HERITABILITIES AND GENETIC CORRELATIONS FOR BIRTH WEIGHT, WEANING WEIGHT, AND YEARLING WEIGHT IN POLLED HEREFORD CATTLE

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Summary

Performance data from a Polled Hereford herd selected for feed conversion were used in the calculation of heritabilities and genetic correlations for birth weight (BWT), weaning weight (WWT), and yearling weight (YWT). Direct heritabilities for BWT, WWT, and YWT were .31, .16, and .25, respectively. Corresponding maternal heritabilities for BWT, WWT and YWT were .04, .01, and .18, respectively. With the exception of the correlation between WWT and YWT (.98), the other genetic correlations were low to moderate, ranging from -.27 to .12.

(Key Words: Birth Weight, Weaning Weight, Yearling Weight, Heritabilities, Genetic Correlations.)

Introduction

Traditionally, beef cattle producers have marketed their product on the basis of weight. This has led to an increased emphasis on growth traits, such as birth weight, weaning weight, and yearling weight, in selection programs. For producers to make the most of their selection programs, they must have an understanding of the genetic relationships between traits. Therefore, the purpose of this study was to estimate the heritabilities and genetic correlations of birth weight, weaning weight, and yearling weight.

Experimental Procedures

Performance data were collected on 1410 animals from a Polled Hereford herd at Kansas State University, from 1967 through 1979. This herd was assembled using animals that were donated by breeders from several states and represented a cross section of the Polled Hereford breed. Calves from the original herd were used to establish a selection herd. The original herd then was used as a nonselected control. Bulls and heifers were selected from within each herd. Two bulls were selected based on feed conversion (high conversion) and used for 2 consecutive years in the selected herd. One bull was randomly selected in the control herd and used as a herd sire for approximately 6 years.

Cows representing the selected 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 calves being weaned in the fall at an average age of 196 days. Bull calves were placed on a performance test, which allowed for selection for feed conversion and individually fed 140 days. Heifers were group fed and were not selected on the basis of feed conversion. Cows were culled according to the following: (1) open at the end of the breeding season, (2) severe structural problems, and (3) horned. Birth weight (BWT), weaning weight (WWT), and yearling weight (YWT) records were available for analysis. The number of observations, means, and standard deviations for each trait are presented in Table 1. Subsets of this data set have been analyzed previously using paternal half-sib analysis procedures. However, with the advent of new technologies, the relationships between animals were incorporated into the analysis.

A derivative-free, restricted maximum likelihood procedure, incorporating a full numerator relationship matrix, was used to analyze the data. The mixed linear animal model included age of dam (2, 3, 4, 5-10, and >10 yr) and contemporary group (sex and year of birth) as fixed effects. Birth date, age at weaning, and age at yearling were included to regress all records to the respective mean ages. Individual animal effect, maternal effect, and permanent environmental effect were included as random effects.

Results and Discussion

Heritabilities and genetic correlations for BWT, WWT, and YWT are presented in Table 2. The direct heritability for BWT (.31) is similar to those previously reported, whereas direct heritabilities for WWT (.16) and YWT (.25) are lower than previously reported estimates. The maternal heritabilities for BWT (.04) and WWT (.01) indicate that the genetic maternal influence on these traits is small, whereas the maternal heritability for YWT (.18) indicates a moderate genetic maternal influence. The strong positive genetic correlation between WWT and YWT (.98) indicates that many of the same genes affect both traits, and may be due to the part-whole relationship of the traits. The genetic correlation (-.27) between maternal birth weight and maternal weaning weight indicates that animals having a genetic uterine environment that increases birth weight tend to have the genetics for lower milk production, and vice versa. Genetic correlations between other traits were low, ranging from -.06 to .12. Another project is currently under way to examine the direct and correlated responses due to selection for feed conversion and to estimate heritabilities and genetic correlations of additional traits.

Table 1. Number of Observations, Means, and Standard Deviations for Each Trait Analyzed

Trait	n	Mean	SD
Birth wt, lb	1369	73.25	9.63
Weaning wt, lb	1284	383.82	68.24
Yearling wt, lb	1045	715.07	145.45

Table 2. Heritabilities and Genetic Correlations [a] for Each Trait Analyzed

	Direct			Maternal		
Trait	BWT	WWT	YWT	BWT	WWT	YWT
Direct						
Birth wt	<u>.31</u>					
Weaning wt	.12	<u>.16</u>				
Yearling wt	.00	.98	<u>.25</u>			
Maternal						
Birth wt	-.03	-.02	.00	<u>.04</u>		
Weaning wt	-.06	.09	.00	-.27	<u>.01</u>	
Yearling wt	.00	.00	.00	.00	.00	<u>.18</u>

[a]Heritabilities are underlined; genetic correlations are below the heritabilities.