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Abstract

Data from a rotational crossbreeding study was used to calculate among-breed heritabilities of birth weight (BWT), weaning weight (WWT), and mature cow weight at 5 years of age. The among-breed estimates were higher than previous within-breed estimates because of the inclusion of genetic differences between breeds. Maternal effects for BWT and WWT also were calculated. These estimates allow for comparisons among breeds and for the eventual calculation of EPDs for hybrid cattle.

Keywords

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AMONG-BREED ESTIMATES OF HERITABILITY FOR BIRTH WEIGHT, WEANING WEIGHT, AND MATURE COW WEIGHT

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Summary

Data from a rotational crossbreeding study was used to calculate among-breed heritabilities of birth weight (BWT), weaning weight (WWT), and mature cow weight at 5 years of age. The among-breed estimates were higher than previous within-breed estimates because of the inclusion of genetic differences between breeds. Maternal effects for BWT and WWT also were calculated. These estimates allow for comparisons among breeds and for the eventual calculation of EPDs for hybrid cattle.

(Key Words: Heritability, Birth Weight, Weaning Weight, Cow Weight.)

Introduction

The wide-scale use of crossbreeding and increased number of available breeds requires comparison between breeds. With the analysis procedures currently being used by breed associations, direct comparisons between breeds are not possible without adjusting the EPDs. The purposes of this study were to produce estimates of heritabilities and correlations among breeds and to increase the data available for use in breed comparisons. These data also will allow for the calculation of EPDs for hybrid cattle. This study is part of the NC-196 national project to study the genetics of body composition of beef cattle.

Experimental Procedure

Data collected between 1970 and 1988 at Louisiana State University, Baton Rouge, were used for the analysis of birth weight (BWT), weaning weight (WWT), and mature cow weight (COWWT) taken at 5 years of age. The data set consisted of 3936 BWT, 3611 WWT, and 627 COWWT records. The data were from generations 1 through 4 of a rotational crossbreeding study involving Angus, Brahman, Charolais, and Hereford. Straightbred and crossbred data were included in the analysis. Cows were bred by natural service to calve between January 15 and April 10. Calves were dehorned, if needed, and weighed and ear notched within 24 h of birth. All bull calves were castrated in July. Calves were weaned in the first week of October at an average age of 220 days. Cows were weighed when the calves were weaned.

Cows were wintered on Bermudagrass hay and ryegrass pastures from November through March. Bermudagrass pastures were grazed during the spring and summer. Replacement heifers were kept from within the herd and managed similarly to the cows. All bulls were purebred and purchased from bull test stations or private sales.

The models used for this analysis included contemporary group (same year of

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birth and sex) and percent heterosis for all three traits. The BWT and WWT analyses also included age of dam and a regression for birth date or age at weaning, respectively. The cow weight analysis included the production status of the cow in her fifth year (weaned a calf, calf died preweaning, or open). Maternal influences also were calculated for BWT and WWT. The pedigree information was included in an animal model.

Results and Discussion

The averages (lb) were 72.6 for BWT, 497.2 for WWT, and 1082.1 for COWWT. Heritabilities and correlations are shown in Table 1. The heritability for BWT (.87) is higher than previously reported values, primarily because the value is an among-breed rather than a within-breed estimate. Heritabilities for WWT (.48) and COWWT (.81) were high, but more similar to within-breed estimates found in the literature. The high heritabilities for all three traits indicate that change can be made through selection among as well as within breeds in all traits.

The correlations between BWT and WWT were high (genetic = .79, phenotypic = .50), indicating that both traits should be considered in selection. These correlations indicate the need to keep BWT in a range that allows for reasonable calving ease, while producing acceptable WWT. The correlations between COWWT and the other two traits were zero, which indicates that selection for acceptable early weights will not necessarily have a direct influence on mature weight of cows. We believe that rate of maturity is one factor influencing this relationship.

Maternal heritability indicates the influence of the dam's genetics on the weight of her calf, apart from the genes she passed on. For BWT, maternal heritability primarily reflects the uterine environment, whereas for WWT, it reflects milking ability. The correlation between maternal and direct BWT was -.22, indicating a compensation by the dam to reduce the BWT of calves that have a high direct genetic value for BWT. This negative correlation was present even when the percent of Brahman in the dam was included in the analysis.

The analysis included the variation between breeds as well as within breeds. This allowed for calculation of among-breed heritabilities and correlations. We expected these estimates to be higher than the within-breed estimates because of the genetic differences between breeds. These values allow for comparisons among the breeds in the study. The high correlation between direct BWT and WWT shows the need to select for moderate BWT in order to achieve acceptable WWT. The high among-breed heritability of BWT indicates that it can be controlled by selection of breeds as well as individuals within a breed. The negative correlation between direct and maternal BWT shows the importance of not relying totally on actual weight to determine genetic potential of an animal. The results of this study can be used to produce EPDs for hybrid cattle in the future.

Table 1. Heritabilities and Correlations of Weight Traits [a]

Trait	Direct Birth wt	Direct Weaning wt	Direct Mature wt	Maternal Birth wt[b]	Maternal Weaning wt[b]
Direct					
Birth wt	.87	.50	0		
Weaning wt	.79	.48	0		
Mature wt	0	0	.81		
Maternal					
Birth wt	-.22	0	0	.26	
Weaning wt	0	0	0	0	.18

[a]Heritabilities are underlined, genetic correlations are below heritabilities, and phenotypic correlations above.

[b]Phenotypic correlations were not calculated for maternal effects.

Heritabilities and Genetic Correlations

Direct heritabilities estimate the fraction of variation among animals caused by genes received from the parents, and range from zero to 1. The dam also provides a maternal environment, such as uterine environment and milking ability which is influenced by the dam's own genetics, separate from the genes she passes on to the offspring. The heritability of this maternal environment is referred to as maternal heritability. Direct heritabilities include a calf's own genetics for growth up to birth, expressed as birth weight heritability or growth to weaning, expressed as weaning weight heritability, etc.

Correlations indicate the relationship between two traits and can range from -1 to +l. Genetic correlations indicate the relationship between two traits caused by the same genes. For example some genes that cause rapid growth from birth to weaning also cause rapid growth from weaning to yearling. Some genetic correlations are less obvious. A correlation between maternal weaning weight and direct yearling weight would indicate that some of the genes that influence milk production also influence the individual's own growth rate.