Alternative Definitions of Stayability

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Beef cow stayability been defined as the probability a cow will remain in the herd until six years of age given she first calved as a two year old. As an economically relevant trait, stayability typically has a large influence on herd profitability. For a herd to be profitable the number of cows remaining in production past their break even age must compensate the number of cows who are culled before this age is reached (Snelling et. al, 1995).

Recently, this traditional definition of stayability has been questioned for different reasons. First of all, are the concerns that young sires remain low accuracy until their daughters have reached this six year benchmark. Waiting for sires to increase in accuracy can slow genetic progress by increasing their generation interval. Second, producers have indicated that if a cow calves as a four year old the probability she will conceive two more times is high. The additional years it required for a cow to obtain a stayability observation are not very informative of her reproductive capability. Martinez et. al. (2004) showed if a cow conceives and then subsequently calves as a two year old, the probability of her remaining in the herd at four and six years of age is 83 and 74 percent respectively. Lastly, stayability has been criticized for being biased with all of the other non-reproductive reasons a cow can be culled. If stayability is to be a prediction of reproductive ability, culling on the basis of non-reproductive reasons can affect the interpretation of stayability. These reasons include but are not limited to disposition, structural soundness, pedigree or even color. During periods of drought herds may be dispersed regardless of performance, conversely during expansion phases of the cattle cycle cow numbers may be increased with less stringent culling guidelines. As a result, stayability may not always be interpreted as predictor of reproductive performance.

Snelling et. al. (1995) reported heritabilities for stayability for ages three, six, nine and twelve years in two purebred herds. These within herd estimates showed stayability to six years of age to have a sufficiently high heritability as well as representing the economic break-even point for a cow. This definition was subsequently adopted as the general definition for many national cattle evaluations.

Economically, the cattle industry is constantly changing. During the early-1990's the breakeven point for individual cows was between 3 and 9 years old (Dalsted and Gutierrez, 1989). However since then calf prices have increased. This increase in calf prices have pushed the industry into a time of expansion with fewer heifers being sold. Smaller differences between replacement heifer prices and salvage cow prices coupled with higher returns per cow have likely shifted the true breakeven age.

To better align the stayability genetic prediction with market prices and to address some of the practical problems, such as the time it takes young sires to increase in accuracy, the objective of this study was to evaluate using younger ages as stayability observation benchmarks. As a basis for this investigation performance data from two different breed associations have been used to investigate heritability and sire re-rankings when stayability is redefined as probability of staying in the herd to younger ages. The first data set, obtained from the American Gelbvieh Association (AGA), was used only to estimate variance

components for stayability to four years of age. The second data set, obtained from the American Simmintal Association (ASA), estimates of heritability to three years of age, rather than four years of age, and six years of age was calculated.

Materials and methods:

Data set one:

Raw data received from the AGA included a total of 838,128 pedigree records with 73,706 individuals having useful stayability observations. A three generation pedigree was generated based on only those animals with data and their ancestors. Defining stayability at two different ages with the same data, under the same sifting guidelines resulted in the following distributions:

	Stayability Definition	
Observation	4 years	6 years
No	20,532	21,861
Yes	53,174	33,372

Data set two:

Raw data supplied by the ASA contained 3,820,059 pedigree records with 447,928 usable records. The following table illustrates the number of observations for the 2 definitions of stayability.

	Stayability Definition	
Observation	3 years	6 years
No	20,862	32,129
Yes	40,454	29,608

Variance component estimation:

Data set one:

Method R was used to estimate heritability for stayability at 4 years. For comparative purposes the genetic variance and heritability currently used to for EPD calculations is summarized in the following table.

Stayability Definition	4 yrs.	6 yrs.
Genetic Variance	0.3465	0.1602
Residual Variance	1	1
Heritability	0.26	0.14

Data set two:

Heritability estimates from the second data set were as follows:

Stayability Definition	3 yrs.	6 yrs.
Genetic Variance	0.2691	0.2526
Residual Variance	1	1
Heritability	0.21	0.20

Expect Progeny Difference Calculation:

Data set one:

The EPD were calculated using the current statistical model for stayability to six years of age only changing the genetic variance and contemporary group definition to define stayability to four years of age. Stayability EPD can be interpreted as the increase (or decrease) in the probability a bull daughters will remain in the herd at a given age. EPD summary statistics for each definition of stayability for sires were:

	N	Mean	Variance	Minimum	Maximum
Stayability to 6	7,123	1.045	9.811	-11.8	17.2
Stayability to 4	8,935	0.906	19.878	-21.1	20.9

As a way of comparing the stayability EPD resulting from each of the two differing definitions, Spearman's rank correlation was calculated for the 6,783 sires with EPD for both 6 and 4 years of age. The rank correlation between the two different definitions of stayability EPD is 0.66 which shows a less than perfect relationship. A rank correlation of one would mean all bulls rank the same in each analysis.

Data set two:

EPD were calculated using each of the estimated variances components, stayability to three years rather than four, or six years of age. A model identical to the one used for data set one was used with the different heritability estimates. The resulting sire EPD for each definition of stayability are summarized in the table below:

	N	Mean	Variance	Minimum	Maximum
Stayability to 6	6,615	1.57	24.02	-19.23	25.30
Stayability to 3	5,721	1.58	20.59	-17.53	23.03

Results similar to those in data set one were found. Comparing sire EPD from stayability at 6 years to stayability at 3 years yielded a rank correlation of 0.59.

Discussion / Conclusion

From this analysis we have found that heritability estimates for stayability to younger ages is at least as heritable if not more heritable

than the currently excepted six year benchmark. A younger definition of stayability may alleviate some problems associated with current definitions of stayability. Lowering the required age by two years would increase young sire's accuracy quicker. If cows are truly culled more often in their fifth and sixth year because of non-reproductive issues lowering the benchmark for stayability may lead to a more accurate prediction of a cow's reproductive performance. However before changing an economically important trait like stayability a complete economic study using current market values should be conducted. Another issue which emerges if stayability were to be redefined is the use of stayability EPD in decision support software. Breed associations must come to a consensus of which age all stayability EPD would be reported if it is to be used properly in decision support software. Further research should be focused in the area of exactly why cows are culled at different ages and when cows truly pay for themselves.

References

Dalsted, N.L., and P.H. Gutierrez. 1989. How long do you keep her? BEEF Spring:15.

Martinez, G.E., R.M. Koch, L.V. Cundiff, K.E. Gregory, and L.D. Van Vleck. 2004. Genetic parameters for six measures of length of productive life and three measures of lifetime production by 6 yr after first calving in Hereford cows. J. Anim. Sci. 82:1912-1918.

Snelling, W.M., B.L. Golden, and R.M. Bourdon. 1995 Within herd genetic analysis of stayability in beef females. J. Anim. Sci. 73:993-1001.