PERFORMANCE COMPARISONS OF ANGUS-HEREFORD RECIPROCAL CROSS COWS AND THEIR CALVES: REPRODUCTION, BIRTH, WEANING, FEEDLOT AND CARCASS CHARACTERISTICS

By

STANLEY ROBERTS MCPEAKE

Bachelor of Science in Agriculture

University of Tennessee at Martin

Martin, Tennessee

1987

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 1989

Thesis
1989
M172p
Cop. 2

Oklahoma State Univ. Library

PERFORMANCE COMPARISONS OF ANGUS-HEREFORD
RECIPROCAL CROSS COWS AND THEIR CALVES:
REPRODUCTION, BIRTH, WEANING,
FEEDLOT AND CARCASS
CHARACTERISTICS

Thesis Approved:

David S Buchanan
Thesis Advisor

J. R. Kropp

Charles A. Hibberd

Norman N. Durham
Dean of the Graduate College

1350269

ACKNOWLEDGEMENTS

I wish to thank my advisor Dr. Dave Buchanan for his support and advice throughout my graduate program. I would also like to thank Dr. Bob Kropp and Dr. Chuck Hibberd for serving on my graduate committee.

I also would like to thank all my fellow graduate students who assisted with data collection. I certainly appreciate the efforts of Leon Knori for his care of the cattle used in this project. A special thanks goes to Larry Burditt and Mike Woltmann for their many times of assisting me with computer problems. A special thanks to Carol Bradley for all the help she has provided me in preparing my thesis.

I wish to thank most of all my parents, Orbin and Helen McPeake for all their support and encouragement throughout my college career. I would also like to thank my uncle, Dr. Charles McPeake, for all his help during my stay in Stillwater.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

Angus and Hereford are two well-known breeds of beef cattle that are utilized very extensively in the U.S. both as purebred and crossbreds (North American Livestock Census 1985). Both breeds offer several advantages and disadvantages in beef cattle programs. Generally, the Angus breed is known for maternal ability and carcass quality while the Hereford breed offers advantages in the ability to maintain body condition and reproductive performance under harsh conditions.

Angus-Hereford or Hereford-Angus crossbred cattle play a major role in commercial beef cattle operations. They may serve as two-way crossbred feeder and slaughter calves or they may serve as females in a commercial operation. There are reasons to choose the Hereford sire mated to the Angus dam for production of market cattle. The Angus dam may offer some advantage in maternal ability during the preweaning period. The cross of choice for production of replacement females is not so apparent.

The results presented in this study were formed by combining data from two different projects that included both Hereford-Angus and Angus-Hereford crossbred cow groups.

The first of the two projects was designed to evaluate the lifetime productivity of various types of two-breed cross cows (Hereford X Angus, Angus X Hereford, Simmental X Angus, Simmental X Hereford, Brown Swiss X Angus, Brown Swiss X Hereford, Jersey X Angus and Jersey X Hereford) when mated to bulls of a third breed. The second project was designed to compare the productivity of crossbred cow groups that were composed of Hereford X Angus, Angus X Hereford, Brahman-Angus x Hereford, Brahman-Hereford X Angus, Brahman X Angus and Brahman X Hereford under spring vs. fall calving systems.

The objectives of this study were to compare (1) cow productivity and calf performance from birth to weaning, (2) postweaning feedlot performance of calves and (3) carcass traits of slaughter calves of Hereford X Angus and Angus X Hereford crossbred cow groups.

CHAPTER II

REVIEW OF LITERATURE

Comparisons of Angus and Hereford Breeds

Breed Effects

It is well known that the Angus and Hereford breeds offer certain attributes that make them attractive choices for inclusion in a commercial cow herd. The Angus breed is primarily known for its maternal ability in females as well as the ability to marble. Gregory et al. (1978e) found that Angus breed excelled the Hereford breed for transmitted breed effects for USDA quality grade. The Hereford breed may not perform as well from a measurable maternal standpoint but promotes maternal traits in subsequent generations. The Hereford breed is also widely believed to be adaptable to range conditions. Gregory et al. (1978b) reported that Herefords were excelled by the Angus breed ($P<.05$) for breed maternal effects for preweaning average daily gain and 200-day weight. In addition, the Hereford breed offers an advantage in postweaning growth rate that may be partially due to compensatory gains resulting from decreased milk production of Hereford dams (Gregory et al., 1978d). It should also be remembered that there is a great deal of variation within each breed so that there is considerable overlap between the breeds for many traits.

Baker et al. (1984) reported among several breed crosses and straightbreds of Angus, Brahman, Hereford, Holstein and Jersey breed composition that Herefords were the thickest in the chuck but ranked last for length and depth of carcass, although few significant differences among straightbreds were found. Herefords and Angus ranked high for conformation score, marbling score and final grade. Among these five straightbred groups, cutability of Herefords was superior only to that of Jerseys. The low cutability of the Herefords was due to their high degree of internal and external fat.

Gregory et al. (1978b) found, in a study involving a diallel design composed of Red Poll, Brown Swiss, Hereford and Angus breeds that for breed transmitted effects the Angus breed was favored in preweaning average daily gain and 200-day weight over the Herefords. Gregory et al. (1978e) reported that the Angus breed ranked first in breed effects for carcass quality grade and for other carcass traits associated with carcass fatness. When examining carcass characteristics, they also found that breed effects for the Angus breed were significantly higher than any of the other breeds for marbling score and quality grade. The Hereford and Angus breeds did not differ from each other for loin eye area. Generally the Angus breed showed higher or positive breed effects for the traits associated with fatness.

Maternal Effects

Chapman et al. (1978) found important breed of dam effects in a study involving the Hereford and Angus breeds. Angus cows produced calves weighing 28.1 kg heavier ($P<.01$) at weaning than Hereford cows. There was also an advantage for the Angus for ratio of calf weight to cow weight. Bailey (1981) found that Red Poll, Angus and Charolais-cross dams weaned heavier ($P<.01$) calves than did Hereford dams.

Gregory et al.(1978b,e) conducted a study involving a 4-breed diallel crossing design of Red Poll, Brown Swiss (European and Domestic), Hereford and Angus breeds to estimate heterosis, breed maternal, and transmitted effects on economic traits of beef cattle. The four breeds did not differ ($P>.05$) from each other in maternal effects for calf crop weaned but differed significantly from each other in maternal effects for preweaning average daily gain and 200-day weight ranking in order (high to low) of Brown Swiss, Red Poll, Angus and Hereford. They also found that breed maternal effects were greatest in the Red Poll and Brown Swiss breeds for carcass traits associated with weight. The Hereford and Angus breeds were similar ($P>.05$) for breed maternal effects of most carcass traits. Generally speaking, however, maternal effects were not important after carcass traits were adjusted for the effects of weight.

Cundiff et al. (1981) found that the effects of breed of sire and of breed of dam were significant for all weights and postweaning average daily gain. Steers with Angus dams were heavier at weaning and at the initiation of the postweaning feeding period than steers with Hereford dams (P<.01). Steers with Hereford dams, however, showed more rapid absolute average daily gain and relative growth rate (P<.01) postweaning than those with Angus dams. Steers with Angus dams were still about 1% heavier (P<.05) at 424 days of age.

Heterosis

General

Heterosis is the advantage of a crossbred individual relative to the average of the component purebreds. Heterosis is due to nonadditive gene action which is gene action that can not be tranferred to the following generation. Results of several studies have indicated that heterotic effects for production traits are significant (Damon et al., 1959, 1961; Gregory et al., 1965, 1966a,b; Kincaid, 1962).

Individual Heterosis

Individual heterosis has important effects on most economic traits of beef cattle (Cartwright et al., 1964; Gregory et al., 1965, 1966a,b,c; Wiltbank et al., 1966, 1967; Klosterman et al., 1968; Pahnish et al., 1969; Hedrick et al., 1970; Lasley et al., 1971; Cundiff. et al., 1974a,b; Long and Gregory, 1974; Urick et al., 1974; Willham, 1974).

Individual calf heterosis mainly becomes of concern in traits related to weight. Gregory et al. (1978b) found that the effects of heterosis were significant for birth weight, calf crop weaned, average daily gain and 200-d weight. They found that the Red Poll, Brown Swiss, Angus and Hereford breeds did not differ significantly in most preweaning traits in breed mean heterosis in their crosses. However when the data were analyzed separatly by sex, male calves showed a higher level of heterosis for preweaning average daily gain than in female calves (12.7 kg vs. 3.1 kg in 200-d weight). They also found that heterosis significantly increased calf survival from birth to weaning and both prenatal and postnatal preweaning growth rate. Long and Gregory (1974), however, found no differences between sexes in level of heterosis for preweaning average daily gain. Pahnish et al. (1969) reported a higher level of heterosis in male than in female calves for traits related to preweaning average daily gain involving Hereford, Angus and Charolais breeds.

Gregory et al. (1978c,d) found the magnitude of heterosis effects on final weight was similar for both sexes (15.2 kg on 424-day weight of steers and 12 kg on 550 d weight of females). Most of the heterosis effects on growth rate were observed during the preweaning period and on average daily gain from 200 to 400 days in females.

Gregory et al. (1978d) found that heterosis had its greatest effects on steer calves during the preweaning period. Thus, most of the heterosis observed on growth rate of steers was on preweaning average daily gain. They also reported that the effects of heterosis on postweaning growth traits were higher for the Hereford X Angus cross females than for steers.

Generally heterosis does not have a great effect on carcass composition traits. Gregory et al. (1978e) found that when carcass traits were adjusted to a weight constant basis, heterosis effects and reciprocal differences were not important. Thus the heterosis and reciprocal differences observed on an age-constant basis were related to growth rate. The breed effects were important in traits associated with carcass composition. After the adjustments were made for the effects of weight; these results reflect important breed differences in additive effects of genes on carcass traits independent of carcass weight. Maternal effects were not important after carcass traits were adjusted for the effects of weight. This would seem to suggest that there was not a major change in carcass composition associated with the heavier weights of carcasses from crossbred steers.

Maternal Heterosis

Crossbred dams usually offer some advantages in reproductive rates. This is evidenced by increased calving percentages and calf survival rates. Also, crossbred dams may offer an advantage in weaning weight. Turner et al. (1968) found that crossbred cows consisting of all mating combinations with the Angus, Brahman, Brangus and Hereford breeds excelled straightbred cows by 9.6% for calf-crop percent ($P<.01$). No significant differences in preweaning death losses were found. Calving percent for all groups of reciprocal crossbred cows was higher than their respective parental average.

Olson et al. (1978c), in a study involving the comparisons of two-breed cross steers from straightbred Hereford, Angus and Shorthorn cows with the three-breed cross steers from reciprocal crossbred cows found that the three-breed cross steers from crossbred dams were 5.2% ($P<.01$) heavier at the beginning of the initial feeding period but had no advantage in postweaning gain over two-breed cross steers from straightbred dams. Three breed cross calves from crossbred dams were slightly fatter at slaughter time thus requiring more kilograms of total digestible nutrients per kilogram of gain during the postweaning period.

They further found that steers and heifers from crossbred dams were 10.4 kg (5.3%, $P<.001$) and 7.9 kg (4.2%, $P<.001$) heavier than progeny from straightbred dams at 200 days of age but were only 5.9 kg (1.4%) and 4.9 kg (1.2%) heavier at 452 days of age, because of compensatory effects of maternal heterosis on postweaning average daily gain (-.02 and -.01 kg). The three breed cross calves from crossbred dams had a weight advantage at 200 days. Their weight advantage due to maternal ability of dams, however, is reduced during the postweaning period as compared to two breed cross calves from straightbred dams. They also reported that maternal heterosis effects on carcass traits of steers and heifers at either a constant age or constant weight were generally nonsignificant.

Comparisons of Reciprocal Angus-Hereford Crossbred Cow Performance

Reproductive Performances

Turner et al. (1969) found that there were no significant differences between Angus-Hereford and Hereford-Angus crossbred cows for percent calves weaned. Cundiff et al. (1974) reported a significant advantage in Angus x Hereford cows for pregnancy rate, percentage calf crop from birth to weaning and weight of calf per cow exposed compared to Hereford X Angus cows. Belcher and Frahm (1979) reported no significant differences in 2-year-old Hereford-Angus and Angus-Hereford crossbred cow groups for percentage calves weaned. Frahm and Marshall (1985), in a study that also included Brown Swiss, Jersey and Simmental crosses, reported that Hereford-Angus and Angus-Hereford crossbred cow groups were similar for percentage of cows exposed to breeding that weaned a calf. Angus-sired cows consistently had a higher calving percentage than Hereford-sired cows.

McCarter et al. (1989b) found that the Hereford-Angus and Angus-Hereford crossbred cows were similar for age at first calf in the spring calving season while Hereford X Angus crossbred cows had a calf at a significantly younger age than Angus X Hereford crossbred in the fall-calving season. They also found no significant differences for lifetime percentage weaned. In addition, McCarter et al. (1989a) also found no significant differences between the Hereford-Angus and Angus-Hereford crossbred cow groups for percentage calves weaned.

Birth Traits

Turner et al. (1969) reported that Angus-Hereford cows had bull calves with heavier birth weights while no differences were observed in heifer calves. Cundiff et al. (1974) found no differences for birth weight between the Angus-Hereford reciprocal cross cows. They also found no differences among the Hereford-Angus and Angus-Hereford crossbred cow groups for calving difficulty.

Belcher and Frahm (1979) found no significant differences between Hereford-Angus and Angus-Hereford crossbred cows for birth weight of their calves. They also reported a significant difference between the Hereford-Angus and Angus-Hereford crossbred cow groups for calving difficulty when they were being evaluated as two year olds. Frahm and Marshall (1985) found that Hereford-Angus crossbred cows averaged 37.9 kg for birth weight whereas the Angus-Hereford averaged 35.9 kg ($P<.05$) in calves out of mature cows. They also found no significant differences among the reciprocal crosses of Angus-Hereford crossbred cows for calving difficulty.

McCarter et al.(1989a) found no significant differences however, between Angus-Hereford and Hereford-Angus cows for calving difficulty when only analyzing heifer data but significant differences were found between the two crossbred groups for calving difficulty when analyzing bull data. They also found no differences between the calves produced by Angus-Hereford and Hereford-Angus cows for birth weight.

Weaning Traits

Turner et al. (1969) reported no significant differences between calves produced by Hereford-Angus reciprocal cross cows for average daily gain from birth to weaning for steers or heifers. They also found no differences between calves from Hereford-Angus and Angus-Hereford crossbred cow groups for weaning conformation score. Furthermore they found no significant differences between calves produced by Hereford-Angus and Angus-Hereford crossbred cow groups for average adjusted weaning weights.

Cundiff et al. (1974) found differences (P<.01) between the Hereford-Angus and Angus-Hereford crossbred cows for the performances of their calves for preweaning average daily gain. They also found a difference (P<.01) for weight at 200 days. In this study Angus-Hereford cows calves averaged 206.2 kg(200-d weight) while the calves from Hereford-Angus cows averaged 192.6 kg. They also reported a significant difference between the Hereford-Angus reciprocal cross cow groups for conformation score favoring the calves out of the Angus-Hereford dams.

Belcher and Frahm (1979) found that there were no differences for preweaning average daily gain between calves from two year old Hereford-Angus and Angus-Hereford cows. They also found no significant differences for the Angus-Hereford reciprocal crossbred cow groups calves for weaning condition score. Futhermore they reported no significant differences for weaning conformation score between calves from Angus-Hereford reciprocal cross cows when being evaluated at two years of age.

Frahm and Marshall (1985) reported a difference between calves from Hereford-Angus and Angus-Hereford crossbred cows for preweaning average daily gain ($P<.05$). Calves from Hereford-Angus cows averaged 853 grams per day while calves from Angus-Hereford cows averaged 874 grams per day. They also reported no significant differences between calves from Hereford-Angus and Angus-Hereford crossbred cow groups for weaning weight. They further reported no significant differences between calves produced by Hereford-Angus and Angus-Hereford crossbred cow groups for weaning condition score. Furthermore, they found a difference ($P<.05$) for conformation scores. The Hereford-Angus cows' calves had a score of 13.4 (12=low choice, 13=avg. choice, and 14=high choice) while Angus-Hereford cows' calves had an average score of 13.4.

McCarter et al. (1989b) reported no differences between the Hereford-Angus and Angus-Hereford crossbred cow groups for average adjusted weaning weights. McCarter et al. (1989a) reported no differences between calves produced by Hereford-Angus and Angus-Hereford crossbred cow groups for preweaning average daily gain.

Breed of Dam of Cow Effects for Preweaning Traits

Notter et al. (1978), in a study involving progeny of 2-year old and 3-year old crossbred cows produced by mating Hereford, Angus, Jersey, South Devon, Simmental, Limousin, and Charolais bulls to Hereford and Angus cows that the effect of breed of dam was not significant for any trait at either age, but the interaction of breed of dam of cow with breed of sire of cow was significant for 200-day weight in progeny of 2-year olds and approached significance ($P<.10$) for average daily gain and 120-day weight. The primary source of interaction was the more rapid growth of progeny of Angus-Hereford cross cows. Progeny of 2-year old Angus-Hereford cows were .7 kg heavier at 120 days and 12 kg heavier at 200 days and grew .05 kg/day faster from birth to weaning than calves from Hereford-Angus cows.

Cundiff et al. (1974) suggested that these differences are probably due to a negative influence of the higher milk production of the purebred Angus cow on the subsequent milk production and maternal ability of her crossbred progeny.

Cow Traits

Belcher and Frahm (1979) reported a difference ($P<.05$) between the Hereford-Angus reciprocal cows for cow weight for two-year old cows. They reported that the crossbred cows with Angus dams were the heaviest. Furthermore no significant differences between the Hereford-Angus and Angus-Hereford crossbred cow groups for ratio of calf weaning weight-cow weight for these crosses as two year olds.

Frahm and Marshall (1985) found a significant difference ($P<.05$) between cow weights for the Hereford-Angus reciprocal cross cows favoring the Hereford-Angus cross cows. They also found a significant difference ($P<.05$) between the Hereford-Angus and Angus-Hereford reciprocal crossbred cows for cow efficiency (adjusted calf weight divided by cow weight). The Angus-Hereford cows had a 52.6% efficiency rating while Hereford-Angus cows had a 50.3% efficiency rating.

Feedlot Traits

Olson et al. (1978a) found no significant differences between calves of the Hereford-Angus or Angus-Hereford crossbred cows when mated to Shorthorn bulls for average daily gain, slaughter age and slaughter weight. Frahm et al. (1985) found no significant differences between calves produced by Hereford-Angus or Angus-Hereford crossbred cows for final finishing weight, feedlot daily gain, and number of days on feed. They did find that calves from Angus-Hereford cows finished at a younger age (457 days,P<.05) than calves from Hereford-Angus cows (466 days).

Carcass Traits

Olson et al. (1978b) reported no significant differences among steer or heifer calves produced by Hereford-Angus and Angus-Hereford crossbred cows for carcass weight, quality grade, marbling score, fat thickness, ribeye area, dressing percent and percent kidney, pelvic, and heart fat. These results were based on a constant slaughter age. They also reported no significant differences among steer calves produced by the Hereford-Angus and Angus-Hereford crossbred cow groups for quality grade, marbling score, fat thickness, ribeye area, dressing percent and percent kidney, pelvic, and heart fat. These results are based on a constant slaughter weight.

Frahm et al. (1985) found no significant differences between calves produced by Hereford-Angus and Angus-Hereford reciprocal cross cow groups for carcass weight, fat thickness, ribeye area, estimated kidney, pelvic and heart fat, marbling score and quality grade. They found significant differences (P<.05) between calves out of reciprocal cross cows for dressing percent with the calves out of Angus-Hereford dams having a higher dressing percent.

Summary

Crossbreeding plays an important part of most commercial producers production systems. The manner in which the producer decides to optimize the advantage of crossbreeding becomes of concern to promote the maximum production and maximum profits.

The use of crossbred dams is of interest to the producer since it enhances reproductive performance. Turner et al. (1969) found that crossbred cows excelled straightbred cows by 9.6% for calf crop weaned when 12 types of crossbred cows of Angus, Brahman, Brangus and Hereford breeding were examined.

There are certain advantages and disadvantages associated with the way in which Hereford and Angus are crossed to produce crossbred dams. Dickerson (1969) and Willham (1972) have shown that reciprocal cross dams are equal in terms of genetic components except for an effect due to maternal granddams expressed through subsequent maternal ability. This interaction primarily occurs if heifers that had heavier weaning weights because of favorable maternal environment provide a poor maternal environment for their calves and produce lighter calves at weaning in the following generation. Furthermore, Koch (1972) indicated that milk production and maternal environment for gain from birth to weaning is negatively influenced by positive maternal effects expressed in the previous generation. In conclusion, previous research shows that Angus-Hereford dams that were produced by Angus dams may have decreased maternal ability for calf performance at an early age whereas there is an enhancement in maternal ability if the crossbred cows are out of Hereford dams.

LITERATURE CITED

Bailey, C. M., 1981. Calf survival and preweaning growth in divergent beef breeds and crosses. J. Anim. Sci. 52:1244.

* Baker, J. F., C. R. Long and T. C. Cartwright. 1984. Characterization of cattle of a five breed diallel. V. Breed and heterosis effects on carcass merit. J. Anim. Sci. 59:922.

Belcher, C. G. and R. R. Frahm. 1979. Productivity of two-year-old crossbred cows producing three-breed cross calves. J. Anim. Sci. 49:1195.

Cartwright, T. C., G. F. Ellis, Jr, W. E. Kruse and E. K. Crouch. 1964. Hybrid vigor in Brahman Hereford crosses. Texas Agr. Exp. Tech. Monogr1.

Chapman, H. D., E. G. Morrison and N. C. Edwards, Jr., 1978. Limousin and Simmental sires mated with Angus and Hereford cows J. Anim. Sci. 46:341.

Cundiff, L. V., K. E. Gregory and R. M. Koch. 1974a. Effects of heterosis on reproduction in Hereford, Angus and Shorthorn cattle. J. Anim. Sci. 38:711.

Cundiff, L. V., K. E. Gregory and R. M. Koch. 1974b. Effects of heterosis on maternal performance and milk production in Hereford, Angus and Shorthorn cattle. J. Anim. Sci. 38:728.

Cundiff, L. V., R. M. Koch, K. E. Gregory and G. M. Smith. 1981. Characterization of biological types of cattle-Cycle II. IV. Postweaning growth and feed efficiency of steers. J. Anim. Sci. 53:332.

Damon, R. A., Jr., W. R. Harvey, C. B. Singletary, S. E. McCraine and R. M. Crown. 1961. Genetic analysis of crossbreeding beef cattle. J. Animal Sci. 20:849.

Damon, R. A., Jr., S. E. McCraine, R. M. Crown and C. B. Singletary. 1959. Performance of crossbred beef cattle in the Gulf Coast region. J. Anim. Sci. 18:437.

Dickerson, Gordon. 1969. Experimental approaches in utilizing breed resources. Anim. Breed. Abstr. 37:191.

Frahm, R. R. and D. M. Marshall. 1985. Comparisons among two breed cross cows groups. I. Cow productivity and calf performance to weaning. J. Anim. Sci. 61:844.

Frahm, R. R., D. M. Marshall and L. E. Walters. 1985. Comparisons among two breed cross cow groups. II. Feedlot and carcass performance of three-breed cross calves. J. Anim. Sci. 61:856.

Gregory, K. E., L. V. Cundiff, G. M. Smith, D. B. Laster and H. A. Fitzhugh, Jr,. 1978a. Characterization of biological types of cattle-Cycle II. I. Birth and weaning traits. J. Anim. Sci. 47:1022.

Gregory, K. E., L. V. Cundiff, R. M. Koch, D. B. Laster and G. M. Smith. 1978b. Heterosis and breed maternal and transmitted effects in beef cattle. I. Preweaning traits. J. Anim. Sci. 47:1031.

Gregory, K. E., D. B. Laster, L. V. Cundiff, R. M. Koch and G. M. Smith. 1978c. Heterosis and breed maternal and transmitted effects in beef cattle. II. Growth rate and puberty in females. J. Anim. Sci. 47:1042.

Gregory, K. E., R. M. Koch, D. B. Laster, L. V. Cundiff and G. M. Smith. 1978d. Heterosis and breed maternal and transmitted effects in beef cattle. III. Growth traits in steers. J. Anim. Sci. 47:1054.

Gregory, K. E., J. D. Crouse, R. M. Koch, D. B. Laster, L. V. Cundiff and G. M. Smith. 1978e. Heterosis and breed maternal and transmitted effects in beef cattle. IV. Carcass traits of steers. 47:1063.

Gregory, K. E., L. A. Swiger, R. M. Koch, L. J. Sumption, W. W. Rowden and J. E. Ingalls. 1965. Heterosis in preweaning traits of beef cattle. J. Anim. Sci. 24:21.

Gregory, K. E., L. A. Swiger, R. M. Koch, L. J. Sumption, J. E. Ingalls, W. W. Rowden and J. A. Rothlisberger. 1966a. Heterosis effects on growth rate of beef heifers. J. Anim. Sci. 25:290.

Gregory, K. E., L. A. Swiger, L. J. Sumption, R. M. Koch, J. E. Ingalls, W. W. Rowden and J. A. Rothlisberger. 1966b. Heterosis effects on growth rate and feed efficiency of beef steers. J. Anim. Sci. 25:299.

Gregory, K. E., L. A. Swiger, L. J. Sumption, R. M. Koch, J. E. Ingalls, W. W. Rowden and J. A. Rothlisberger. 1966c. Heterosis effects on carcass traits of beef steers. J. Anim. Sci. 25:311.

Hedrick, H. B., J. F. Lasley, J. P. Jain, G. F. Krause, B. Sibbit, L. Langford, J. E. Comfort and A. J. Dyer. 1970. Quantitative carcass characteristics of reciprocally crossed Angus, Charolais and Hereford heifers. J. Anim. Sci. 31:633.

Kincaid, C. M., 1962. Breed crosses of beef cattle in the South. Southern Cooperative Series Bul. 81.

Klosterman, E. W., V. R. Cahill and C. F. Parker. 1968. A comparison of the Hereford and Charolais breeds and their crosses under two systems of management. Ohio Agr. Res. and Dev. Ctr. Res. Bull. 1011.

Koch, R. M. 1972. The role of maternal effects in animal breeding. IV. Maternal effects in beef cattle. J. Anim. Sci. 35:1316.

Lasley, J. F., G. F. Krause, J. P. Jain, H. B. Hedrick, Bob Sibbit, L. Langford, J. E. Comfort and A. J. Dyer. 1971. Carcass quality characteristics in heifers of reciprocal crosses of the Angus, Charolais and Hereford breeds. J. Animal Sci. 32:406.

Long, Charles R. and K. E. Gregory. 1974. Heterosis and breed effects in preweaning traits of Angus, Hereford, reciprocal cross calves. J. Anim. Sci. 39:11.

McCarter, M. N., D. S. Buchanan and R. R. Frahm. 1989a. Productivity of three-, four- and five-year-old crossbred cows containing various proportions of Brahman breeding in spring or fall calving systems. J. Anim. Sci. (submitted).

McCarter, M. N., D. S. Buchanan and R. R. Frahm. 1989b. Effects of genotype x environment interaction on lifetime productivity of young crossbred cows containing various proportions of Brahman breeding in spring or fall calving systems. J. Anim. Sci. (submitted).

Notter, D. R., L. V. Cundiff, G. M. Smith, D. B. Laster and K. E. Gregory. Characterization of Biological types of cattle. VII. Milk production in young cows and transmitted and maternal effects on preweaning growth of progeny. J. Anim. Sci. 46:908.

Olson, L.W., L.V. Cundiff and K.E. Gregory. 1978c. Maternal heterosis effects on postweaning growth and carcass traits in beef cattle. J. Anim. Sci. 46:1552.

Olson, L. W., G. E. Dickerson, L. V. Cundiff and K. E. Gregory. 1978a. Individual Heterosis for postweaning growth efficiency in beef cattle. J. Anim. Sci. 46:1529.

Olson, L. W., L. V. Cundiff, G. E. Dickerson and K. E. Gregory. 1978b. Maternal Heterosis effects on postweaning growth efficiency in beef cattle. J. Anim. Sci. 46:1539.

Pahnish, L. F., J. S. Brinks, J. J. Urick, B. W. Knapp and T. M. Riley. 1969. Results from crossing beef x beef and beef x diary breeds: calf performance to weaning J. Anim. Sci. 28:291.

Turner, J. W., B. R. Farthing and George L. Robertson. 1968. Heterosis in reproductive performance of beef cows. J. Anim. Sci. 27:336.

Turner, J. W. 1969. Preweaning production differences among reciprocal crossbred beef cows. J. Anim. Sci. 29:857.

Urick, J. J., B. W. Knapp, R. L. Hiner, O. F. Pahnish, J. S. Brinks and R. L. Blackwell. 1974. Results from crossing beef x beef and beef x Brown Swiss: Carcass quantity quality traits. J. Anim. Sci. 39:292.

Willham, R. L. 1974. Beef-dairy crossbreeding. Proc. Working Symp. on Breed Evaluation and Crossing Experiments. Zeist, The Netherlands.

Willham, R. L. 1972. The role of maternal effects in animal breeding. III. Biometrical aspects of maternal effects in animals. J. Anim. Sci. 35:1288.

Wiltbank, J. N., K. E. Gregory, J. A. Rothlisberger, J. E. Ingalls and C. W. Kasson. 1967. Fertility of beef cows bred to produce straightbred and crossbred calves. J. Anim. Sci. 26:1005.

Wiltbank, J. N., K. E. Gregory, L. A. Swiger, J. E. Ingalls, J. A. Rothlisberger and R. M. Koch. 1966. Effects of heterosis on age and weight at puberty in beef heifers. J. Anim. Sci. 25:744.

CHAPTER III

PERFORMANCE COMPARISONS OF ANGUS-HEREFORD RECIPROCAL CROSS COWS AND THEIR CALVES: REPRODUCTION, BIRTH, WEANING, FEEDLOT AND CARCASS CHARACTERISTICS

S.R. McPeake, D.S. Buchanan and R.R. Frahm

Oklahoma Agricultural Experiment Station, Stillwater 74078

ABSTRACT

Performance of Angus-Hereford (AH, sire breed listed first) and Hereford-Angus (HA) crossbred cows producing 946 three breed cross calves over the years 1975 through 1987 was compared. Differences (P<.05) were found between the crossbred cow groups (HA, AH) for percentage of calves weaned (72.8%, 63.8%), lifetime percentage weaned (83.4%, 72.1%), cow weight (422.0 kg, 407.0 kg) and calf wt/cow wt (50.1%, 52.2%). Significant differences were also found between calves produced by the crossbred cow groups (HA, AH) for conformation score (13.0, 13.1), days on feed (259d, 252d) and slaughter age (492d, 484d, slaughtered at anticipated low choice). No significant differences were found between calves produced by AH and HA cow groups for birth weight, calving difficulty, preweaning average daily gain, age adjusted weaning weight, weaning condition score, feedlot average daily gain, final finishing weight, hot

carcass weight, quality grade, marbling score, dressing percent, single fat thickness, adjusted fat thickness, kidney, pelvic and heart fat percent, ribeye area and yield grade. These results indicate that HA cows may be superior to AH cows in reproductive performance. There was a small advantage in maternal ability for the AH cows for some traits. Since these results showed an advantage for HA cows over AH for reproductive performance, the magnitude of the reproductive advantage for HA cows may offset the small maternal advantage of AH cows in relation to pounds of calf weaned per cow exposed to breeding.

(Key Words: Crossbreds, Cows, Progeny, Performance, Angus, Hereford.)

Introduction

Crossbreeding plays a major role in most commercial beef production systems. It is of interest to the commercial cattleman to know the benefits that a crossbreeding program may offer. There certainly are varying advantages for the way in which different breeds are crossed. Results of crossbreeding have been summarized by Cundiff (1970), Franke (1980) and Long (1980).

Angus-Hereford reciprocal crossbred cattle are used very extensively throughout the U.S. They serve as a base for the commercial beef cattle industry. They are often utilized as feeder, stocker and slaughter calves or they may serve as females in a commercial cow-calf operation. How useful they are may depend on the way in which they are crossed and the segment of the industry in which they are being utilized.

This study was conducted to evaluate the performances of Angus-Hereford and Hereford-Angus cow performance and performance of their calves when mated to bulls of a third breed.

Materials and Methods

Data for this study were formed by combining Angus-Hereford and Hereford-Angus reproduction, birth, weaning, feedlot and carcass data from two other projects at the Oklahoma Agricultural Experiment Station. Cows from the first project were produced by mating Angus (A) and Hereford (H) cows to A and H bulls in 1972, 1973, and 1974. A total of 12 bulls of each sire breed was used over the three year period with 4 bulls being used each year. The calves from these matings were born from January through April of 1973, 1974, and 1975 and remained with their dams on native range until weaning and then were kept in the herd to be evaulated as cows. In the second project Angus and Hereford dams were assigned at random to spring- and fall-calving groups and mated to Angus and Hereford bulls to produce crossbred calves that were 1/2 A-1/2H and 1/2 H-1/2A over a three year period (1981-1983). The origin of the foundation breeding stock and growth performance of crossbred calves were reported by Bolton et al. (1987).

Data from the first project were collected from 1975 through 1986 with the cows starting production as two year olds in 1975. The cow-calf records collected from this project consisted of cows ranging in age from 2 to 13-yr old. In the second project, the cows started production as two year olds in 1983 and continued through 1987 in both the spring and fall seasons.

In the first project, Brahman, Charolais, Gelbvieh, Limousin, Red Poll, Salers and Shorthorn sires were utilized. In the second project, only Limousin and Salers sires were used.

In a given year, each bull was mated to approximately the same number of cows and bulls were randomly assigned to the cows within each crossbred cow group. The cows were primarily bred by artificial insemination although some cows were bred by natural service in single sire breeding pastures.

Cows in the first project were maintained on native tallgrass and bermudagrass pastures at the Lake Carl Blackwell Research Range near Stillwater. The cows from the second project were maintained on pastures consisting of big bluestem, little bluestem, buffalograss, sideoats gramma, silver bluestem and bermudagrass at the Southwestern Livestock and Forage Research Laboratory, El Reno, Oklahoma for the 1984-1986 calf crops. After weaning the 1986 calf crops, the cows were moved to Stillwater, Oklahoma.

The breeding season lasted approximately 75d, starting in early May each year for spring calving cows and early December for fall calving cows. The spring calf crops were born primarily in February, March and April. Calves that were born in the fall were born primarily in September, October and November.. The calves that were born in the spring were weaned at approximately 205 d of age while calves that were born in the fall were weaned at approximately 240 d of age.

Cows were assigned calving difficulty scores by the herdsman on a basis of: 1=no difficulty, 2=minor assistance without a mechanical puller, 3=moderately difficult, 4=hard pull, 5=Caesarian birth and 6=abnormal presentation. At weaning each calf was weighed and assigned a subjective weaning condition score (1=very thin to 9=very fat) and a conformation score was assigned on the basis of muscling (12=low choice, 13=average choice and 14=high choice).

Birth weights were collected and male calves were castrated within 24 hours of birth. Calves remained with their dams from birth until weaning without creep feed. Feedlot and carcass data were collected on 492 three-breed cross calves from 1975 to 1987.

For calves involved in the first project, immediately after weaning, calves were transported to feedlot facilities at the Southwestern Livestock and Forage Research Station near El Reno, Oklahoma. Calves from the second project were fed in feedlots in West Texas or Western Kansas and were started on feed immediately following weaning. Calves were removed from the feedlot when the calves were expected to grade low choice. Cattle were killed at a commercial plant where university personnel evaluated carcass characteristics.

Carcass weight and dressing percent were based on hot carcass weight. After allowing at least 24 hours for chilling, carcasses were evaluated for marbling (5=small amount, 6=modest amount), and were assigned quality grades (9=high good, 10=low choice, 11=average choice). External fat thicknesses were measured at the 12/13th rib. Kidney, heart and pelvic fat was visually appraised. The ribeye area was traced at the 12th rib interface and estimated using a planimeter.

Data were analyzed with least squares procedures. Cows were grouped together by age in the following way for weaning traits: 2-year old cows, 3-year old cows, 4-year old cows, 5-10 year-old cows and 11 years old or older. For weaning traits, the full model for the analyses included calf's sire breed, experiment and year combinations, individual sire nested within these combinations, crossbred cow group, sex of calf, age of dam and calving season. Two-way interactions and a covariate for days from birth to weaning were included in models. All two-way interactions with probability levels over .4 were removed with a stepwise procedure. For birth weight and calving difficulty, the covariate for days from birth to weaning was not used in the models.

For the analyses of the feedlot and carcass traits, ages of cows were grouped together by age in the following way: 2-3 year old cows, 4-year old cows, 5-10 year old cows and 11-year old or greater. The feedlot and carcass data analyzed consisted of the same full models as the weaning traits with the exception of marbling score serving as a covariate in both the full and reduced models. Furthermore, two way interactions with $(P>.4)$ were deleted for the reduced models and data were preadjusted for initial age of calf if probability levels for initial age of calf were $(P<.4)$.

For the reproductive traits, calving interval and lifetime percentage weaned the models consisted of crossbred cow group and experiment - year combinations in which the cows had their first calf. Weaned calf percent was based on the number of cows exposed to breeding. Included in the model for this trait were sire breed of calf, experiment-year combinations, crossbred cow group, dam age, calving season and the two way interaction of crossbred dam group X calving season.

Results and Discussion

Cow Reproductive Performance. The percentage calves weaned based on the number of cows exposed to breeding was higher (P<.05) for the HA (72.8%) than for the AH (63.8%) crossbred cow groups (Table 1). Turner et al. (1968) found no significant differences between AH and HA crossbred cow groups for percentage weaned but there was a numerical advantage for the HA crossbred cows as compared to the AH crossbred cows. However, Cundiff et al. (1974a) found that the AH crossbred cow group had the advantage (P<.05) for percentage calf weaned averaging 90.2% while the HA cows averaged 79.1% based on the number of cows exposed. No significant differences were found for calving interval between the two crossbred cow groups. Differences (P<.05) were found for lifetime percentage weaned with the HA cows averaging 83.4% while the AH cows averaged 72.1%.

Cow Weight and Cow Efficiency Traits. The least squares means for these traits are presented in Table 2. Differences (P<.05) were found for cow weight with the HA cows the heaviest (422.0 kg) while the AH cows averaged 407.0 kg. Differences (P<.05) were found for cow efficiency with HA cows averaging 50.1% and AH cows averaging 52.2%.

Birth Traits. Least squares means for birth traits are presented in Table 2. No significant differences were found for birth weight or calving difficulty between the crossbred cow groups. Birth weights for calves produced by HA cows averaged 34.3 kg while calves from the AH cows averaged 33.7 kg. Calving difficulty scores averaged 1.37 for the HA cows and 1.44 for AH cows on a scale in which 1=no difficulty and 2=minor assistance.

Turner (1969) found a difference (P<.05) for birth weight between calves from AH and HA crossbred cows when evaluating their steer calves, but found no difference in heifer calves. Cundiff et al. (1974b) found no differences among the AH and HA crossbred cow groups for birth weight of their calves when mated to Shorthorn bulls. Cundiff et al. (1974a) reported no significant differences between HA and AH crossbred cow groups for calving difficulty.

Weaning Traits. Least squares means are presented in Table 3. Crossbred cow group was significant for only weaning conformation score. The interaction of crossbred cow group x sex of calf approached significance (P<.10) for weaning condition score.

Differences (P<.05) were found between calves produced by AH and HA crossbred cow groups for weaning conformation scores with the calves from HA cows averaging 13.00 and calves from AH cows averaging 13.10. These results are similar to the findings of Cundiff et al. (1974b).

No significant differences were found for preweaning average daily gain, weaning weight, age adjusted weaning weight, dam age adjusted weaning weight or weaning condition scores. Calves produced by HA cows averaged (.79 kg/d, 197.1 kg, 207.8 kg, 219.6 kg, 5.1) while calves from AH cows averaged (.79 kg/d, 199.4 kg, 209.9 kg, 221.8 kg, 5.0). Turner et al. (1969) also found no significant differences for preweaning average daily gain or weaning weight.

Feedlot Traits. Least squares means for feedlot traits are presented in Table 4. Crossbred dam group was a significant source of variation for days on feed, slaughter age and approached significance (P<.10) for feedlot daily gain.

Cow group differences (P<.05) were found for days on feed and slaughter age. Calves from the HA cows averaged 259 days on feed while calves from AH cows averaged 252 days on feed. Also calves from HA dams averaged 492 days for final slaughter age while calves from AH dams averaged 484 days. Olson et al. (1978a.) found no differences between calves out of HA and AH crossbred cows for slaughter age.

No significant differences between crossbred cow groups were found for final finishing weight or average feedlot daily gain between calves produced by the AH (487.3 kg, 1.12 kg/d) or HA (477.2 kg, 1.09 kg/d) crossbred cow groups. However, there was a tendency (P=.06) for feedlot average daily gain to be different. Olson et al. (1978a) also found no significant differences between calves from the HA and AH crossbred cows for feedlot daily gain and slaughter weight.

Carcass Traits. Least squares means for carcass traits are presented in Tables 5 and 6. No significant differences were found between the two crossbred cow groups for hot carcass weight, quality grade, marbling score, dressing percent, single fat thickness, adjusted fat thickness, KPH, ribeye area or yield grade.

The interaction of crossbred cow group x sex of calf was a significant source of variation for quality grade. The interaction of crossbred cow group x dam age was a significant source of variation for yield grade. The interaction of sex of calf x dam age was significant for yield grade. The covariate marbling score was important ($P<.05$) for final finishing weight, days on feed, slaughter age, hot carcass weight, quality grade, single fat thickness, adjusted fat thickness, ribeye area and yield grade. Olson et al. (1978b) found no differences for carcass composition traits between calves produced by AH or HA cows when adjusted to a constant age or weight.

Discussion. These results indicate that HA crossbred cows may have an advantage in reproductive performance. Maternal ability of the AH cows may exceed the HA cows because of the maternal environment in which they were reared in the previous generation. The more favorable maternal environment that is generally provided by the Angus cow may have a negative effect on the maternal ability of her offspring. This offers at least some partial explanation of why AH cows in this study seem to have some advantage during the preweaning period. These maternal environment differences between calves produced by AH and HA crossbred cows may still remain when calves reach market age.

Results from this study indicated an advantage for the HA crossbred cows for reproductive performance and an advantage for AH cows for maternal ability. Due to the magnitude of the reproductive performance advantage for HA cows in this study it seems that HA cows may have an advantage over AH in relation to pounds of calf weaned per cow exposed to breeding

Literature Cited

Beef Improvement Federation. 1986. Guidelines for Uniform Beef Improvement Programs. Fifth ed.

Cundiff, L. V. 1970. Experimental results on crossbreeding cattle for beef production. J. Anim. Sci. 30:694.

Cundiff, L. V., K. E. Gregory and R. M. Koch. 1974a. Effects of heterosis on reproduction in Hereford, Angus and Shorthorn cattle. J. Anim. Sci. 38:711.

Cundiff, L. V., K. E. Gregory, F. J. Schwulst and R. M. Koch. 1974b. Effects of heterosis on materanl performance and milk production in Hereford, Angus and Shorthorn cattle. J. Anim. Sci. 38:728.

Franke, D. E. 1980. Breed and heterosis effects of American Zebu cattle. J. Anim. Sci. 50:1206.

Harvey, W. R. 1987. User's guide for LSMLMW PC-1 version mixed model least squares and maximum likelihood computer program.

Long, C. R. 1980. Crossbreeding for beef production: experimental results. J. Anim. Sci. 51:1197.

Olson, L. W., L. V. Cundiff, G. E. Dickerson and K. E. Gregory 1978a. Maternal heterosis effects on postweaning growth efficiency in beef cattle. J. Anim. Sci. 46:1539.

Olson, L. W., L. V. Cundiff and K. E. Gregory. 1978b. Maternal heterosis effects on postweaning growth and carcass traits in beef cattle. J. Anim. Sci. 46:1552.

Turner, J. W., B. R. Farthing and G. L. Robertson. 1968. Heterosis in reproductive performance of beef cows. J. Anim. Sci. 27:336.

Turner, J. W. 1969. Preweaning production differences among reciprocal crossbred beef cows. J. Anim. Sci. 29:857.

TABLE 1

LEAST SQUARES MEANS FOR COW REPRODUCTIVE PERFORMANCE

Crossbred cow group[a]	Number of Exposures	% Calves Weaned[b]	Number of Cows	Lifetime % Weaned	Calving Interval
HA	642	72.8±.03	98	83.4±.03	417±7.0
AH	548	63.8±.04	80	72.1±.03	419±8.3
Probability Levels For Differences		.02		<.01	.75

[a] H=Hereford, A=Angus.
[b] Based on number of cows exposed.

TABLE 2

LEAST SQUARES MEANS FOR COW WEIGHT, COW EFFICIENCY, CALF BIRTH WEIGHT AND CALVING DIFFICULTY SCORE

Crossbred Cow Group[a]	Number of Observations	Cow Wt kg.	Cow Efficiency %[b]	Number of Observations	Birth Wt kg.	Calving Difficulty[c]
HA	496	422.0±4.74	50.1±.66	523	34.3±.47	1.37±.073
AH	403	407.0±4.77	52.2±.67	423	33.7±.53	1.44±.075
Probability Levels For Differences		<.01	<.01		.26	.38

[a] H=Hereford, A=Angus.
[b] Cow Effeciency=Age Adj. Weaning Wt./Cow Wt. X 100.
[c] 1=No difficulty, 2=Little difficulty, 3=Moderate difficulty, 4=Major difficulty, 5=Caesarian.

TABLE 3

LEAST SQUARES MEANS FOR PREWEANING AVERAGE DAILY GAIN, WEANING WEIGHT, AGE ADJUSTED WEANING WEIGHT, DAM ADJUSTED WEANING WEIGHT AND WEANING SCORES

Crossbred Cow Group[a]	Number of Observations	Preweaning Daily Gain kg/day	Wean Wt kg	Age Adj. Wean. Wt.[b] kg	Dam Adj. Wean. Wt.[b] kg	Weaning Scores Conformation[c]	Weaning Scores Condition[d]
HA	498	.79±.009	197.1±2.08	207.8±1.99	219.6±1.83	13.0±.06	5.1±.05
AH	403	.79±.010	199.4±2.10	209.9±1.99	221.8±1.83	13.1±.1	5.0±.05
Probability Levels For Differences		.71	.14	.17	.15	.04	.29

[a] H=Hereford, A=Angus.
[b] Actual data adjusted by Beef Improvement Federation adjustment factors (BIF,1986).
[c] Conformation score equivalents: 12=low choice, 13=avg choice and 14=high choice.
[d] Condition score equivalents: 1=very thin, 5=average and 9=very fat.

TABLE 4

LEAST SQUARES MEANS FOR FEEDLOT TRAITS

Crossbred Cow Group[a]	No of Observations	Final Finishing Wt. kg	Feedlot Daily Gain kg/d	Slaughter Age days	Days On Feed
HA	256	477.2±9.18	1.09±.034	492±6.6	259±6.6
AH	236	487.3±9.57	1.12±.033	484±6.5	252±6.5
Probability Levels For Differences		.42	.06	<.01	<.01

[a] H=Hereford, A=Angus.

TABLE 5

LEAST SQUARES MEANS FOR HOT CARCASS WEIGHT, SINGLE FAT THICKNESS, ADJUSTED FAT THICKNESS, KHP FAT, RIBEYE AREA AND YIELD GRADE

Crossbred Cow Group[a]	Number of Observations	Hot Carcass Wt kg	Single Fat Thickness cm	Adj. Fat Thickness[b] cm	KHP Fat %	Ribeye Area cm^2	Yield Grade[b]
HA	256	309.1±5.13	1.43±.092	1.67±.109	2.71±.126	82.6±2.09	3.20±.183
AH	236	310.0±4.89	1.42±.089	1.75±.106	2.66±.121	82.6±2.03	3.25±.179
Probability Levels For Differences		.78	.86	.23	.51	.76	.66

[a] H=Hereford, A=Angus
[b] Based upon 234 observations for HA cows and 214 observations for AH cows.

TABLE 6

LEAST SQUARES MEANS FOR QUALITY GRADE, MARBLING SCORE AND DRESSING PERCENTAGE

Crossbred Cow Group[a]	Number of Observations	Quality Grade[b]	Marbling Score[c]	Dressing Percentage
HA	256	9.9$\pm$.12	504$\pm$18.1	64.4$\pm$.60
AH	236	9.9$\pm$.12	501$\pm$18.1	63.8$\pm$.62
Probability Levels For Differences		.81	.77	.52

[a] H=Hereford, A=Angus.
[b] 9=Select+, 10=Choice-, 11=Choice avg.
[c] 500=Small, 600=Modest.

APPENDIX

TABLE 1

PROBABILITIES OF ATTAINING GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR COW REPRODUCTIVE TRAITS[a]

SOURCE	% Calves Weaned[b]	Lifetime % Weaned[c]	Calving Interval[d]
Sire breed of calf, experiment and year combinations	<.01	-	-
Experiment and year combination[e]	-	.19	<.01
Crossbred cow group (C)	.02	<.01	.75
Dam age	.04	-	-
Season of calving (S)	<.01	-	-
C X S	.02	-	-

[a] - = Source of variation not included in model.
[b] Percentage cows exposed to breeding that weaned a calf.
[c] Number of calves that cow weaned in lifetime/cow age-1.
[d] Calving Interval= birth date of last calf-birth date of first calf+365/Number of calves.
[e] Experiment and year combinations when cow had first calf.

TABLE 2

PROBABILITIES OF ATTAINING GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR COW WEIGHT, COW EFFICIENCY, BIRTH WEIGHT AND CALVING DIFFICULTY[a]

Source	Cow Weight	Cow Efficiency[b]	Birth Weight	Calving Difficulty[c]
Sire breed of calf, experiment, and year combinations (SEY)	<.01	<.01	<.01	<.01
Individual sire/SEY	<.01	<.01	<.01	.88
Crossbred cow group (CG)	<.01	<.01	.26	.38
Sex of calf (SX)	.68	<.01	<.01	<.01
Age of dam (DA)	<.01	<.01	<.01	.02
Season of calving (CS)	.02	.01	<.01	.46
CG X SX	.22	.20	-	-
CG X DA	-	-	.26	.02
CG X CS	-	-	.28	-
SX X DA	-	.01	.29	.11
SX X CS	.35	.17	.35	-
Age of calf at weaning in days[d]	.79	.99	-	-

[a] - = source of variation not included in model.
[b] Cow efficiency=age adj. weaning wt./cow wt. x 100.
[c] Calving difficulty scores: 1=no difficulty, 2=little difficulty, 3=moderate difficulty, 4=major difficulty and 5=caesarian.
[d] Age of calf served as a covariate in model.

TABLE 3

PROBABILITIES OF ATTAINING GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR PREWEANING AVERAGE DAILY GAIN, WEANING WEIGHT, AGE ADJUSTED WEANING WEIGHT, DAM ADJUSTED WEANING WEIGHT AND WEANING SCORES[a]

					Weaning Scores	
Source	Preweaning Daily Gain	Wean. Wt.	Age Adj. Wean. Wt.[b]	Dam Adj. Wean. Wt.[b]	Conformation[c]	Condition[d]
Sire breed of calf, experiment and year combinations (SEY)	<.01	<.01	<.01	<.01	<.01	<.01
Individual sire/SEY	.02	<.01	<.01	<.01	.13	.56
Crossbred cow group (CG)	.71	.14	.17	.15	.04	.29
Sex of calf (SX)	<.01	<.01	<.01	<.01	.03	.89
Age of dam (DA)	<.01	<.01	<.01	NI	.03	.84
Season of calving (CS)	<.01	<.01	.40	.38	<.01	<.01
CG X SX	-	-	-	-	-	-
CG X DA	-	-	-	-	-	.06
CG X CS	.30	-	-	-	-	-
SX X DA	<.01	<.01	<.01	-	<.01	.05
SX X CS	-	-	-	-	-	.11
Age of calf at weaning in days[e]	.39	<.01	-	-	<.01	<.01

[a] - = source of variation not included in model.
[b] Actual data adjusted by Beef Improvement Federation adj. factors (BIF, 1986).
[c] Conformation score equivalents: 12=low choice, 13=avg choice and 14=high choice.
[d] Condition score equivalents: 1=very thin, 5=average and 9=very fat.
[e] Age of calf served as a covariate in model.

TABLE 4

PROBABILITIES OF ATTAINIMG GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR FEEDLOT TRAITS[a]

Source	Final Finishing wt.	Feedlot Daily Gain	Slaughter Age	Days On Feed
Sire breed of calf, experiment and year combinations (SEY)	<.01	<.01	<.01	<.01
Individual sire/SEY	.94	.01	<.01	<.01
Crossbred cow group (CG)	.42	.06	<.01	<.01
Sex of calf (SX)	<.01	<.01	.81	.70
Age of dam (DA)	.31	.59	.77	.78
Season of calving (CS)	.79	.01	<.01	<.01
CG X SX	-	-	-	-
CG X DA	.19	-	-	-
CG X CS	.38	-	-	-
SX X DA	.38	-	.11	.18
SX X CS	-	-	.32	.31
Marbling score[b]	.05	.44	<.01	<.01

a - = source of variation not included in model.
b Marbling score served as a covariate in model.

TABLE 5

PROBABILITIES OF ATTAINING GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR HOT CARCASS WEIGHT, SINGLE FAT THICKNESS, ADJUSTED FAT THICKNESS, KHP FAT, RIBEYE AREA AND YIELD GRADE[a]

Source	Hot Carcass Weight	Single Fat Thickness	Adjusted Fat Thickness	KHP Fat	Ribeye Area	Yield Grade
Sire breed of calf, experiment and year combinations (SEY)	<.01	<.01	<.01	<.01	<.01	<.01
Individual sire/SEY	.84	.01	<.01	.08	<.01	<.01
Crossbred cow group (CG)	.78	.86	.23	.51	.76	.66
Sex of calf (SX)	<.01	.01	.13	.04	.89	.98
Age of dam (DA)	.42	.64	.60	.39	.42	.37
Season of calving (CS)	.63	.83	.96	.67	.89	.91
CG X SX	-	.39	.25	-	-	-
CG X DA	.20	.27	.16	.06	.30	.03
CG X CS	-	-	-	-	-	-
SX X DA	.13	.37	.28	.12	.14	.04
SX X CS	-	-	-	-	.32	-
Marbling score[b]	.03	.01	<.01	.21	<.01	<.01

[a] - = source of variation not included in model.
[b] Marbling score served as a covariate in model.

TABLE 6

PROBABILITIES OF ATTAINING GREATER F-VALUES FROM REDUCED MODEL ANALYSES OF VARIANCE FOR QUALITY GRADE, MARBLING SCORE AND DRESSING PERCENTAGE[a]

Source	Quality Grade	Marbling Score	Dressing Percentage
Sire breed of calf, experiment and year combinations (SEY)	<.01	<.01	<.01
Individual sire/SEY	<.01	.02	.32
Crossbred cow group (CG)	.81	.77	.52
Sex of calf (SX)	.22	.87	<.01
Age of dam (DA)	.03	.16	.66
Season of calving (CS)	.15	.69	.55
CG X SX	.03	.36	-
CG X DA	-	.34	.28
CG X CS	-	-	.37
SX X DA	-	-	-
SX X CS	-	-	-
Marbling Score[b]	<.01	-	.65

[a] - = source of variation was not included in model.
[b] Marbling score served as a covariate in model.

/

VITA

Stanley R. McPeake

Candidate for the Degree of

Master of Science

Thesis: PERFORMANCE COMPARISONS OF ANGUS-HEREFORD RECIPROCAL CROSS COWS AND THEIR CALVES: REPRODUCTION BIRTH, WEANING, FEEDLOT, AND CARCASS CHARACTERISTICS

Major Field: Animal Science

Biographical:

Personal Data: Born in Lexington, Tennessee, January 18, 1965, the son of Orbin and Helen McPeake.

Education: Graduated from Lexington High School, Lexington, Tennessee in May 1983. Received Bachelor of Science in Agriculture degree from University of Tennessee at Martin, June 1987. Completed requirements for the Master of Science degree at Oklahoma State University in December, 1989.

Professional Experience: Graduate Assistant at Oklahoma State University, 1987-1989.

Professional Organizations: American Society of Animal Animal Science, Alpha Gamma Rho Fraternity.