



Repro Tracks

► by **Bill Beal**, beef cattle reproductive physiologist, Virginia Tech

Low heritability of reproductive traits

Genetic improvement in any trait depends on the selection of sires and dams that can pass the genes for superior performance on to their offspring. The portion of the parents' superiority that can be transmitted depends on the heritability of the trait. The low heritability of most reproductive traits and the lack of a system for whole-herd reporting of reproductive performance limits the potential for development of expected progeny differences (EPDs) for reproductive traits.

Introduction

Selection and mating of parents with outstanding performance in economically important traits (ERTs) is the key to genetic improvement of Angus cattle. The superior performance of a selected sire or dam is due in part to genetics and in part to the effects of the “environment” in which the selected parent achieved the outstanding performance.

Obviously, only the genetic component of the parent's performance can be passed on to the offspring. The statistical measure of the proportion of the advantage that is controlled by genetics and can be passed on is referred to as the heritability. Heritability is expressed as a decimal value between 0 and 1, but is usually referred to as the percent heritability (for example, 0.40 as 40%).

Performance traits have different heritabilities or, put another way, some performance traits are affected more by the environment (feed supply, health status, temperature, etc.) than others. Traits with heritabilities of 40% are referred to as highly heritable traits. Those traits with heritabilities between 20% and 40% are considered to have moderate heritability, and those less than 20%, low heritability.

The higher the heritability, the more the genetic superiority of the parents can be passed on to the next generation. Hence, the most rapid genetic progress can be made when selecting for highly heritable traits (mature weight, height, carcass traits). Unfortunately, reproductive traits (first-service conception rate, calving interval,

heifer pregnancy rate) have heritabilities less than 15%. This makes improvement in reproductive efficiency through genetic selection a very slow process and leads to numerous questions about the value of selection for reproductive traits.

Breeder question No. 1

I have had problems getting 2- and 3-year-old cows in my herd rebred. Recently, another Angus breeder suggested I could improve my herd's reproductive efficiency by only selecting replacement heifers from older cows that have always calved in the first three weeks of my calving season. Would this reduce my breed-back failures?

Response: The ability of a cow to become pregnant again after calving is certainly controlled in part by genetics. However, the heritability reported for calving interval (the ability to calve early each year) is typically less than 5%. This suggests that even if you identify cows in your herd that have consistently calved early in the calving season, only 5% of that

advantage will be passed on to their female offspring. Hence, this will not ensure that the daughters of early-calving cows will calve early themselves.

Another way to view the control of rebreeding is to consider that if the genetic component is only 5%, the role of the “environment” (everything other than genetics) accounts for 95% of the factors controlling when (or if) a cow rebreeds. This is where factors such as body condition score (BCS) at calving, the time of calving relative to the beginning of the next breeding season,

nutrient availability during the breeding season and other “man-made” variables come into play. Because they exert such a large effect on rebreeding success, managing to optimize those variables may improve your rebreeding success more than placing heavy selection pressure on early calving of the dams of your replacement heifers.

Breeder question No. 2

I use artificial insemination (AI) to breed my heifers and would like to select heifers with better genetics for AI conception rate. Can't the American Angus Association develop an EPD for fertility?

Response: There are several barriers to developing a valid and useful EPD for first-service conception rate. The first problem is that the research done by several university geneticists in conjunction with the American Angus Association staff indicated the heritability of first-service conception rate was, in their words, “virtually zero.” The researchers went on to say, “Producers must rely on environmental factors rather than genetics to make improvements in first-service conception rate to artificial insemination.”

On the other hand, the same researchers found that the genetic variation in whether a heifer became pregnant during the first breeding season, referred to as “heifer pregnancy rate,” was influenced less by environmental factors and had a calculated heritability of 13%. They stated, “Although its heritability is low, some improvement in fertility could be made by selecting on heifer pregnancy rate.” They also noted that the genetic correlation between yearling pregnancy rate and lifetime pregnancy rate was greater than 90%.

The encouraging analysis of heifer pregnancy rate caused the Association staff to publish the first Research Report on Heifer Pregnancy Evaluation in 2007. That evaluation was updated recently and now includes 26,746 heifer breeding records used to generate EPDs for 719 sires.

While this sounds impressive, it brings up the second problem in calculating meaningful EPDs for reproductive traits — not enough records. The 26,746 heifer breedings may seem like a lot of records,

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**Heritability:
the portion of
a sire or dam's
superiority
in a given
performance
trait that is due
to genetics and
can be passed
on to their
offspring.**

but it is less than $\frac{1}{200}$ of the number of records used to generate the EPDs for birth weight in the *Fall 2010 National Sire Evaluation Report*.

There is no accepted system for reporting data on reproductive performance of cows and heifers. Breeders don't have an incentive to take the time to submit AI or natural-service breeding information on each cow or heifer in their herd. Furthermore, breeding records often fail to include the cows or heifers that did not become pregnant and

were culled from the herd. Hence, the lack of an accepted "whole-herd" reporting system limits the strength and accuracy of the EPD for heifer pregnancy and makes the development of EPDs for other reproductive traits less likely.

A handwritten signature in black ink that reads "Bill Beal". The signature is written in a cursive, flowing style.

Editor's Note: *Bill Beal is a beef cattle reproductive physiologist at Virginia Tech. He conducts research involving estrus synchronization, AI, embryo transfer and the use of ultrasound technology. This column is designed to provide answers to questions about reproductive management commonly posed by commercial and purebred breeders. If you have questions or comments related to the reproductive management of cows or bulls, e-mail them to Beal at wbeal@vt.edu or mail them to him at the Dept. of Animal & Poultry Sciences, Virginia Tech, Blacksburg, VA 24061-0306.*