GENETIC RELATIONSHIPS AMONG BREEDING SOUNDNESS TRAITS IN YEARLING BULLS

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Summary

Breeding soundness examination data on over 1,200 yearling Angus bulls were analyzed to determine heritability of and genetic relationships among breeding soundness traits. Breeding soundness exam procedures were consistent with those currently recommended by the Society of Theriogenology. Presence of seminal white blood cells (an indicator of seminal vesiculitis), penile warts and persistent frenulums were noted and recorded. Data were adjusted for age at measurement and contemporary group effects. Heritability was high for scrotal circumference, moderate for percentage of abnormalities, low for sperm motility, and near zero for semen white blood cells, persistent frenulum, and penile warts. Genetic correlations between scrotal circumference and both sperm motility and abnormalities were favorable, indicating that selection for increased scrotal circumference should result in higher fertility.

(Key Words: Bulls, Breeding Soundness Exam, Heritability, Genetic Correlation, Scrotal Circumference.)

Introduction

Most beef producers use yearling bulls as at least part of their bull battery. Many factors may influence a cow-calf producer's bull selection decisions, including growth and performance, carcass traits, and fertility. Of all these factors, fertility is the most economically important. For a bull to be considered fertile, he must be able to copulate normally and have semen of adequate quality. Currently, the breeding soundness examination (BSE) is the best predictor of fertility in beef bulls. The most common defects in the BSE of yearling beef bulls are inadequate semen quality, persistent penile frenulum, and penile warts.

We conducted this study to estimate the heritabilities of scrotal circumference, sperm motility, semen abnormalities, and common defects of the penis. Additionally, we determined estimates of the genetic correlation of these components with scrotal circumference.

Experimental Procedures

A BSE was performed on 1,282 registered Angus bulls developed at three private producers in the Kansas Flint Hills, or at the K-State Purebred Beef Unit between 1994 and 2000. Scrotal measurements were recorded to the nearest 0.5 cm. Semen was collected via electroejaculation and analyzed for motility, morphology, and the presence of white blood cells. Birth dates and complete five-generation pedigrees for all bulls were obtained from the American Angus Association, St. Joseph, MO. Average age at examination was 383 days, with a range of 288 to 455 days. Bulls outside this age range were excluded from analysis. Data in this study were from initial examinations; no data from rechecks were included. Averages for the analyzed traits are shown in Table 1.

Semen abnormalities were classified as primary or secondary, as described by the

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Society for Theriogenology, and recorded as a percentage of the total sperm counted. Primary and secondary abnormalities were added to get percent total abnormalities. If motility was <30% or total abnormalities were >30% the bull was collected at least two more times on the day of examination. The results from the best sample (highest motility and lowest number of total abnormalities) were recorded. All slides were evaluated for the presence of white blood cells, an indicator of seminal vesiculitis. The presence of persistent penile frenulum or penile warts was recorded.

The statistical model used adjusted measurements for age in days at the time of evaluation and contemporary group effects. Contemporary groups defined the bull's origination from a common herd and management system in the same year. Heritability estimates were obtained from single trait analyses. Genetic correlations were determined by pair-wise analyses of each trait with scrotal circumference. A derivative-free REML algorithm was used to estimate variance components for estimates of heritabilities and genetic correlations, similar to procedures used in most breeds' national cattle evaluation programs for other traits.

Results and Discussion

Estimates of heritabilities and genetic correlations for the analyzed traits are shown in Table 2. As expected, scrotal circumference was highly heritable (0.56), and can easily be improved through selection. Primary, secondary, and total abnormalities were moderately heritable, ranging from 0.26 to 0.35. Heritability of sperm motility was low (0.07), and presence of white blood cells, persistent frenulum, and penile warts were found to have little or no genetic cause, perhaps because their incidence in this study was very low.

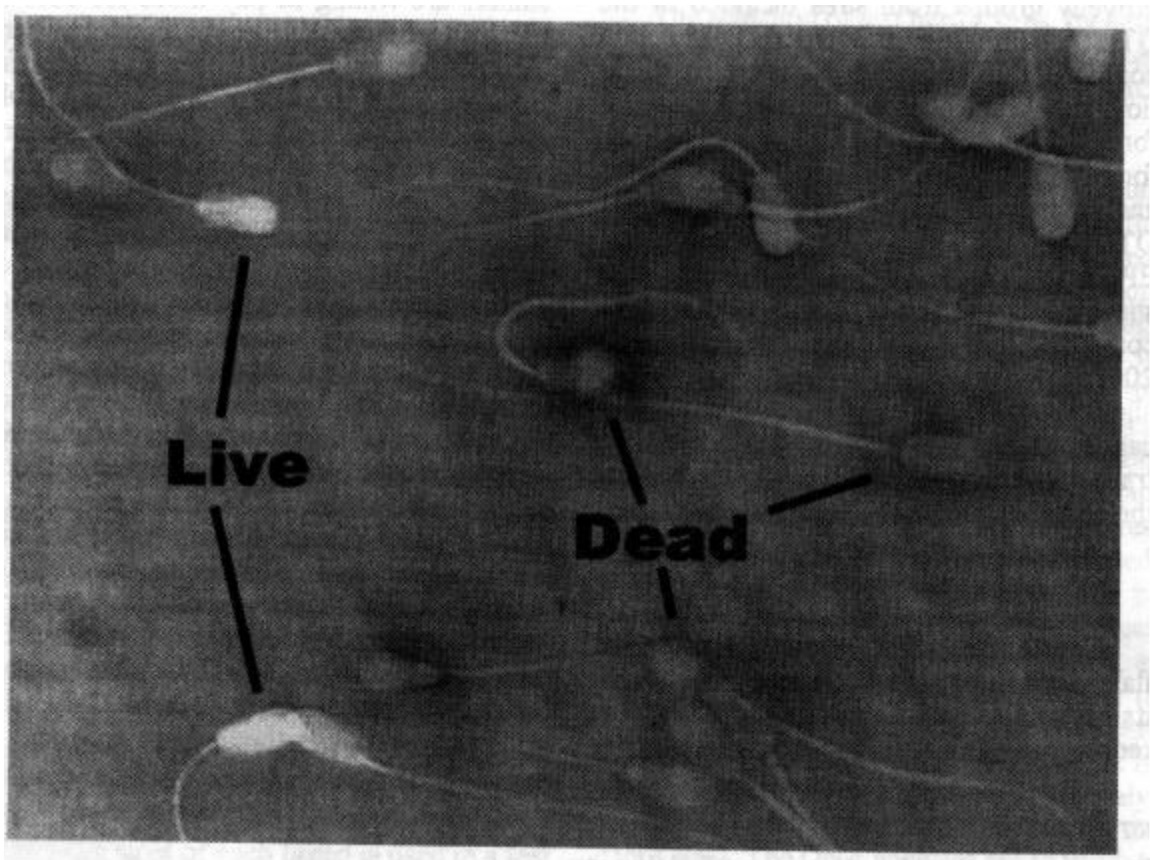
Genetic correlations between scrotal circumference and semen quality were moderate and in a favorable direction. Increased scrotal circumference was associated with increased motility (0.56), and decreased primary (-0.25), secondary (-0.40), and total (-0.32) abnormalities. The genetic correlation between scrotal circumference and presence of white blood cells was low (-.09) and in a favorable direction, indicating slightly lower incidence of seminal vesiculitis in large scrotal circumference bulls.

Table 1. Averages, Standard Deviations (SD), and Ranges for Breeding Soundness Components and Common Reproductive Abnormalities in Yearling Angus Bulls

Trait	Average	SD	Minimum	Maximum
Scrotal Circumference, cm	35.00	2.57	21.00	43.00
% Motile Sperm	44.36	12.34	0.00	85.00
% Primary Abnormalities	13.76	16.82	2.00	100.00
% Secondary Abnormalities	12.16	10.26	0.00	90.00
% Total Abnormalities	25.92	19.87	6.00	100.00
Percent with:				
Seminal White Blood Cells	5%			
Persistent Penile Frenulum	1%			
Penile Warts	3%			

Table 2. Heritabilites and Genetic Correlations for Breeding Soundness Exam Traits of Yearling Angus Bulls

Trait	Heritability	Genetic Correlation with Scrotal Circumference
Scrotal Circumference, cm	**0.56**	
% Motile Sperm	**0.07**	**0.56**
% Primary Abnormalities	**0.35**	**-0.25**
% Secondary Abnormalities	**0.26**	**-0.40**
% Total Abnomalities	**0.29**	**-0.32**
Seminal White Blood Cells	**0.02**	**-0.09**
Persistent Penile Frenulum	**0.00**	
Penile Warts	**0.00**	



This photo taken through a microscope, live sperm cells with healthy membranes have rejected the Eosin/Nigrosin stain and dead sperm with damaged membranes accept it. photo courtesy of Dr. Peter Chenoweth, Department of Clinical Sciences, College of Veterinary Medicine.