, FT, LMA, MS and TOTMED.

Phenotypic correlations were analyzed by using the correlation procedure in SAS (1999-2000) between net income, initial weight, carcass weight, fat thickness, marbling score, average daily gain, longissimus muscle area, yield grade, total medication cost, and carcass value.

Table 3. Breed abbreviations

Breed	Abreviation[1]
Angus	AN
Barzona	BA
Beefmaster	BM
Blonde 'D Aquitane	BD
Brahman	BR
Braler	BL
Brangus	BN
Braunvieh	BU
Charolais	CH
Chianina	CI
Cross	CR
Gelbvieh	GV
Guernsey	GU
Hereford	HH
Holstein	HO
Hotlander	HT
Jersey	JE
Limousin	LM
Longhorn	TL
Maine Anjou	MA
Polled Hereford	HP
Red Angus	AR
Red Brangus	RB
Saler	SA
Santa Gertrudis	SG
Senepol	SE
Shorthorn	SS
Simbrah	SI
Simmental	SM

[1]Breed abbreviations were taken from Beef Improvement Federation Guidelines (2002).

Table 4. Sire breed frequencies and assigned biological groups

Sire breed[1]	N	Biological Group
1/2AN 1/4AR 1/8BU 1/8CR	1	-
1/2AN 1/4BA 1/4HH	2	-
1/2SA 1/2AN	5	-
3/4AN 1/4BR	2	-
3/4HH 1/4BR	1	-
AN	122	B
AR	28	B
BD	5	C
BM	94	A
BN	88	A
BN CR	5	A
BR	209	R
BU	41	C
CH	54	C
CR	3	-
GV	22	C
HH	61	B
HP	1	B
HT	6	S
LM	24	C
RB	26	A
SA	2	C
SE	1	S
SG	56	A
SI	24	A
SM	21	C
SM CR	13	C
Total	916	100.0

[1]Sire breed abbreviations located in Table 3

Table 5. Dam Breed Frequencies and assigned biological groups

Breed[1]	N	BIO[2]	Breed[1]	N	BIO[2]
1/2BR 1/4MA 1/4CR	1	RCX	3/4SM 1/4BR	1	A
1/2AN 1/2LM	1	CBX	5/8AN 1/4BA 1/8HH	1	BAX
1/2BR 1/4 AR 1/4 BA	1	RBX	5/8AN 3/8BR	1	A
1/2BR 1/4 AR 1/4 CR	1	RBX	7/8SM 1/8CR	2	CX
1/2AN 1/2BM	8	BA	AN-GV-BM	1	CBAX
1/2AN 1/2HH	1	B	AN	19	B
1/2AN 1/2LM	2	CB	AN BA	2	BA
1/2AN 1/4SM 1/4HO	1	CBD	AN CR	1	BX
1/2AN 3/8BA 1/8CH	1	CBAX	AN HH	1	B
1/2AR 1/4BR 1/4HP	2	RBX	AN BU	15	CA
1/2AR 1/4BU 1/4CR	1	CBX	AR	1	A
1/2BA 1/4AN 1/4AR	1	BA	AR BA	6	BA
1/2BN 1/2LM	1	CA	BL	10	AX
1/2BN 1/4SM 1/4HH	1	CBAX	BM	112	AX
1/2BR 1/2SM	1	CR	BN	45	AX
1/2BR 1/2HH	3	RBX	BN CR	31	AX
1/2BR 1/4AN 1/4BA	1	RBX	BN HH	2	CA
1/2BR 1/4AN 1/4HP	1	RBX	BN MA	1	CA
1/2BR 1/4AR 1/4BA	1	RX	BR	48	R
1/2BR 1/4MA 1/4CR	2	RCX	BR AN	8	BR
1/2BR1/2AN	2	RBX	BR CR	1	RX
1/2BR1/2AR	1	RBX	BR HH	22	RBX
1/2BU 1/4AR 1/16BA 1/16CR	1	CBAX	BR HP	1	BR
1/2BU 1/4AR 1/8BA 1/8CR	1	CBAX	BR CR	3	RX
1/2BU 1/4AR 1/8BR 1/8HP	1	CBRX	BU AN	1	CB
1/2BU 1/4BR 1/4HP	1	RBX	CH	2	C
1/2BU 1/4HO 1/4CR	1	CDX	CH AN	1	CB
1/2CH 1/2LM	1	CX	CH BM	1	CA
1/2GU 1/2JE	1	DX	CH CR	2	CX
1/2GV 1/4BA 1/4 HP	1	CB	CI AN	1	CBX
1/2HH 1/2AN	2	B	CR	221	X
1/2HH 1/2BN	2	BA	1/2BR 1/2HH	1	BR
1/2HH 1/2BR	4	RBX	GV	23	C
1/2HH 1/2SM	1	CBX	HH	38	B

Table 5. Continued

Breed[1]	N	BIO[2]	Breed[1]	N	BIO[2]
1/2JE 1/2AN	1	BDX	HH AN	1	B
1/2JE 1/2BR	1	RDX	HH HO	2	BDX
1/2LM 1/2BM	1	CA	HH TL	1	BS
1/2LM 1/2JE	1	CDX	HP	6	B
1/2LM 1/2SM	2	CX	JE	1	DX
1/2LM 1/4HH 1/4BR	2	CBR	JE HH	1	DX
1/2LM 1/4SG 1/4SM	2	CA	LM	3	C
1/2MA 1/4AN 1/4SA	2	CBX	LM MA	1	CX
1/2MA 1/4LM 1/4CR	1	CX	MA CR	1	CX
1/2SI 1/2LM	1	CA	RB	65	A
1/2SM 1/2BR	1	CR	SA CR	1	CX
1/2SM 1/2SG	1	CA	SE	1	S
1/2SS 1/4HH 1/4BR	11	RBX	SG	66	A
1/4BR 1/4CH 1/2CR	1	CRX	SG HH	5	BA
1/4BR 1/4CH 1/2MA	1	CR	SI	22	A
1/4BR 1/4HO 1/2BU	2	CRX	SM	9	C
3/4AN 1/4BA	1	BA	SM BR	1	A
3/4BU 1/8AN 1/8HH	1	CBX	SM CR	15	C
3/4HH 1/4BR	1	RBX	TL	1	S
3/4SA 1/4SG	1	CA			
			Total	916	

[1]Breed abbreviations found in Table 3
[2]Biological group

Table 6. Sire and dam biological-type frequencies

Sire	American	British	Continental	Brahman	Total
Dam					
American	209	50	51	0	310
American Cross	26	0	0	0	26
British	5	20	3	36	64
British American	8	12	1	8	29
Continental	1	14	29	0	44
Continental American	1	3	4	1	9
Continental British	0	15	11	0	26
Continental Brahman	1	2	9	1	13
Continental Cross	2	2	15	3	22
Brahman	2	22	5	17	46
Brahman British Cross	2	37	13	2	54
Cross	30	22	31	134	217
Total	287	199	172	202	860

RESULTS AND DISCUSSION

Analysis of Covariance

Average Daily Gain (ADG). Sire Biological type showed a significant effect on average daily gain (Table 7). The least squares means for American-, British-, Continental-, and Brahman-sired steers were 1.38 kg/d, 1.39 kg/d, 1.35 kg/d, and 1.32 kg/d, respectively (Table 8). The means for this study were similar to the results found by Crockett et al. (1979), and Cundiff et al. (2001a) who also showed little difference among mean average daily gains (1.50 kg/d to 1.57 kg) among several sire breeds. There was a large difference (P < .0001) across dam biological types (Table 7), where steers out of Continental dams exhibited the highest ADG (1.57 kg/d), and American cross dams produced steers with the lowest ADG (1.40 kg/d) (Table 8). There were also differences in average daily gain among kill groups (P < 0.0001), but these can partially be attributed to the days on feed. The least squares means for average daily gain of kill groups ranged from 1.82 kg/d (Group 1) to 1.27 kg/d (Group 14) (Table 8). Between the two entry months there was no significant difference in average daily gain (Table 7).

Slaughter Weight (OUTWT). Sire biological type did not have a significant effect on slaughter weight (Table 7). While the historical slaughter weights of cattle have changed, the more recent studies have shown similar results and trends between sire biological types and slaughter weights. Paschal et al. (1995) showed British-sired (Angus) steers showed to have an OUTWT of 468 kg, while Bos indicus-sired (Gray Brahman, Red Brahman, Gir, Indu-Brazil, Nellore, and Red Brahman) steers averaged

Table 7. Levels of significance from analyses of variance with initial weight as covariate

Source	df	NI[a]	ADG[b]	SW[c]	CW[d]	FT[e]	LMA[f]	MS[g]	YG[h]	MED[i]	CVL[j]
SBIO[k]	3	0.0026	0.0349	0.2406	0.2557	<0.0001	<0.0001	<0.0001	<0.0001	0.5734	0.0108
DBIO[l]	11	0.0004	<0.0001	<0.0001	<0.0001	0.0004	0.0001	0.0070	0.0164	0.1036	<0.0001
KILL[m]	13	<0.0001	<0.0001	<0.0001	<0.0001	0.0054	<0.0001	<0.0001	0.0002	0.5665	<0.0001
ENTRYMON[n]	1	0.0762	0.1131	0.9547	0.1443	0.5188	0.1680	0.5610	0.1145	0.9899	0.3873
INWT[o]	1	0.0056	<0.0001	<0.0001	<0.0001	0.1144	<0.0001	0.7026	0.1045	0.8192	<0.0001
MSE		6880.63	0.04	2021.86	948.50	5366.83	91.13	5013.85	0.70	43.27	0.28
R-square		0.23	0.25	0.39	0.36	0.37	0.25	0.11	0.17	0.04	0.14

[a]Net income($)
[b]Average daily gain (kg)
[c]Slaughter weight (kg)
[d]Carcass weight (kg)
[e]Fat thickness (cm)
[f]Longissimus muscle area (cm2)
[g]Marbling score

[h]Yield grade
[i]Total medicine cost ($)
[j]Carcass value ($)
[k]Sire biological group
[l]Dam biological group
[m]Kill group
[n]Entry month

[o]Initial weight

Table 8. Least squares means and standard errors for feedlot performance traits with initial weight as the covariate

Parameter	n	TOTMED[1]	Average daily gain	Slaughter weight
SIRE GROUP				
American	285	1.89 ± 0.67	1.38 ± 0.02^{ab}	614.3 ± 4.61
British	197	1.70 ± 0.58	1.39 ± 0.02^{a}	617.4 ± 3.97
Continental	168	2.27 ± 0.63	1.35 ± 0.02^{bc}	606.1 ± 4.32
Brahman	202	2.90 ± 0.78	1.32 ± 0.02^{c}	599.0 ± 5.34
DAM GROUP				
American	307	3.66 ± 0.55	1.38 ± 0.02^{abcdef}	613.1 ± 3.73^{cdef}
American Cross	26	1.30 ± 1.60	1.29 ± 0.05^{cghijk}	592.3 ± 10.90^{egijk}
British	64	2.43 ± 0.94	1.35 ± 0.03^{bcdefg}	608.2 ± 6.45^{edfg}
British American	29	1.39 ± 1.28	1.39 ± 0.04^{abcde}	616.1 ± 8.78^{cde}
Continental	44	3.29 ± 1.13	1.45 ± 0.03^{a}	632.6 ± 7.72^{a}
Continental American	9	6.18 ± 2.22	1.34 ± 0.07^{bcdefghi}	607.1 ± 15.18^{edfgh}
Continental British Cross	26	3.01 ± 1.36	1.40 ± 0.04^{abcd}	621.6 ± 9.27^{abc}
Continental Brahman Cross	13	-0.36 ± 1.87	1.40 ± 0.06^{abc}	619.9 ± 12.78^{abcd}
Continental Cross	21	1.08 ± 1.46	1.42 ± 0.04^{ab}	624.7 ± 9.98^{ab}
Brahman	46	0.68 ± 1.09	1.22 ± 0.03^{ijk}	575.2 ± 7.48^{jk}
Brahman British Cross	54	1.56 ± 0.99	1.35 ± 0.03^{bcdefgh}	606.3 ± 6.74^{cdefghi}
Cross	213	2.06 ± 0.62	1.30 ± 0.02^{cghij}	593.6 ± 4.26^{eghij}
KILL GROUP				
1	33	0.91 ± 1.59	1.67 ± 0.05^{a}	564.2 ± 10.88^{k}
2	84	0.62 ± 1.41	1.56 ± 0.04^{b}	562.4 ± 9.61^{l}
3	70	2.34 ± 1.29	1.40 ± 0.04^{cde}	542.7 ± 8.81^{m}
4	63	0.45 ± 1.27	1.35 ± 0.04^{efg}	556.8 ± 8.67^{m}
5	73	1.21 ± 1.30	1.45 ± 0.04^{cd}	610.2 ± 8.86^{hi}
6	57	1.39 ± 1.28	1.40 ± 0.04^{cdef}	612.9 ± 8.77^{eh}
7	66	2.41 ± 1.17	1.27 ± 0.03^{hi}	591.0 ± 7.98^{j}
8	76	1.67 ± 1.15	1.50 ± 0.03^{bc}	652.5 ± 7.84^{a}
9	76	3.11 ± 1.13	1.35 ± 0.03^{fgh}	640.6 ± 7.71^{d}
10	31	3.47 ± 1.50	1.19 ± 0.04^{ijkl}	626.0 ± 10.28^{efg}
11	70	1.85 ± 1.03	1.24 ± 0.03^{ijk}	636.1 ± 7.07^{ef}
12	73	3.35 ± 1.18	1.27 ± 0.03^{ij}	648.8 ± 8.07^{ab}
13	63	3.40 ± 1.28	1.18 ± 0.04^{iklm}	639.4 ± 8.72^{e}
14	25	4.47 ± 1.69	1.16 ± 0.05^{iklm}	645.6 ± 11.54^{c}
ENTRY MONTH				
November	357	2.20 ± 1.03	1.40 ± 0.03	600.9 ± 7.05
October	495	2.18 ± 0.78	1.32 ± 0.02	617.5 ± 5.31

[1]Medication cost

[a-m]Least squares means within a column and independent variable with different superscripts are different ($P < 0.05$)

an OUTWT of 491 kg. Cundiff et al. (2001b) showed British-sired steers (Hereford, Angus, and Red Angus) to have an average slaughter weight of 620 kg, and Continental-sired steers weighed an average of 614 kg. Table 8 shows Continental dams to produce steers with the highest least squares means for slaughter weight (632 kg), and steers produced from Brahman females exhibited the lowest weight (575 kg) (P < 0.0001). Kill group 14 exhibited the highest slaughter weight (646 kg), and kill group three exhibited the lowest (542 kg) (P < 0.0001).

Carcass Weight. There were no significant differences found between sire biological groups on carcass weight (Table 7). Significant differences were found among dam biological groups. Steers produced by Continental dams exhibited the highest weight (398 kg.), while steers produced by Brahman dams exhibited the lowest (358 kg) (Table 9). Kill groups were also different at (P < 0.0001), where kill group nine exhibited the highest least squares mean (410 kg) for carcass weight, and kill group four exhibited the lowest least squares mean (348 kg). There were no significant differences found on carcass weight between the two entry months (Table 7).

Yield Grade. Yield grade differences were significant in sire and dam biological groups and across kill groups (Table 7). American- and Brahman-sired steers exhibited the highest least squares means for yield grade of 3.15 and 3.14, respectively (Table 9). Conversely, Continental-sired steers exhibited the lowest numerical yield grade (2.51). These results were similar with the conclusions reported by Crockett et al. (1979), where American-sired (Beefmaster, 3.2; Brahman, 3.6; Brangus, 3.4) steers exhibited higher

Table 9. Least squares means and standard errors for post harvest traits with initial weight as the covariate

Parameter	n	Carcass weight	Yield grade	LMA[1]
SIRE GROUP				
American	285	386.9 ± 3.16	3.15 ± 0.09^a	90.08 ± 0.98^c
British	197	388.4 ± 2.72	3.10 ± 0.07^{ab}	92.34 ± 0.84^b
Continental	168	382.9± 2.96	2.51 ± 0.08^c	97.65 ± 0.92^a
Brahman	202	381.64 ± 3.66	3.14 ± 0.10^{ab}	89.90 ± 1.13^c
DAM GROUP				
American	307	383.2 ± 2.56^{bcdefgh}	2.95 ± 0.07^{bcdefg}	92.37 ± 0.79^{cdefg}
American Cross	26	372.5 ± 7.47^{fhijk}	3.12 ± 0.20^{abc}	88.53 ± 2.32^{ehijk}
British	64	386.7 ± 4.42^{abcdefg}	3.08 ± 0.12^{abcd}	93.02 ± 1.37^{abcdef}
British American	29	390.8 ± 6.02^{abcde}	3.14 ± 0.16^{ab}	93.90 ± 1.86^{abcd}
Continental	44	398.3 ± 5.29^a	3.03 ± 0.14^{abcde}	94.61 ± 1.64^{abc}
Continental American	9	389.7 ± 10.39^{abcdef}	2.86 ± 0.28^{bcdefghi}	92.11 ± 3.22^{cdefgh}
Continental British Cross	26	392.9 ± 6.35^{abcd}	2.79 ± 0.17^{bcdefghij}	96.93 ± 1.97^{ab}
Continental Brahman Cross	13	393.6 ± 8.75^{abc}	2.99 ± 0.24^{abcdef}	93.87 ± 2.71^{abcde}
Continental Cross	21	394.7 ± 6.83^{ab}	2.74 ± 0.19^{bcdefghijk}	97.53 ± 2.12^a
Brahman	46	358.7 ± 5.13^k	2.69 ± 0.14^{cefghijk}	87.18 ± 1.59^{hijk}
Brahman British Cross	54	382.4 ± 4.62^{bcdefghi}	3.39 ± 0.13^a	89.12 ± 1.43^{ehij}
Cross	213	375.6 ± 2.92^{fgh}	2.92 ± 0.08^{bcdefgh}	90.76 ± 0.90^{defghi}
KILL GROUP				
1	33	358.6 ± 7.45^{kl}	2.57 ± 0.20^{hij}	91.99 ± 2.31^{cdefghi}
2	84	360.5 ± 6.58^k	2.45 ± 0.18^{hjklm}	92.67 ± 2.04^{bcdef}
3	70	349.2 ± 6.03^{klm}	2.49 ± 0.16^{hjkl}	91.80 ± 1.87^{cdefghij}
4	63	348.7 ± 5.94^{klm}	2.48 ± 0.16^{hjlm}	91.71 ± 1.84^{cdefghijk}
5	73	384.8 ± 6.07^{cdfghi}	2.65 ± 0.17^{hi}	96.46 ± 1.88^{ab}
6	57	385.1 ± 6.01^{cdfgh}	2.63 ± 0.16^{hij}	97.08 ± 1.86^a
7	66	375.4 ± 5.46^{hij}	2.70 ± 0.15^h	94.54 ± 1.69^{abc}
8	76	409.4 ± 5.37^{ab}	3.48 ± 0.15^{abc}	89.81 ± 1.66^{cdfghijkl}
9	76	410.7 ± 5.28^a	3.29 ± 0.14^{bcde}	94.35 ± 1.64^{abcde}
10	31	402.3 ± 7.04^{abcde}	3.27 ± 0.19^{bcdef}	94.50 ± 2.18^{abcd}
11	70	397.4 ± 4.84^{cdefg}	3.50 ± 0.13^{ab}	89.40 ± 1.50^{dfghijklm}
12	73	403.2 ± 5.52^{abcd}	3.20 ± 0.15^{bcdefg}	92.23 ± 1.71^{bcdefgh}
13	63	399.9 ± 5.97^{abcdef}	3.60 ± 0.16^a	85.92 ± 1.85^{ijkm}
14	25	403.8 ± 7.90^{abc}	3.34 ± 0.22^{abcd}	92.43 ± 2.45^{bcdefg}
ENTRY MONTH				
November	357	379.3 ± 4.83	2.81 ± 0.13	94.13 ± 1.50
October	495	390.5 ± 3.64	3.14 ± 0.10	90.86 ± 1.13

[1]Longissimus muscle area (cm^2)

[a-m]Least squares means within a column and independent variable with different superscripts are different ($P < 0.05$)

Table 9. continued

Parameter	n	Marbling score[1]	Fat thickness (cm)
SIRE GROUP			
American	285	439 ± 7.26^b	1.42 ± 0.05^{ab}
British	197	457 ± 6.25^a	1.45 ± 0.05^{ab}
Continental	168	443 ± 6.80^{ab}	1.18 ± 0.05^c
Brahman	202	405 ± 8.41^c	1.45 ± 0.06^a
DAM GROUP			
American	307	433 ± 5.88^{bcdef}	1.36 ± 0.04^{bcdefg}
American Cross	26	439 ± 17.17^{bcd}	1.44 ± 0.13^{abcd}
British	64	479 ± 10.15^a	1.50 ± 0.08^{abc}
British American	29	437 ± 13.83^{bcde}	1.55 ± 0.10^{ab}
Continental	44	456 ± 12.16^{ab}	1.41 ± 0.09^{abcde}
Continental American	9	$424 \pm 23.90^{bcdefghij}$	1.20 ± 0.18^{defghijk}
Continental British Cross	26	430 ± 14.60^{bcdefg}	1.35 ± 0.11^{bcdefgh}
Continental Brahman Cross	13	$421 \pm 20.12^{bcdefghijk}$	1.38 ± 0.15^{abcdef}
Continental Cross	21	426 ± 15.71^{bcdefghi}	1.29 ± 0.12^{defghij}
Brahman	46	419 ± 11.79^{defghik}	1.08 ± 0.09^{fjk}
Brahman British Cross	54	$427 \pm 10.62^{bcdefghikl}$	1.63 ± 0.08^a
Cross	213	444 ± 6.71^{bc}	1.32 ± 0.05^{defghi}
KILL GROUP			
1	33	$431 \pm 17.13^{acdefghijk}$	1.14 ± 0.13^{ghijkl}
2	84	450 ± 15.14^{abc}	1.06 ± 0.11^{jklm}
3	70	$425 \pm 13.87^{acdefghijkl}$	1.18 ± 0.10^{ghijk}
4	63	401 ± 13.65^{km}	1.14 ± 0.10^{ghijklm}
5	73	450 ± 13.95^{abcd}	1.23 ± 0.10^{fghij}
6	57	442 ± 13.81^{abcde}	1.26 ± 0.10^{cdfghi}
7	66	$433 \pm 12.56^{abcdefghi}$	1.29 ± 0.09^{bcdfgh}
8	76	$432 \pm 12.35^{acdefghij}$	1.54 ± 0.09^{abcdef}
9	76	458 ± 12.14^{ab}	1.58 ± 0.09^{abcde}
10	31	435 ± 16.18^{abcdefgh}	1.61 ± 0.12^{ab}
11	70	439 ± 11.14^{abcdefg}	1.66 ± 0.08^a
12	73	440 ± 12.70^{abcdef}	1.45 ± 0.09^{bcdefg}
13	63	$403 \pm 13.73^{cefghiklm}$	1.58 ± 0.10^{abc}
14	25	466 ± 18.17^a	1.58 ± 0.13^{abcd}
ENTRY MONTH			
November	357	431 ± 11.11	1.34 ± 0.08
October	495	441 ± 8.36	1.42 ± 0.06

[a-m]Least squares means within a column and independent variable with different superscripts are different ($P < 0.05$)

yield grades than steers sired by Continental sires (Limousin, 2.4; Maine-Anjou, 2.5; Simmental, 2.7). Table 9 shows the highest least squares means for yield grade were observed from steers produced by Brahman/British Cross dams (3.39) and the lowest were produced by Brahman dams (2.69). Kill group 13 exhibited the highest LSM for yield grade (3.60), and kill group 2 exhibited the lowest (2.45). Kill group 2 consisted entirely of Brahman sired-steers and kill group 13 exhibited a balanced mixture of biological types.

Longissimus Muscle Area (LMA). Table 7 displays levels of significance from analysis of variance of LMA with initial weight as the covariate. Sire and dam biological groups and kill groups all showed significant effects on LMA. Table 9 shows the least squares means for American-, British-, Continental-, and Brahman-sired sired steers as 90.08 cm^2, 92.34 cm^2, 97.65 cm^2, and 89.90 cm^2, respectively. A similar trend was reported by Cundiff et al. (2001b) with Continental (Charolais and Limousin) sired steers exhibiting larger mean longissimus muscle areas (90.45 and 90.39 cm^2, respectively) and British (Angus and Red Angus) sired steers exhibiting smaller mean longissimus muscle areas (82.19 and 78.77 cm^2, respectively). Dam biological groups ranged from 97.53 cm^2 (Continental Cross) to 87.18 cm^2 (Brahman). The kill group least squares means ranged from 97.08 cm^2 (Group 6) to 85.92 cm^2 (Group 13). This significance can be attributed to the differences seen in carcass weight as kill groups with heavier carcasses tended to have larger LMA. These differences could partially be attributed to the non-randomized and unbalanced number of biological types in each kill group. Those steers that entered the feeding trial in November also had a higher least

squares mean for LMA (94.13 cm^2) compared to steers that entered the feeding period in

October (90.86 cm^2), but this difference was not significant.

Marbling Score. British-sired steers exhibited the highest least squares mean for

marbling score (457), while Brahman-sired steers exhibited the lowest (405) (P <

0.0001) (Table 9). Similar results were reported by Paschal et al. (1995) as British-sired

(Angus) steers had higher marbling scores when compared to Brahman and other *Bos*

indicus sire breeds. Wheeler et al. (1996) also found British-sired (Shorthorn, Hereford,

and Angus) steers tend to have higher marbling scores (527, 540, and 540, respectively)

when compared to Continental (Charolais) type sired steers (490). The same trends were

exhibited by steers out of British dams (478) and Brahman dams (419) (Table 9) in this

study. Kill group 14 steers had the highest least squares means for marbling score (466),

while Kill group 4 exhibited the lowest least squares mean (400). November steers had a

least squares mean of 431, but were not different (P = 0.56) from those steers that

entered the feedlot in October which exhibited a least squares mean of 441 for marbling

score (Table 9) (300 = Sl^{00}; 400 = Sm^{00}; etc.).

Fat Thickness. Table 7shows the significant differences for the following groups

on fat thickness. American-, British-, Continental-, and Brahman-sired steers exhibited

least squares means for fat thickness of 1.42 cm, 1.45 cm, 1.18 cm, and 1.45 cm,

respectively (Table 9). The same trend was reported by Cundiff et al. (2001b) as British-

sired steers (Angus, Hereford, and Red Angus) exhibited the larger fat thickness

measurements (1.47, 1.40, and 1.52 cm, respectively), when compared to Continental-

sired (Simmental, Gelbvieh, Charolais, and Limousin) (1.07, .99, 1.09, and 1.04,

respectively). The least squares means for fat thickness across dam biological types ranged from 1.08 cm (Brahman dams) to 1.63 cm (Brahman-British cross dams) (Table 9). Although there were significant differences in fat thickness among kill groups, this significance can be partly attributed to the non randomization of breed type, number of head in the individual kill groups, and the time each individual was on feed (Table 9). Kill group 2 exhibited the lowest least squares mean for fat thickness as shown in Table 9. Kill group 2 consisted completely of steers sired by Brahman bulls. Kill group 11 had the highest least squares mean for fat thickness (1.63 cm) (Table 9). The month of entry in to the feeding period had no significant effect on fat thickness (P = 0.51) (Table 7).

Medicine Cost. There were no significant differences in medicine cost due to sire biological type (P = 0.57), dam biological type (P = 0.10), kill groups (P = 0.56), or entry month groups (P = 0.98) (Table 7).

Carcass Value. The major determining factors of carcass value at the time the steers were harvested were the current market prices and carcass weight. There was a significant difference between sire biological types in carcass value (Table 7). The carcass value least squares means for American-, British-, Continental-, Brahman-sired steers were $879, $891, $887, and $859, respectively per steer (Table 11). Steers produced by Continental cross dams exhibited the highest least squares mean for carcass value ($921), and the Brahman dams produced steers with the lowest least squares mean ($831) (Table 7). There were significant differences among kill groups for carcass value,

Table 10. Average days on feed listed by kill group

Kill group	Days on feed
1	160
2	167
3	181
4	198
5	219
6	228
7	235
8	217
9	234
10	276
11	254
12	254
13	261
14	268

where kill group 2 showed the highest least squares mean ($916) and kill group 4 had the lowest ($815) (Table 11).

Net Income. There are many factors that contribute to net income. These factors include but are not limited to initial value, carcass weight, marbling score, yield, medicine cost, grain prices and feed efficiency. The least squares means for steers sired by American, British, Continental, and Brahman bulls were $15.27, $25.62, $12.98, and $17.80, respectively per animal (P = 0.0026) (Table 7 and 11). Steers produced from Continental dams exhibited the highest least squares mean ($55.26), and Brahman females produced steers with the lowest net income ($-36.16). There was a significant difference in net income among kill groups. Those groups that were killed earlier in the program tended to have higher net incomes. For example, kill groups one and two exhibited the highest net incomes $131.31 and $141.72, respectively) while seven of the last eight kill groups had negative least squares means for net income (Table 11). This difference can be attributed to the increase in days on feed (Table 10) and the decrease in carcass price.

Table 11. Least squares means and standard errors for economic traits with initial weight as the covariate

Parameter	n	Net income ($)	Carcass value ($)
SIRE BIOLOGICAL GROUP			
American	285	15.27 ± 8.54[a]	879.1 ± 7.51[ab]
British	197	25.62 ± 7.35[a]	891.2 ± 6.47[a]
Continental	168	12.98 ± 8.02[a]	887.8 ± 7.03[b]
Brahman	202	-17.80 ± 9.90[b]	859.2 ± 8.70[b]
DAM BIOLOGICAL GROUP			
American	307	1.71 ± 6.92[cdefg]	869.7 ± 6.08[abcdef]
American Cross	26	-10.74 ± 20.13[cefghi]	851.6 ± 17.77[dghijk]
British	64	10.38 ± 11.90[bcdef]	881.3 ± 10.50[bcdefgh]
British American	29	25.29 ± 16.21[abcd]	891.0 ± 14.31[abcde]
Continental	44	43.72 ± 14.25[ab]	913.2 ± 12.58[a]
Continental American	9	-5.32 ± 28.01[cdefg]	893.9 ± 24.73[bcdefghi]
Continental British Cross	26	17.95 ± 17.12[abcde]	882.2 ± 15.11[abc]
Continental Brahman Cross	13	29.89 ± 23.59[abc]	900.5 ± 20.82[abcd]
Continental Cross	21	55.36 ± 18.82a	921.0 ± 16.25[ab]
Brahman	46	-36.16 ± 13.82[ghij]	831.1 ± 12.19[ijk]
Brahman British Cross	54	-14.43 ± 12.49[cefghij]	856.5 ± 10.99[bcdefg]
Cross	213	-9.46 ± 8.03[cdefgh]	859.6 ± 6.94[dghij]
KILL GROUP			
1	33	131.31 ± 20.14[a]	905.1 ± 17.73[a]
2	84	141.72 ± 17.79[a]	916.2 ± 15.66[b]
3	70	35.40 ± 16.29[bc]	842.6 ± 14.35[bcd]
4	63	-13.29 ± 16.01[efg]	815.4 ± 14.12[cd]
5	73	36.65 ± 16.37[b]	900.7 ± 14.43[cde]
6	57	32.64 ± 16.19[bcd]	900.3 ± 14.29[cdef]
7	66	-32.97 ± 13.00[fghij]	847.8 ± 13.00[efg]
8	76	10.14 ± 12.77[bcde]	886.7 ± 12.77[efgh]
9	76	-2.11 ± 12.56[bcdef]	902.1 ± 12.56[hi]
10	31	-31.73 ± 16.74[fghi]	896.5 ± 16.74[ijk]
11	70	-77.95 ± 11.52[l]	863.9 ± 11.52[ijkl]
12	73	-24.00 ± 13.14[fgh]	886.8 ± 13.14[ijkl]
13	63	-34.50 ± 14.21[ghijk]	875.6 ± 14.21[iklm]
14	25	-45.08 ± 18.80[ghijkl]	870.7 ± 18.80[iklm]
ENTRY MONTH			
November	357	27.31 ± 11.49	871.4 ± 11.49
October	495	-9.28 ± 8.65	887.2 ± 8.65

[a-m]Least square means within a column and independent variable with different superscripts are different (P < 0.05)

Correlation Coefficients

The following results are taken from Table 12**.** Correlation coefficients were analyzed between all feedlot and carcass variables evaluated in this study. Net income showed to be moderately correlated to carcass weight (0.59), average daily gain (0.66), and carcass value (0.81). The correlation of carcass weight and carcass value to net income can be attributed to their place in the net income equation (net income= revenue minus expenses), and carcass value would be the major part of the revenue. The relationship between average daily gain and net income shows faster gaining steers were more profitable. Marbling score was lowly correlated to net income (0.30). This can be connected to carcass value as marbling score is lowly correlated to carcass value (0.32). A moderate correlation of 0.63 was seen between average daily gain and carcass weight, while a low correlation was seen between ADG and fat thickness (0.33). Longissimus muscle area and carcass weight were shown to be moderately correlated (0.43). Similar results were reported by Koch et al. (1978 and 1982) (0.37 and 0.43), Lamb et al. (1990) (0.58), and Wilson et al. (1993) (0.43). Carcass weight exhibited high correlation to carcass value (0.80). This can be expected as carcass weight multiplied by price determines carcass value. Table 12 also shows fat thickness to have a high positive correlation (0.87), and longissimus muscle area a medium negative correlation (-0.51) to yield grade. This can be accounted for as both of these factors are in the equation used to determine yield grade. Average daily gain and longissimus muscle area were moderately correlated to carcass value (0.54 and 0.49, respectively).

Table 12. Correlation coefficients between feedlot and carcass traits

Trait	INWT[b]	HCW[c]	FAT[d]	MARB[e]	ADG[f]	REA[g]	YG[h]	TOTME	CARCV
NET[a]	0.1533 <.0001	0.5882 <.0001	0.0705 0.0397	0.2971 <.0001	0.6629 <.0001	0.3502 <.0001	0.0626 <.0674	-0.1493 <.0001	0.8074 <.0001
INWT[b]		0.3193 <.0001	-0.0619 0.0693	-0.0170 0.6181	-0.0663 0.0451	0.2282 <.0001	-0.0625 0.0668	-0.0521 0.1156	0.4984 <.0001
HCW[c]			0.4414 <.0001	0.2646 <.0001	0.6325 <.0001	0.4328 <.0001	0.3940 <.0001	-0.0282 0.3944	0.7962 <.0001
FAT[d]				0.2646 <.0001	0.3323 <.0001	-0.1397 <.0001	0.8705 <.0001	-0.0423 0.2148	0.1104 0.0012
MARB[e]					0.2158 <.0001	0.0721 0.0344	0.2310 <.0001	-0.0344 0.0032	0.3173 <.0001
ADG[f]						0.2121 <.0001	0.3281 <.0001	-0.0316 0.3399	0.5391 <.0001
LMA[b]							-0.5058 <.0001	-0.0116 0.7251	0.4865 <.0001
YG[h]								-0.0344 0.2593	0.0822 0.0159
TOTMED[i]									-0.0779 0.0223

[a]Net income
[b]Actual weight at beginning of feeding trial
[c]Hot carcass weight
[d]Subcutaneous fat thickness measured between the 12th and 13th ribs
[e]Marbling score
[f]Average daily gain
[g]Longissimus muscle area
[h]Yield grade
[i]All medication cost during feeding trial

Prediction of Carcass Value and Net Income

Carcass Value. The following results come from Table 13. Carcasses harvested from British-sired steers were worth $6.78 more on average compared to Brahman-sired steers. Continental cross dams produced steers with carcasses worth $19.30 more than those steers that were produced from Crossbred dams. On the other hand, Continental British cross dams produced steers whose carcass value was $13.65 less than that of Cross dams. Kill group two exhibited carcasses with the highest value when compared to kill group 14, and steers that entered the feeding period in November produced carcasses worth $4.76 dollars more than those that entered in October. Table 13 also shows that ADG levels did not have an effect on carcass value, but as expected, carcass weight, fat thickness, longissimus muscle area, and marbling all greatly influenced carcass value.

Table 13. Estimated levels of independent effects on carcass value

Parameter	Estimate	SE	t-value	Pr > |t|
SBIO[a]				
A	1.39	5.13	0.27	0.79
B	6.78	4.75	1.43	0.15
C	4.31	5.15	0.84	0.40
R	0.00	.	.	.
DBIO[b]				
A	-3.25	4.44	-0.73	0.46
AX	5.21	8.45	0.62	0.54
B	-2.65	5.60	-0.47	0.64
BA	7.67	7.39	1.04	0.30
C	4.74	6.61	0.72	0.47
CA	3.15	11.91	0.26	0.79
CBX	-13.65	7.82	-1.74	0.08
CRX	7.41	10.19	0.73	0.47
CX	19.30	8.22	2.35	0.02
R	4.26	6.65	0.64	0.52
RBX	-1.88	6.17	-0.31	0.76
X	0.00	.	.	.
KILL[c]				
1	119.77	16.86	7.10	<.0001
2	120.07	15.45	7.77	<.0001
3	79.93	14.44	5.53	<.0001
4	56.83	13.93	4.08	<.0001
5	57.29	13.64	4.20	<.0001
6	58.55	13.20	4.44	<.0001
7	30.67	12.36	2.48	0.01
8	10.27	9.33	1.10	0.27
9	17.18	8.80	1.95	0.05
10	34.47	12.44	2.77	0.01
11	16.38	8.65	1.89	0.06
12	17.41	8.51	2.05	0.04
13	28.55	8.22	3.47	0.00
14	0	.	.	.

R-Square= 0.87

[a]Sire biological group A = American, B = British, C = Continental, R = Brahman

[b]Dam biological group

[c]Kill group

Table 13. Continued

Parameter	Estimate	SE	*t*-value	Pr > |*t*|
ENTRYMONTH				
November	4.76	8.58	0.55	0.58
October	0.00	.	.	.
INWTM[a]	-0.00	0.07	-0.03	0.98
ADGM[b]	-0.54	12.44	-0.04	0.97
HCWM[c]	2.12	0.09	24.63	<.0001
FATM[d]	-38.37	2.71	-14.18	<.0001
REAM[e]	0.56	0.14	4.02	<.0001
MARB[f]	0.18	0.02	10.49	<.0001
TOTMED[g]	-0.09	0.18	-0.51	0.61

R-square = 0.87

[a]Initial weight

[b]Average daily gain

[c]Hot carcass weight

[d]Fat thickness measurement taken between the 12th and 13th ribs

[e]Longissimus muscle area

[f]Marbling score

[g]Total medication cost per steer

Net Income. American- and British-sired steers produced a net income of $11.82 and $11.78 higher than Brahman-sired steers, respectively (Table 14). Continental Cross dams produced steers that had a net income of $26.67 higher than steers produced from Cross dams, while at the same time steers from Continental American dams exhibited a net income of $19.15 less than Cross Dams. Kill group one steers had a net income of $271.82 dollars more than Kill Group 14. Kill Group 11 steers had a net income $9.70 less than kill group 14. Steers that were placed on feed in November showed a net income of $58.29 more than steers that were placed in October. These differences show the changes in market conditions during the feeding period. As with carcass value, regression on average daily gain and medicine cost had no significant effect on net income, but initial weight, carcass weight, fat thickness, longissimus muscle area, marbling score, and medicine cost all greatly influenced net income

Table 14. Estimated levels of independent effects on net income

Parameter	Estimate	SE	*t*-value	Pr > |*t*|
SBIO[a]				
A	11.82	7.06	1.67	0.09
B	11.78	6.55	1.80	0.07
C	1.90	7.11	0.27	0.79
R	0.00	.	.	.
DBIO[b]				
A	3.48	6.18	0.56	0.57
AX	14.52	11.60	1.25	0.21
B	-0.36	7.71	-0.05	0.96
BA	15.72	10.18	1.54	0.12
C	8.31	9.12	0.91	0.36
CA	-19.15	16.37	-1.17	0.24
CBX	-2.20	10.79	-0.20	0.84
CRX	8.13	14.03	0.58	0.56
CX	26.67	11.56	2.31	0.02
R	12.15	9.20	1.32	0.19
RBX	5.31	8.57	0.62	0.54
X	0.00	.	.	.
KILL[c]				
1	271.82	23.20	11.72	<.0001
2	270.77	21.24	12.75	<.0001
3	198.26	19.86	9.98	<.0001
4	151.93	19.15	7.93	<.0001
5	112.36	18.75	5.99	<.0001
6	110.47	18.13	6.09	<.0001
7	70.97	16.97	4.18	<.0001
8	47.56	12.83	3.71	0.00
9	23.97	12.14	1.97	0.05
10	21.54	17.06	1.26	0.21
11	-9.70	11.86	-0.82	0.41
12	24.08	11.69	2.06	0.04
13	35.14	11.28	3.12	0.00
14	0.00	.	.	.

R-square= 0.76

[a]Sire biological group; A=American, B=British, C=Continental, R=Brahman

[b]Dam biological group

[c]Kill group

Table 14. continued

Parameter	Estimate	SE	*t*-value	Pr > |*t*|
ENTRYMON				
November	58.29	8.58	0.55	0.58
October	0.00	.	.	.
INWTM[a]	-1.35	1.00	-14.1	<.0001
ADGM[b]	-9.44	17.09	-0.55	0.5812
HCWM[c]	2.29	0.12	19.37	<.0001
FATM[d]	-43.08	3.71	-11.60	<.0001
LMA[e]	0.53	0.19	2.75	0.0060
MARB[f]	0.20	0.02	8.34	<.0001
TOTMED[g]	-1.10	0.25	-4.45	<.0001
R-square = 0.76				

[a]Initial weight

[b]Average daily gain

[c]Hot carcass weight

[d]Fat thickness measured between the 12th and 13th ribs

[e]Longissimus muscle area

[f]Marbling score

[g]Total medication cost per steer

CONCLUSIONS AND IMPLICATIONS

Beef cattle producers are constantly trying to improve the economic value and the profitability of the cattle that they are producing and marketing. While trying to maximize the value of their product, many producers try to find the "perfect" breed or breed combinations in order to meet the demands and pressures of a consumer driven industry. With a large genetic base and numerous breeds available, this can become an extremely confusing and discouraging task. Through programs such as the Texas A&M University Ranch to Rail Program, producers can receive feedback on the product they are producing and continue to use or change their genetics to improve in the direction needed to be more profitable.

The bull(s) that producers choose to use in their herds will have the most substantial effect on the herd as each sire may produce 25-35 offspring on average and each cow only produces one calf naturally each year. This investigation showed sire and dam biological types to have a significant effect on the economically valuable traits such average daily gain, marbling score, longissimus muscle area, fat thickness, and carcass weight.

As many researchers have shown before that no one particular breed excels in all of the economically valuable traits mentioned above, most breeds excel in either growth or carcass traits, but not both. The same results were exhibited in this study. Some sire biological groups (British) have excelled in carcass quality traits such as marbling score, but at the same time they were not the highest in cutability (YG), while other biological

types produce carcasses that had larger longissimus muscle areas (LMA), heavier carcass (HCW), and were faster gaining (ADG), but these are typically less desirable for carcass quality traits. Dam biological group also had a significant effect on the economically valuable traits, but the results were similar to sire biological groups as no one biological group excelled in all traits.

In order to produce cattle that will be the most economically valuable, producers should utilize programs such as the ranch to rail to evaluate the offspring they are producing, understand the avenues and options they will have to market there cattle, and try to match their cow herd genetics to the production environment in which they operate.

LITERATURE CITED

Beef Improvement Federation. 2002. Guidelines for Uniform Beef Improvement Programs. (8th Ed.) Available at http://www.beefimprovement.org/guidelines Accessed June 2, 2003.

Comerford, J.W., L.L. Benyshek, J.K. Bertrand, and M. H. Johnson. 1988. Evaluation of performance characteristics in a diallel among Simmental, Limousin, Polled Hereford, and Brahman Cattle. II. Carcass Traits. J. Anim. Sci. 66:306-316.

Crockett, J.R., F.S. Baker,Jr., J.W. Carpenter, and M. Koger. 1979. Preweaning, feedlot, and carcass characteristics of calves sired by continental, Brahman and Brahman derivative sires in sub tropical Florida. J. Anim. Sci. 49:900-907.

Cundiff, L.V., T.L. Wheeler, K.E. Gregory, S.D. Shackelford, M. Koohmaraie, R.M. Thallman, and L.D. Van Vleck. 2001a. Preliminary results from cycle VII of the cattle germplasm evaluation program at the Roman L. Hruska U.S. Meat Animal Research Center. Germplasm Evaluation Program Progress Report No. 20. R.L. Hruska Meat Anim. Res. Ctr., ARS, USDA.

Cundiff, L.V., T.L. Wheeler, S.D. Shackelford, M. Koohmaraie, R.M. Thallman, K.E. Gregory, and L.D. Van Vleck. 2001b. Preliminary results from cycle VI of the cattle germplasm evaluation program at the Roman L. Hruska U.S. Meat Animal Research Center. Germplasm Evaluation Program Progress Report No. 21. R.L. Hruska Meat Anim. Res. Ctr., ARS, USDA.

Damon, Jr., R.A., R.M. Crown, C.B. Singletary, and S.E. McCraine. 1960. Carcass characteristics of purebred and crossbred beef steers in the gulf coast region. J. Anim. Sci 19:821-844.

DeRouen, S.M., W. E. Wyatt, T.D. Binder, and M.A. Persica. 2002. Feedlot and carcass performance of Angus-, Brangus-, Gelbvieh- and Gelbray-Sired crossbred steers. Prof. Anim. Sci. 16:6-12.

Edwards, A. 1996. Respiratory disease of feedlot cattle in central USA. The Bovine Practitioner. 30:5-7

Gardner, B.A., H.G. Dolezal, L.K. Bryant, F.N. Owens, and R.A. Smith. 1999. Health of Finishing Steers: Effects on performance, carcass traits, and meat tenderness. J. Anim. Sci. 77:3168-3175.

Koch, R.M. 1978. Selection in beef cattle III. Correlated response of carcass traits to selection for weaning weight, yearling weight, and muscling score in cattle. J. Anim. Sci. 47:142.

Koch, R.M., L. V. Cundiff, and K.E. Gregory. 1982. Heritabilities and genetic, environmental, and phenotypic correlations of carcass traits in a population of diverse biological types and their implications in selection programs. J. Anim. Sci. 55:1319.

Lamb, M.A., O. W. Robinson, and M.W. Tess. 1990. Genetic parameters for carcass traits in Hereford bulls. J. Anim. Sci. 68:64.

McKissick, J.C. and D.T. Brown. 2001. Profitable cattle marketing for the cow-calf producer. Georgia Coop. Ext. Ser. Bull. 1078. Available at http:// www.ces.uga.edu/pubcd/b1078-w.html. Accessed April 25, 2003.

McNeill, J. W. 1993. 1992-93 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. Available at http://animalscience.tamu.edu/ansc/publications/rrpubs /9293.pdf. Accessed June 26, 2003.

McNeill, J. W. 1994. 1993-94 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9394sum.pdf Accessed June 26, 2003.

McNeill, J. W. 1995. 1994-95 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9495.pdf Accessed June 26, 2003.

McNeill, J. W. 1996. 1995-96 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9596sum.pdf. Accessed June 26, 2003.

McNeill, J. W., J.C. Paschal, M.S. McNeill, and W.M. Morgan. 1996. Effect of morbidity on performance and profitability of feedlot steers. J. Anim. Sci. 74(Suppl. 1):135. (Abstract).

McNeill, J. W. 1997. 1996-97 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9697sumary.pdf. Accessed June 26, 2003.

McNeill, J. W. 1998. 1997-98 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9798.pdf. Accessed June 26, 2003.

McNeill, J. W. 1999. 1998-99 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/9899sum.pdf. Accessed June 26, 2003.

McNeill, J. W. 2000. 1999-2000 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/ASWeb066-2000summary.pdf. Accessed June 26, 2003.

McNeill, J. W. 2001. 2000-01 Texas A&M Ranch to Rail Summary Report. Tx Ag. Exp. Stn. http://animalscience.tamu.edu/ansc/publications/rrpubs/ASWeb084-2001summary.pdf. Accessed June 26, 2003.

Muggli-Cockett, N.E., L.V. Cundiff, and K.E. Gregory. 1992. Genetic analysis of bovine respiratory disease in beef cattle during the first year of life. J. Anim. Sci. 70:2013-2019.

Paschal, J.C., J. O. Sanders, J.L. Kerr, D.K. Lunt, and A. D. Herring. 1995. Post weaning and feed lot growth and carcass characteristics of Angus-, Gray Brahman-, Gir-, Indu-Brazil, Nellore-, and Red Brahman –Sired F_1 Calves. J. Anim. Sci. 73:373-380.

Porter, V. 1992. Cattle: A Handbook to the Breeds of the World. Facts on File, New York, New York.

Taylor, R.E. and T.G. Field. 2003. Beef Production and Management Decisions. (4th Ed.) Prentice Hall, Upper Saddle River, New Jersey.

Urick J.J., M. D. MacNeil, and W.L. Reynolds. 1991. Biological type effects on postweaning growth feed efficiency and carcass characteristics of steers. J. Anim. Sci. 68:490-497.

West, R.L., M.A. Elzo, and D. L. Wakeman. 1995. Effects of breed composition on carcass and meat traits. 1995 Florida Beef Cattle Shortcourse Proc. http://www.ufl.edu/extension/beef/documents/short95/west.pdf. Accessed May 28, 2003

Wheeler, T.L., L.V. Cundiff, R.M. Koch, and J.D. Crouse. 1996. Characterization of biological types of cattle (Cycle IV): Carcass traits and longissimus palatability. J. Anim. Sci. 74:1023-1035.

Wheeler, T.L., L.V. Cundiff, S.D. Shackelford, and M. Koohmaraie. 2001. Characterization of biological types of cattle (Cycle V): Carcass traits and longissimus palatability. J. Anim. Sci. 79:1209-1222.

Wilson, D.E., R. L. Williams, S. L. Northcutt, G.H. Rouse. 1993. Genetic parameters for carcass traits estimated from Angus field records. J. Anim. Sci. 71:2365.

Wyatt, W.E., T.D. Binder, P.E. Humes, D.E. Franke, and D.C. Blouin. 2002. Cow-calf and feedlot performance of Brahman-derivative breeds. J. Anim. Sci. 80:3037-3045.

APPENDIX

Table 15. Levels of significance from analyses of variance with fat thickness as covariate

Source	df	NI[a]	ADG[b]	SW[c]	CW[d]	LMA[e]	MS[f]	YG[g]	MED[h]	CVL[i]
SBIO[j]	3	0.0007	0.0055	0.2406	0.7599	< 0.0001	< 0.0001	< 0.0001	0.5875	0.1202
DBIO[k]	11	0.0009	0.0002	< 0.0001	< 0.0001	< 0.0001	0.0141	0.2431	0.0995	<.0001
KILL[l]	13	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0006	0.491	<.0001
ENTRYMON[m]	1	0.122	0.3325	0.9547	0.8927	0.0551	0.6044	0.0477	0.9935	0.6841
FT[n]	1	0.0002	<0.0001	< 0.0001	< 0.0001	0.0002	< 0.0001	< 0.0001	0.0794	<.0001
MSE		6828	0.04	2052	4429	93.16	4667	0.18	43.11	5993
R-square		0.23	0.29	0.38	0.38	0.23	0.17	0.79	0.05	0.30

[a]Net income($)

[b]Average daily gain (kg)

[c]Slaughter weight (kg)

[d]Carcass weight (kg)

[e]Longissimus muscle area (cm^2)

[f]Marbling score

[g]Yield grade

[h]Total medicine cost ($)

[i]Carcass value ($)

[j]Sire biological group

[k]Dam biological group

[l]Kill group

[m]Entry month

[n]Fat thickness

Table 16. Least squares means and standard errors for feedlot performance traits with fat thickness as the covariate

Parameter	n	TOTMED[a]	ADG[b]	OUTWT[c]
SIRE GROUP				
American	285	1.92 ± 0.67	1.36 ± 0.02	616 ± 4.64
British	197	1.75 ± 0.58	1.38 ± 0.02	614 ± 4.00
Continental	168	2.12 ± 0.64	1.37 ± 0.02	613 ± 4.38
Brahman	202	2.99 ± 0.78	1.29 ± 0.02	602 ± 5.36
DAM GROUP				
American	307	3.63 ± 0.54	1.39 ± 0.02	610 ± 3.75
American Cross	26	1.32 ± 1.59	1.30 ± 0.05	584 ± 10.98
British	64	2.53 ± 0.94	1.33 ± 0.03	605 ± 6.50
British American	29	1.51 ± 1.28	1.38 ± 0.04	606 ± 8.86
Continental	44	3.32 ± 1.13	1.44 ± 0.03	632 ± 7.78
Continental American	9	6.09 ± 2.22	1.34 ± 0.06	622 ± 15.28
Continental British Cross	26	3.00 ± 1.35	1.40 ± 0.04	624 ± 9.34
Continental Brahman Cross	13	-0.32 ± 1.86	1.37 ± 0.05	629 ± 12.85
Continental Cross	21	1.05 ± 1.45	1.41 ± 0.04	636 ± 10.02
Brahman	46	0.44 ± 1.10	1.28 ± 0.03	583 ± 7.59
Brahman British Cross	54	1.79 ± 0.99	1.29 ± 0.03	606 ± 6.80
Cross	213	2.02 ± 0.62	1.30 ± 0.02	555 ± 4.25
KILL GROUP				
1	33	0.94 ± 1.45	1.55 ± 0.04	626 ± 10.00
2	84	0.48 ± 1.37	1.53 ± 0.04	599 ± 9.48
3	70	2.31 ± 1.23	1.33 ± 0.04	581 ± 8.50
4	63	0.33 ± 1.26	1.34 ± 0.04	580 ± 8.67
5	73	1.18 ± 1.27	1.42 ± 0.04	635 ± 8.78
6	57	1.34 ± 1.28	1.40 ± 0.04	627 ± 8.80
7	66	2.36 ± 1.16	1.28 ± 0.03	597 ± 8.04
8	76	1.77 ± 1.14	1.50 ± 0.03	641 ± 7.90
9	76	3.29 ± 1.13	1.31 ± 0.04	640 ± 7.78
10	31	3.55 ± 1.48	1.23 ± 0.03	595 ± 10.59
11	70	1.95 ± 0.97	1.29 ± 0.03	596 ± 6.70
12	73	3.38 ± 1.17	1.28 ± 0.04	638 ± 8.10
13	63	3.44 ± 1.22	1.24 ± 0.04	603 ± 8.45
14	25	4.46 ± 1.60	1.27 ± 0.05	596 ± 11.07
ENTRY MONTH				
November	357	2.21 ± 1.02	1.38 ± 0.03	611 ± 7.07
October	495	2.19 ± 0.77	1.33 ± 0.02	611 ± 5.33

[a]Medication cost
[b]Average daily gain

Table 17. Least squares means and standard errors for post harvest traits with fat thickness as the covariate

Parameter	n	HCW[a]	Yield grade	LMA[b]
SIRE GROUP				
American	285	388 ± 3.10	3.09 ± 0.04	90 ± 0.99
British	197	386 ± 2.67	2.99 ± 0.04	92 ± 0.85
Continental	168	388 ± 2.92	2.77 ± 0.04	97 ± 0.93
Brahman	202	384 ± 3.57	3.05 ± 0.05	91 ± 1.14
DAM GROUP				
American	307	381 ± 2.50	2.97 ± 0.03	92 ± 0.80
American Cross	26	367 ± 7.33	3.03 ± 0.10	88 ± 2.33
British	64	385 ± 4.34	2.92 ± 0.06	93 ± 1.39
British American	29	383 ± 5.91	2.90 ± 0.08	94 ± 1.89
Continental	44	397 ± 5.20	2.98 ± 0.07	95 ± 1.66
Continental American	9	400 ± 10.20	3.11 ± 0.14	93 ± 3.26
Continental British Cross	26	375 ± 6.24	2.83 ± 0.09	97 ± 1.99
Continental Brahman Cross	13	400 ± 8.56	2.98 ± 0.12	95 ± 2.74
Continental Cross	21	403 ± 6.70	2.86 ± 0.09	98 ± 2.14
Brahman	46	365 ± 5.07	3.10 ± 0.07	86 ± 1.62
Brahman British Cross	54	381 ± 4.54	3.05 ± 0.06	91 ± 1.45
Cross	213	377 ± 2.87	3.00 ± 0.04	91 ± 0.91
KILL GROUP				
1	33	402 ± 6.68	2.92 ± 0.09	97 ± 2.13
2	84	387 ± 6.33	2.89 ± 0.09	95 ± 2.02
3	70	376 ± 5.67	2.78 ± 0.08	95 ± 1.81
4	63	365 ± 5.79	2.81 ± 0.08	93 ± 1.85
5	73	403 ± 5.86	2.87 ± 0.08	98 ± 1.87
6	57	395 ± 5.88	2.79 ± 0.08	98 ± 1.88
7	66	380 ± 5.37	2.83 ± 0.07	95 ± 1.71
8	76	401 ± 5.27	3.25 ± 0.07	90 ± 1.68
9	76	409 ± 5.19	3.02 ± 0.07	96 ± 1.66
10	31	380 ± 6.80	2.95 ± 0.10	93 ± 2.17
11	70	370 ± 4.48	3.10 ± 0.06	87 ± 1.43
12	73	396 ± 5.41	3.10 ± 0.08	92 ± 1.73
13	63	374 ± 5.64	3.31 ± 0.08	83 ± 1.80
14	25	369 ± 7.39	3.05 ± 0.10	88 ± 2.36
ENTRY MONTH				
November	357	387 ± 4.72	2.87 ± 0.07	95 ± 1.51
October	495	386 ± 3.56	3.08 ± 0.05	90 ± 1.14

[a]Hot carcass weight (kg)
[b]Longissimus muscle area (cm^2)

Table 17. continued

Parameter	n	Marbling score[1]
SIRE GROUP		
American	285	437 ± 7.00
British	197	455 ± 6.04
Continental	168	450 ± 6.62
Brahman	202	402 ± 8.09
DAM GROUP		
American	307	434 ± 5.65
American Cross	26	438 ± 16.55
British	64	474 ± 9.81
British American	29	431 ± 13.36
Continental	44	454 ± 11.74
Continental American	9	429 ± 23.05
Continental British Cross	26	430 ± 14.09
Continental Brahman Cross	13	420 ± 19.38
Continental Cross	21	428 ± 15.12
Brahman	46	430 ± 11.45
Brahman British Cross	54	417 ± 10.26
Cross	213	446 ± 6.47
KILL GROUP		
1	33	434 ± 15.09
2	84	458 ± 14.30
3	70	429 ± 12.81
4	63	407 ± 13.08
5	73	453 ± 13.24
6	57	446 ± 13.28
7	66	436 ± 12.12
8	76	427 ± 11.91
9	76	451 ± 11.72
10	31	429 ± 15.37
11	70	433 ± 10.11
12	73	438 ± 12.22
13	63	399 ± 12.74
14	25	464 ± 16.69
ENTRY MONTH		
November	357	432 ± 10.66
October	495	440 ± 8.04

[1]$400 = Sm^{00}$; $300 = Sl^{00}$ etc.

Table 18. Least squares means and standard errors for economic traits with fat thickness as the covariate

Parameter	n	Net income ($)	Carcass value ($)
SIRE BIOLOGICAL			
American	285	13.28 ± 8.50	882 ± 7.93
British	197	24.48 ± 7.34	887 ± 6.84
Continental	168	17.27 ± 8.06	892 ± 7.50
Brahman	202	-22.05 ± 9.18	866 ± 9.16
DAM BIOLOGICAL			
American	307	3.87 ± 6.87	864 ± 6.40
American Cross	26	-9.56 ± 20.04	841 ± 18.76
British	64	7.09 ± 11.87	880 ± 11.12
British American	29	23.32 ± 16.16	881 ± 15.14
Continental	44	42.92± 14.20	913 ± 13.30
Continental American	9	-5.54 ± 27.88	911 ± 26.12
Continental British Cross	26	18.04 ± 17.06	885 ± 15.97
Continental Brahman Cross	13	25.62 ± 23.46	914 ± 21.97
Continental Cross	21	53.56 ± 18.71	936 ± 17.14
Brahman	46	-28.45 ± 13.86	834 ± 12.97
Brahman British Cross	54	-23.29 ± 12.44	863 ± 11.63
Cross	213	-8.63 ± 8.00	861 ± 7.34
KILL GROUP			
1	33	111.41 ± 18.26	991 ± 17.10
2	84	136.62 ± 17.34	963 ± 16.20
3	70	25.13 ± 15.51	894 ± 14.52
4	63	-15.24 ± 15.83	843 ± 14.82
5	73	30.64 ± 16.02	934 ± 15.00
6	57	30.84 ± 16.07	917 ± 15.05
7	66	-32.41 ± 14.68	855 ± 13.74
8	76	9.96 ± 14.60	873 ± 13.49
9	76	-9.33 ± 14.32	906 ± 13.28
10	31	-25.91 ± 18.59	857 ± 17.42
11	70	-69.86 ± 12.23	812 ± 11.46
12	73	-21.89 ± 14.79	873 ± 13.84
13	63	-25.09 ± 15.41	827 ± 14.43
14	25	-29.42 ± 20.19	802 ± 18.92
ENTRY MONTH			
November	357	24.04 ± 12.89	886 ± 12.08
October	495	-7.55 ± 9.74	878 ± 9.11

Table 19. Levels of significance from analyses of variance with hot carcass weight as covariate

Source	df	NI[a]	ADG[b]	SW[c]	FT[d]	LMA[e]	MS[f]	YG[g]	MED[h]	CVL[i]
SBIOj	3	<.0001	0.0011	0.0098	<.0001	<.0001	<.0001	<.0001	0.5878	<.0001
DBIO[k]	11	0.0384	0.0038	0.1104	0.0043	0.0619	0.0063	0.0063	0.0802	0.0258
KILL[l]	13	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	.5060	<.0001
ENTRYMON[m]	1	0.0492	0.2879	0.9037	0.6249	0.0306	0.5333	0.1305	0.9744	0.4414
HCW[n]	1	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.0940	<.0001
MSE		392.50	0.02	415.47	0.22	9.80	4707	0.58	43.13	1613
R-square		0.56	0.55	0.87	0.30	0.33	0.17	0.31	0.05	0.81

[a]Net income($)

[b]Average daily gain

[c]Slaughter weight (kg)

[d]Fat thickness

[e]Longissimus muscle area

[f]Marbling score

[g]Yield grade

[h]Total medicine cost ($)

[i]Carcass value ($)

[j]Sire biological group

[k]Dam biological group

[l]Kill group

[m]Entry month

[n]Carcass weight

Table 20. Least squares means and standard errors for feedlot performance traits with hot carcass weight as the covariate

Parameter	n	TOTMED[a]	ADG[b]	OUTWT[c]
SIRE GROUP				
American	285	1.97 ± 0.67	1.34 ± 0.02	609 ± 2.09
British	197	1.76 ± 0.58	1.37 ± 0.01	609 ± 1.08
Continental	168	2.27 ± 0.63	1.34 ± 0.01	605 ± 1.96
Brahman	202	2.97 ± 0.78	1.29 ± 0.02	600 ± 2.41
DAM GROUP				
American	307	3.63 ± 0.54	1.40 ± 0.01	612 ± 1.69
American Cross	26	1.12 ± 1.59	1.36 ± 0.04	605 ± 4.95
British	64	2.50 ± 0.94	1.33 ± 0.02	603 ± 2.92
British American	29	1.45 ± 1.28	1.38 ± 0.03	605 ± 3.98
Continental	44	3.47 ± 1.13	1.38 ± 0.03	612 ± 3.52
Continental American	9	6.36 ± 2.22	1.27 ± 0.05	598 ± 6.88
Continental British Cross	26	3.15 ± 1.36	1.35 ± 0.03	608 ± 4.21
Continental Brahman Cross	13	-0.13 ± 1.87	1.30 ± 0.04	606 ± 5.79
Continental Cross	21	1.31 ± 1.46	1.33 ± 0.03	609 ± 4.52
Brahman	46	0.38 ± 1.11	1.34 ± 0.03	606 ± 3.43
Brahman British Cross	54	1.66 ± 0.98	1.31 ± 0.02	607 ± 3.04
Cross	213	1.99 ± 0.62	1.32 ± 0.01	603 ± 1.94
KILL GROUP				
1	33	1.24 ± 1.45	1.46 ± 0.03	620 ± 4.51
2	84	0.65 ± 1.37	1.50 ± 0.03	594 ± 4.25
3	70	2.31 ± 1.23	1.36 ± 0.03	599 ± 3.82
4	63	0.23 ± 1.26	1.40 ± 0.03	602 ± 3.92
5	73	1.46 ± 1.28	1.33 ± 0.03	609 ± 3.96
6	57	1.53 ± 1.28	1.34 ± 0.03	610 ± 3.96
7	66	2.37 ± 1.16	1.28 ± 0.03	601 ± 3.61
8	76	1.91 ± 1.15	1.43 ± 0.03	616 ± 3.58
9	76	3.50 ± 1.14	1.20 ± 0.03	604 ± 3.55
10	31	3.45 ± 1.48	1.24 ± 0.03	598 ± 4.57
11	70	1.69 ± 0.97	1.34 ± 0.02	614 ± 3.00
12	73	3.51 ± 1.18	1.23 ± 0.03	621 ± 3.66
13	63	3.28 ± 1.22	1.28 ± 0.03	614 ± 3.80
14	25	4.24 ± 1.60	1.32 ± 0.04	614 ± 4.98
ENTRY MONTH				
November	357	2.27 ± 1.02	1.36 ± 0.02	606 ± 3.18
October	495	2.21 ± 0.77	1.32 ± 0.02	606 ± 2.40

[a]Medication cost
[b]Average daily gain

Table 21. Least squares means and standard errors for post harvest traits with hot carcass weight as the covariate

Parameter	n	Yield grade	LMA[a]
SIRE GROUP			
American	285	3.09 ± 0.08	90 ± 0.92
British	197	3.04 ± 0.07	92 ± 0.79
Continental	168	2.51 ± 0.07	98 ± 0.86
Brahman	202	3.12 ± 0.09	90 ± 1.06
DAM GROUP			
American	307	2.96 ± 0.06	92 ± 0.74
American Cross	26	3.25 ± 0.18	89 ± 2.18
British	64	3.03 ± 0.11	93 ± 1.29
British American	29	3.08 ± 0.15	93 ± 1.76
Continental	44	2.86 ± 0.13	93 ± 1.55
Continental American	9	2.74 ± 0.26	91 ± 3.03
Continental British Cross	26	2.67 ± 0.16	96 ± 1.86
Continental Brahman Cross	13	2.82 ± 0.22	93 ± 2.56
Continental Cross	21	2.57 ± 0.17	96 ± 2.00
Brahman	46	2.95 ± 0.13	90 ± 1.52
Brahman British Cross	54	3.35 ± 0.11	89 ± 1.34
Cross	213	2.99 ± 0.07	91 ± 0.85
KILL GROUP			
1	33	2.54 ± 0.17	96 ± 1.99
2	84	2.54 ± 0.16	96 ± 1.88
3	70	2.68 ± 0.14	96 ± 1.69
4	63	2.76 ± 0.15	96 ± 1.73
5	73	2.53 ± 0.15	97 ± 1.75
6	57	2.55 ± 0.15	97 ± 1.75
7	66	2.76 ± 0.14	95 ± 1.60
8	76	3.23 ± 0.13	87 ± 1.58
9	76	2.97 ± 0.13	91 ± 1.57
10	31	3.18 ± 0.17	92 ± 2.02
11	70	3.49 ± 0.11	87 ± 1.58
12	73	3.03 ± 0.14	90 ± 1.61
13	63	3.57 ± 0.14	83 ± 1.67
14	25	3.33 ± 0.19	89 ± 2.20
ENTRY MONTH			
November	357	2.80 ± 0.12	95 ± 1.40
October	495	3.08 ± 0.09	90 ± 1.06

[a]Longissimus muscle area (cm^2)

Table 21. (continued)

Parameter	n	Marbling score[1]	Fat thickness (cm)
SIRE GROUP			
American	285	435 ± 7.04	1.42 ± 0.54
British	197	454 ± 6.07	1.50 ± 0.61
Continental	168	443 ± 6.59	1.24 ± 0.47
Brahman	202	403 ± 8.12	1.32 ± 0.56
DAM GROUP			
American	307	434 ± 5.68	1.38 ± 0.53
American Cross	26	447 ± 16.65	1.38 ± 0.53
British	64	476 ± 9.84	1.59 ± 0.60
British American	29	434 ± 13.40	1.69 ± 0.58
Continental	44	447 ± 11.84	1.40 ± 0.52
Continental American	9	416 ± 23.15	1.13 ± 0.36
Continental British Cross	26	424 ± 14.17	1.39 ± 0.50
Continental Brahman Cross	13	411 ± 19.51	1.33 ± 0.53
Continental Cross	21	416 ± 15.24	1.25 ± 0.48
Brahman	46	433 ± 11.56	1.21 ± 0.61
Brahman British Cross	54	423 ± 10.24	1.75 ± 0.76
Cross	213	447 ± 6.51	1.24 ± 0.47
KILL GROUP			
1	33	420 ± 15.18	1.27 ± 0.34
2	84	450 ± 14.31	1.16 ± 0.38
3	70	429 ± 12.87	1.28 ± 0.46
4	63	412 ± 13.20	1.19 ± 0.44
5	73	440 ± 13.34	1.36 ± 0.55
6	57	437 ± 13.34	1.33 ± 0.52
7	66	436 ± 12.17	1.31 ± 0.53
8	76	421 ± 12.04	1.50 ± 0.61
9	76	441 ± 11.96	1.58 ± 0.57
10	31	434 ± 15.41	1.57 ± 0.51
11	70	444 ± 10.11	1.62 ± 0.56
12	73	433 ± 12.31	1.32 ± 0.58
13	63	406 ± 12.78	1.45 ± 0.79
14	25	473 ± 16.77	1.46 ± 0.54
ENTRY MONTH			
November	357	429 ± 10.70	1.48 ± 0.63
October	495	439 ± 8.08	1.30 ± 0.49

$400 = Sm^{00}$; $300 = Sl^{00}$ etc.

Table 22. Least squares means and standard errors for economic traits with hot carcass weight as the covariate

Parameter	n	Net income ($)	Carcass value ($)
SIRE BIOLOGICAL			
American	285	4.57 ± 6.45	870 ± 4.12
British	197	16.45 ± 5.57	879 ± 3.55
Continental	168	13.267 ± 6.05	887 ± 3.85
Brahman	202	-25.63 ± 7.44	861 ± 4.75
DAM BIOLOGICAL			
American	307	6.52 ± 5.21	868 ± 3.32
American Cross	26	13.34 ± 15.21	871 ± 9.79
British	64	0.55 ± 8.89	873 ± 5.76
British American	29	17.86 ± 12.24	874 ± 7.84
Continental	44	17.22 ± 10.82	881 ± 6.93
Continental American	9	-30.56 ± 21.15	880 ± 13.55
Continental British Cross	26	0.08 ± 12.95	861 ± 8.30
Continental Brahman Cross	13	-2.93 ± 17.82	879 ± 11.42
Continental Cross	21	22.52 ± 14.23	897 ± 8.92
Brahman	46	8.71 ± 10.57	879 ± 6.77
Brahman British Cross	54	-26.14 ± 9.38	857 ± 6.00
Cross	213	-1.14 ± 6.07	873 ± 3.81
KILL GROUP			
1	33	82.89 ± 13.86	956 ± 8.88
2	84	137.74 ± 13.09	962 ± 8.37
3	70	39.16 ± 11.76	911 ± 7.53
4	63	18.29 ± 12.06	884 ± 7.73
5	73	0.78 ± 12.18	897 ± 7.81
6	57	13.79 ± 12.19	895 ± 7.81
7	66	-25.72 ± 11.12	862 ± 7.12
8	76	-23.41 ± 11.14	832 ± 7.05
9	76	-61.84 ± 11.06	846 ± 7.00
10	31	-27.74 ± 14.07	855 ± 9.02
11	70	-53.54 ± 9.24	832 ± 5.92
12	73	-44.65 ± 11.25	845 ± 7.21
13	63	-15.2 ± 11.67	839 ± 7.48
14	25	-10.25 ± 15.32	825 ± 9.81
ENTRY MONTH			
November	357	17.4 ± 9.78	878 ± 6.27
October	495	-13.07 ± 7.39	871 ± 4.73

VITA

Name:	Karl Walter Harborth
Birth Date:	January 24, 1977
Place of Birth:	New Braunfels, TX
Marital Status:	Married Wife-Sondra

Family
    Parents
    Siblings
	
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