USING HERITABILITY TO YOUR ADVANTAGE

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Having a basic understanding with respect to the heritability of traits allows for an understanding how genetic selections may impact the phenotype observed and how quickly these changes may be observed in a herd. The degree to which the genes of an individual influence the phenotypic variation is described by the heritability of a given trait. It is important to consider that heritability estimates are specific to a given population and environment. This fact is perhaps better realized if one were to look at the heritability estimates for a few traits listed by various breed associations. For example the heritability estimates for birth weight and milk / maternal milk reported by the American Angus Association, American-International Charolais Association and the American Hereford Association are 0.42, 0.14, 0.43, 0.10, 0.49 and 0.14. Though the values are very similar they are not exactly the same for all three breeds. The higher the heritability estimate, the more rapidly change may be observed through genetic selection.

The tables below list the heritability of some traits as reported by others. In general, reproductive traits are considered to be lowly heritable. These traits respond more positively through heterosis and crossbreeding. Performance traits such as birth, weaning and yearling weights are consider low-moderately heritable. Carcass traits are moderately heritable. While traits such as hip height, frame score (age adjusted hip height) and mature weight are highly heritable. This can be seen by looking at how rapidly the frame size of past national shows changed over time. Note that even phenotypic characteristics have some degree of heritability as indicated by the Simmental data set. Also, keep in mind that one should utilize the heritability estimates for a specific breed where appropriate (i.e. purebred breeders).

Additionally, it is important to be aware of the genetic correlations between traits. In other words, selection of one trait may result in changes in other traits. An example of this is the genetic correlations between birth, weaning and yearling weight. The genetic correlations are 0.53 and 0.54 for birth weight to weaning and yearling weight. In general, calves with higher birth weights would be anticipated to have heavier weaning and yearling weights. Keep in mind however that there is variation within a population and a normal distribution is assumed with low birth weight and high weaning weight individuals being found (i.e. curve benders) as well as those with high birth weights and low weaning weights.

Recently, I was asked about pelvic area measurements and if they were heritable. The answer is yes, but one needs to understand what selection for increased pelvic areas could result in. Many individuals measure pelvic area in their breeding animals as indicator for reducing calving difficulty. USDA researchers illustrated selection for increased pelvic area can reduce calving difficulty while at the same time this selection method can also result in increased birth and weaning weights (Bennett and Gregory, 2001). The genetic correlation for pelvic area and these weight traits were 0.39 and 0.43 for birth and weaning weight, respectively. The use of pelvic area measurements are better utilized in culling heifers that are below a set target or a minimal threshold size. In a Canadian veterinary journal, it was stated "Our analyses suggest there is no evidence to justify the continued use of pelvimetry as an on-farm test to reduce dystocia in beef cattle" (Van Donkersgoed et al., 1993). In a separate journal article by USDA researchers, they indicate that the selection of for increased pelvic area in yearling bulls would not likely reduce calving difficulty (Kriese et al., 1993). Using birth weight combined with calving difficulty score of 2-year old heifers was suggested to be the more accurate in predicting heifer calving difficulty (Bennett and Gregory, 2001). The literature indicates that if yearling weights were able to kept constant or such that the frame of the animals were not increased through selection for pelvic area then one may see a reduction in calving difficulty. This illustrates the complexity of predicting selection responses and that not all things are "cut and dry".

Hopefully, you have gained some insight as to how quickly progress may be observed in your herd through genetic selection. If you have questions, contact your local county extension agent for more information.

Table 1. Estimates of heritability for beef cattle traits.

Conception rate	**0.05-0.17[a]**
Calving ease	**0.10-0.13[a]**
Scrotal circumference	**0.48[a]**
Birth weight	**0.31[a]**
Weaning weight	**0.24[a]**
Yearling weight	**0.33[a]**
Frame Score	**0.61[a]**
Mature weight	**0.53-0.79[b] 0.44-0.53[c]**

Table 2. Estimates of heritability for carcass traits of beef cattle (Bertand et al., 2001).

Carcass weight	**0.39**
REA	**0.47**
Fat thickness	**0.34**
Marbling Score	**0.46**
% Retail Cuts	**0.41**
WB Shear Force	**0.22**
Ultrasound REA	**0.32**
Ultrasound FAT	**0.28**
Ultrasound IMF %	**0.41**

Table 3. Estimates of heritability for phenotypic traits of Simmental cattle (Kirschten, 2002).

Stature (ht)	**0.60**
Body length	**0.39**
Muscling	**0.42**
Capacity	**0.44**
Feminity	**0.32**
Rear legs	**0.12**
Foot/pastern	**0.13**
Udder attach	**0.23**
Udder depth	**0.35**
Teat size	**0.39**