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J.B. Jr. Glaze

R.R. Schalles

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Abstract

Direct and correlated responses to selection for improved feed conversion were estimated from performance records of 1459 Polled Hereford cattle born from the spring of 1967 through the spring of 1979. Data were analyzed using a multiple-trait, derivative-free, restricted maximum likelihood (MTDFREML) procedure. A full animal model was used to calculate genetic and phenotypic (co)variances. The withinherd breeding values that resulted from the solution of the mixed model equations were regressed on year to create selection response curves. Feed conversion was shown to respond favorably to direct selection, with feed/gain changing -.005 per year.

Keywords

Cattlemen's Day, 1999; Kansas Agricultural Experiment Station contribution; no. 99-339-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 831; Beef; Selection; Response; Feed conversion; Polled Hereford

SELECTION RESPONSE FOR FEED CONVERSION AND GROWTH TRAITS IN POLLED HEREFORD CATTLE

J. B. Glaze, Jr.[1] and R. R. Schalles

Summary

Direct and correlated responses to selection for improved feed conversion were estimated from performance records of 1459 Polled Hereford cattle born from the spring of 1967 through the spring of 1979. Data were analyzed using a multiple-trait, derivative-free, restricted maximum likelihood (MTDFREML) procedure. A full animal model was used to calculate genetic and phenotypic (co)variances. The within-herd breeding values that resulted from the solution of the mixed model equations were regressed on year to create selection response curves. Feed conversion was shown to respond favorably to direct selection, with feed/gain changing -.005 per year.

(Key Words: Selection, Response, Feed Conversion, Polled Hereford.)

Introduction

In beef cattle production, growth rates and the animal's ability to efficiently convert feed into body weight are economically important traits. Improvements in feed conversion can lead to greater efficiencies in overall production systems. Even though beef producers traditionally have placed emphasis on improving growth traits, many are unaware of the relationships between feed conversion and growth traits, as well as how these traits respond in selection programs. Our purposes were to estimate the direct and correlated responses to selection for improved feed conversion and to provide basic information that can be included in selection programs.

Experimental Procedures

Performance data were collected on 1459 Polled Hereford cattle that were born from the spring of 1967 through the spring of 1979. These data were the result of a project conducted at Kansas State University in which animals were selected on the basis of improved feed conversion. Beginning with the 1971 breeding season, cows were assigned randomly to either a selection or control herd. Once these herds were established, they were closed, and no other genetic material was introduced. Each year in the selection herd, the two bulls exhibiting the best feed conversion (feed/gain) were selected as herd sires and used for 2 consecutive years. In the control herd, the first bull born to the oldest herd sire was selected to replace his sire. These bulls were used in the control herd for approximately 6 years.

Cows representing the selection and control herds were maintained on native pasture throughout the year and were supplemented in the winter. Cows were bred to calve in March and April, with progeny being weaned in the fall at approximately 200 days of age. Following a 3- to 4-week weaning period, bull calves were placed on an individual 140-day postweaning performance test, which allowed for the selection for feed conversion. Heifers were group fed and not selected on the basis of improved feed conversion. In both the selection and control herds, cows were culled if they: (1)

[1]University of Vermont Extension, White River Junction, VT 05001.

were not pregnant at the end of the breeding season, (2) had severe structural problems, or (3) were horned. Birth weight (BWT), weaning weight (WWT), yearling weight (YWT), yearling height (YHT), daily feed intake (INT), average daily gain (ADG), feed conversion (CONV), mature height (MHT), and mature weight (MWT) records were available for analysis.

A multiple-trait, derivative-free, restricted maximum likelihood (MTDFREML) procedure was used to analyze the data. A full animal model was used to calculate the genetic and phenotypic (co)variances. The fixed effects used in the model included age of dam (2, 3, 4, 5-10, and >10 years) and contemporary group (sex and year of birth). For the analyses of MHT and MWT, age of cow was the only fixed effect included in the model. Ages at which various measurements were recorded were used as covariates for the respective trait. Average weight maintained over the 140-day test period was used as a covariate in the analyses of INT and CONV. Maternal and permanent environmental effects were included as random effects in the analyses of BWT and WWT. The breeding values that resulted from the solution of the mixed model equations were used in a regression analysis to estimate the amount of change that resulted in each trait from selection for improved feed conversion. Breeding values were used to estimate the amount of direct selection response for CONV and the correlated selection responses for all other traits. Direct and correlated responses were estimated by regressing each trait's selection herd breeding values on year.

Results and Discussion

The within-herd time trend figures (response curves) are presented in Figures 1 - 9. In many of the response curves, pronounced changes in the selection herd can be seen between the years of 1973 and 1974. This was due to the fact that beginning in 1974, female offspring of selection herd sires began calving, which resulted in greater selection intensities. Because of selection for improved feed conversion (feed/gain), feed conversion (Figure 1) in this study changed by -.005 units per year. Although the sign may seem unfavorable, it in fact suggests that selection for improved feed conversion (feed/gain) has resulted in less feed being required per unit of gain.

As a result of the selection for improved feed conversion, the preweaning traits BWT (Figure 2) and WWT (Figure 3) decreased from 1974 until the end of the study. Yearling weight (Figure 4) and YHT (Figure 5) increased throughout the study. The increase in YWT was due to the increased ADG exhibited during the postweaning period. Both traits relating to mature size, MHT (Figure 6) and MWT (Figure 7), increased in response to selection for improved feed conversion. The increase in these traits was expected as a result of the genetic correlations between MHT and MWT (r_g = .88) and between MWT and CONV (r_g = -.95).

The response curve for INT (Figure 8) shows that the trait was somewhat variable but increased from beginning to end. As cattle on the postweaning test ate more, they in turn gained more, as shown in the response curve for ADG (Figure 9). This is consistent with the r_g = .42 between INT and ADG. Selection for improved feed conversion (feed/gain) was successful, as shown in the response curve for CONV (Figure 1). The response curves for ADG (Figure 9) and CONV (Figure 1) show that faster gaining cattle are more efficient in their ability to convert feed into weight gain, which is consistent with the r_g = -.82 between ADG and CONV. For a complete presentation of the heritabilities (h^2) and genetic correlations (r_g) for these traits, see the preceding paper by Glaze and Schalles.

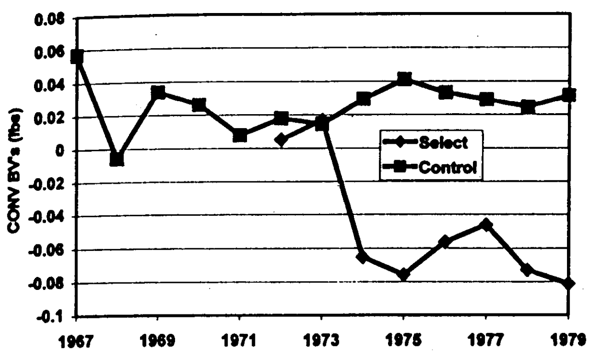


Figure 1. Within-Herd Time Trend of Feed Conversion (CONV) Breeding Values.

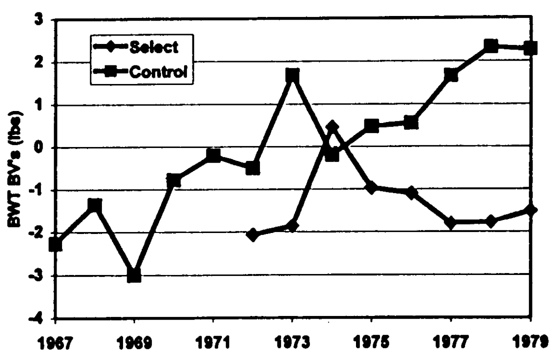


Figure 2. Within-Herd Time Trend of Birth Weight (BWT) Breeding Values.

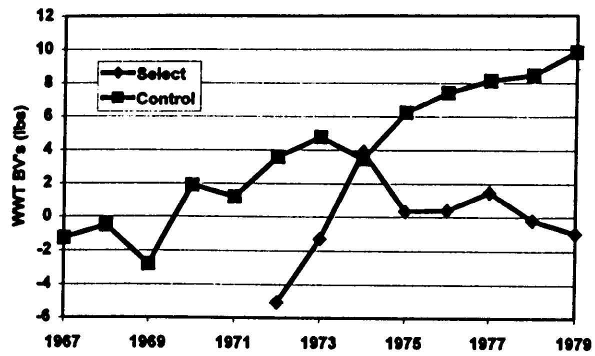


Figure 3. Within-Herd Time Trend of Weaning Weight (WWT) Breeding Values.

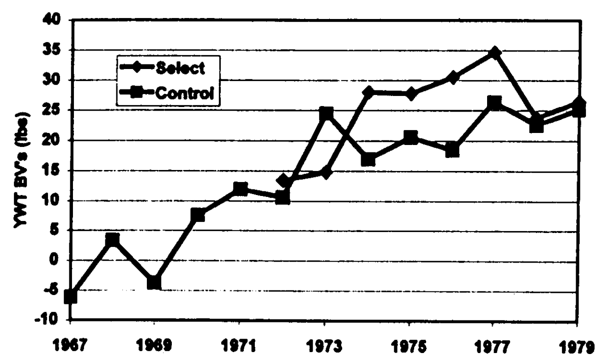
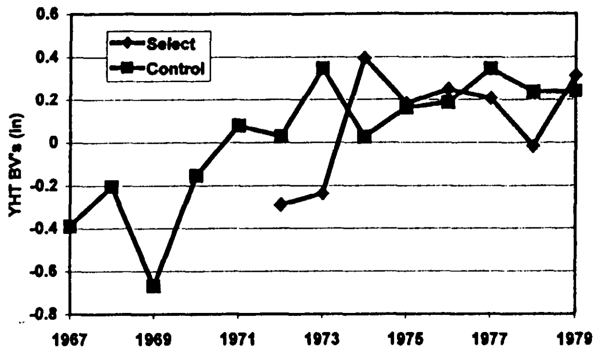


Figure 4. Within-Herd Time Trend of Yearling Weight (YWT) Breeding Values.



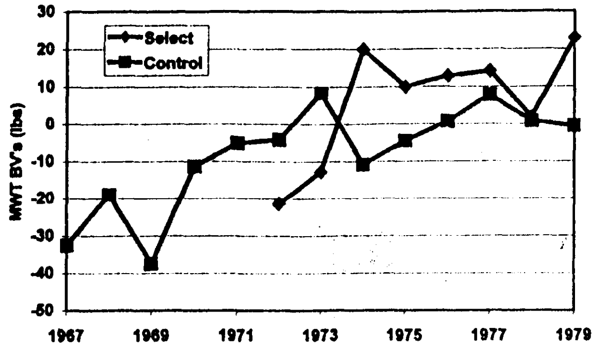
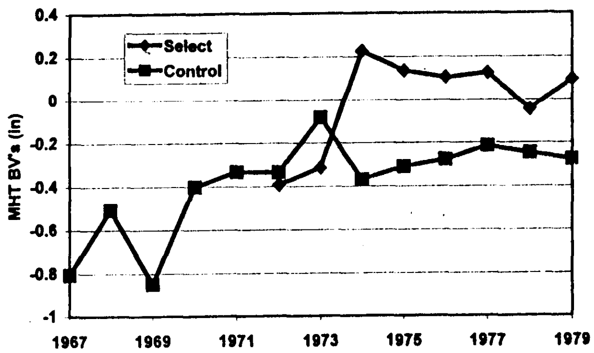


Figure 5. Within-Herd Time Trend of Yearling Height (YHT) Breeding Values.

Figure 7. Within-Herd Time Trend of Mature Weight (MWT) Breeding Values.



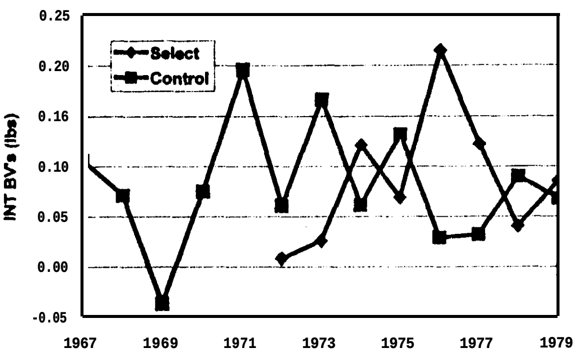


Figure 6. Within-Herd Time Trend of Mature Height (MHT) Breeding Values.

Figure 8. Within-Herd Time Trend of Daily Feed Intake (INT) Breeding Values.

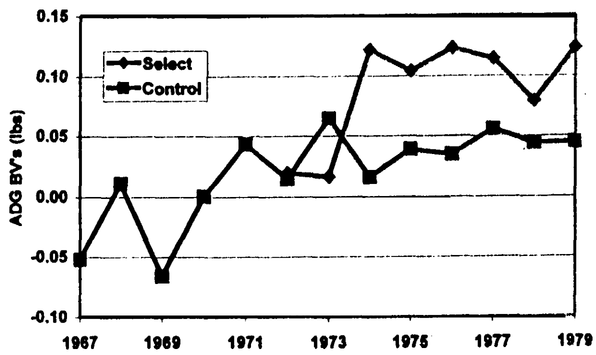


Figure 9. Within-Herd Time Trend of Average Daily Gain (ADG) Breeding Values.