Productive Longevity in Beef Cows

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Introduction. Cow longevity is one of the most economically important traits in the beef cow. Longevity is inter-related to other important traits, and, therefore, it is difficult to separate the importance of longevity, itself, from the importance of traits that are related to longevity. For example, reproductive performance is usually part of the culling criteria. It is often stated that reproductive performance is the single most economically important trait in beef cattle. It can be argued that, if reproductive performance is included as a criterion for culling, productive longevity can be the most economically important trait to the cow-calf producer. Since the only reason that the seedstock industry exists as a business is to meet the demands of the commercial cattle industry, I will discuss longevity as a factor in commercial herds. However, since most of the genetic improvement for longevity must come from seedstock producers, it is also important to consider longevity in purebred (or other seedstock) herds.

Experimental results have shown that both breed differences and hybrid vigor can have major effects on cow longevity. There are also individual genetic differences within breeds for factors that affect longevity.

Reasons that cows leave herds. I will discuss productive longevity as the length of time that a cow can stay in a herd without dying or being culled. Of course, cows can leave a herd for other reasons besides death and culling. Some other reasons are sales of cows due to drought, reductions in herd size due to selling land or losing a lease on pasture land, the sale of young productive cows as breeding cows, or converting to a different breeding program.

Culling criteria can differ greatly between different producers. Generally, in a commercial herd, a cow should be culled when she can no longer be expected to be profitable in the herd. In a sense, this could be considered to be the case in seedstock herds, but profit may be realized in a different manner, through the future sale of breeding stock. That is, the culling criteria in a purebred or other seedstock herd may be part of the genetic improvement program. In our research herds, we have attempted to use a culling criterion that provides the most information about low long a cow of a given type can remain productive.

For example, in a commercial herd of a particular breed or cross in a particular location, it may be feasible to cull all remaining cows at a given age, because, on the average, cows of this age have too high of a probability of losing their next calf, weaning too light of a calf, dying, or being too thin to have adequate value as a cull cow, if kept for another year.

By contrast, if a seedstock producer is trying to improve genetic merit for longevity, cows of this same age may be given the opportunity to produce additional calves to determine which cows can stay productive to advanced ages so bulls can be kept out of them

In our research herds, we use a criterion that we think provides the most information about cows of a given type, with regard to them staying productive to advanced ages.

Culling Criteria. Some of the culling criteria that are used are reproductive performance, tooth wear (and/or lost teeth), udder problems, eye problems, poor body condition of the cow, lameness or skeletal unsoundness of the cow, death of her calf, light or unthrifty calf at or before weaning, and age of the cow (independent of other factors),

Of course, these reasons for culling are (or can be) related to each other. Some of the reasons for culling for factors other than reproduction would cause reproductive problems if the cow remained in the herd.

Since cows can leave a breeding herd for a variety of reasons, longevity is actually a combination of a number of different traits. Since different producers place different amounts of emphasis on different traits in their culling criteria, the effects of different traits on longevity can differ between operations. Also, different environmental and management differences can affect the ability of a cow to remain productive.

Longevity is mostly a lack of problems. Therefore, it is easier to consider the reasons that cows leave the breeding herd (through either death or culling) than it is to consider why other cows stay in the herd longer.

I have heard someone say (and it may or not have been original from the person from whom I heard it): "The best cow is the one that goes the longest before you notice her." Of course this implies that you didn't notice her because she didn't cause (or have) any problems.

Age of the Cow. In some commercial herds all cows are culled when they reach a certain age. As I said earlier, this may be feasible, if, on the average, cows of this age have too high of a probability of losing their next calf, weaning too light of a calf, dying, or being too thin to have adequate value as a cull cow, if kept for another year. However, there are genetic differences that affect all of these factors. For example, experience may have shown that it is not profitable to keep cows of a given breed after they are ten years of age at a given location; however, cows of another breed or cross may last longer under those same conditions. Even for the same breed of cow, current prices can determine whether it makes sense to sell cows of a given age in a particular year.

Tooth Wear and/or Lost Teeth. In some cases, cows are culled based on the condition of the mouth (i.e., based on the size and/or condition of the incisors (front teeth)). Most people (myself included) have considered the problem with lost or badly worn teeth to be that cows with bad mouths were not able to graze as effectively as those whose mouths were in better condition. However, we have probably all seen cows that have stayed productive after their mouths were smooth. We have usually thought that the kind of pasture that cows were on determined whether cows could stay productive after their mouths had deteriorated.

This is probably true, but, as we have learned more about gum disease (in both people and animals), it seems likely that bad mouths may lead to problems even if the bad mouth does not impair the cow's ability to graze.

There are major genetic differences in the age at which cows' teeth are lost are worn down. In a crossbreeding study at Ft. Robinson, Nebraska, involving straightbred Angus, Hereford, and Shorthorn cows and all of the first crosses of these breeds, cow's mouths were scored for cows from 10 to 15 years of age (Núñez –Dominguez et al., 1991). There were differences among the three different breeds, and the crossbreds had significantly better mouth scores than the straightbred cows.

In a study that we started at the Riesel station and completed at the McGregor station, we found that first crosses of five *Bos indicus* breeds with the Hereford all had significantly better mouth scores than Angus-Hereford first cross cows (Riley et al., (2001).

In what was then Rhodesia, Steenkamp (1969, 1970) found that Hereford cattle had more wear and earlier loss of their temporary incisor teeth than local indigenous Sanga cattle. They measured the hardness of the enamel and studied the type of occlusion (bite) in the two different breeds. They found that the tooth enamel was significantly harder in the indigenous cattle than in the Herefords at 31 to 35 months of age. They also found that, in the Hereford cattle, the incisors bit into the maxillary pad, whereas, in the indigenous cattle the incisors closed on the front edge of the pad. They concluded that this difference in occlusion (bite) caused the teeth of the indigenous cattle to get sharper with age and the teeth of the Hereford cattle to wear prematurely.

In a study at the McGregor station we artificially inseminated both Angus ad Hereford cows to Brahman, Boran (an East African *Bos indicus* breed), and Tuli (a Sanga breed fro Zimbabwe) in 1992 and 1993. We took mouth scores on the resulting crossbred cows starting in 2004 (when the cows were either 11 or 12 years of age). Both the Brahman and Boran crosses had better mouth scores (more solid mouths and fewer broken or smooth mouths) than the Tuli crosses (Sanders et. al., 2005, and Muntean, 2011).

In these studies where mouths have been scored in old cows, it is possible that some of the cows that were culled at earlier ages for reproductive (or other) reasons could have had bad mouths (badly worn or lost teeth).

Udder Problems. In some cases, cows are culled for udder problems. In other cases, cows lose their calves because of udder problems and the cows are culled because they fail to wean a calf. There are two very different types of udder problems. One is the lack of milk, and the other is the inability of the calf to nurse without assistance because of pendulous udders and/or large teats (length and/or diameter).
In our research herds, we have culled cows if their calves are unable to nurse without assistance and it appears that the udder is bad enough that future calves would not be able to nurse without assistance. That is, we do not cull cows due to the appearance of the udder unless it is rather clear that future calve will be unable to nurse without assistance.

Of course, there are large breed differences in udder characteristics. The main problems are pendulous udders and/or large teats (length and/or diameter). Udder problems can be confounded by the amount of milk that a cow has. Of course, this can lead to more udder problems in cows that produce more milk. However, feed conditions can also lead to udder problems. In many case, a cow whose calves can nurse with no difficulty in the fall or winter will have problems if she calves under lush forage conditions in the spring.

In our study that I referred to earlier, where we compared five crosses of five *Bos indicus* breeds with the Hereford, we made detailed evaluations of the udders each time that a cow calved. There were major differences in udder characteristics and major differences in the proportions of cows that were culled for udder problems. None of the Angus-Hereford crosses or Nellore-Hereford crosses were culled for udder problems, but 19% or more of the other four crossbred types had left the herd for udder problems by the time they were 14 years of age. As stated earlier, cows were culled for udder problems only if their calves could not nurse without assistance. These cows all calved in the spring, often with very lush forage conditions. Therefore, the amount of udder problems was probably higher than it would have been under some other conditions.

In our current genomics project at the McGregor station (using second generation *Bos indicus*-British crosses), we make detailed udder measurements, somewhat like we did in the earlier breed evaluation. We recently have reported apparent chromosomal locations for genes affecting teat length, teat diameter, and udder support score (Williams et al., 2012).

Eye Problems. Most of the eye problems that cause cows to leave the breeding herd are associated with cancer eye. Cancer eye is known to be more prevalent in cows with white pigment around their eyes, and there are probably genetic differences in the susceptibility to cancer eye that are independent of pigmentation.

Reproductive Performance. There are many different ways that reproductive performance can be evaluated and used as culling criteria. As with longevity, high fertility is largely a lack of problems. There are certainly genetic differences in inherent fertility, but many reproductive problems result from the failure to meet nutritional requirements, either due to high nutritional requirements and/or due to inadequate adaptation to the environment.

I believe that the most severe culling for reproductive performance that I know about is that used by Casey Beefmasters at Albany, TX. They require that a yearling heifer conceive in a 45 day breeding season, calve as a two year old, raise a calf every year, and continue to conceive in a 45 day breeding season each year.

It is difficult to genetically improve reproductive performance by selection, but, <u>for the environment in which the cattle are raised</u>, this program combined with selection of bulls out of old cows that have survived the program, probably places about as much emphasis on reproductive longevity as is possible with our current state of knowledge.

As I wrote earlier, some of the other reasons for culling can cause reproductive problems. Depending on the amount and kind of available forage, mouth problems (mainly worn or missing front teeth) can limit the amount that a cow can eat, and, in turn, cause her to fail to come into heat and get bred. There are major genetic differences in the age at which teeth deteriorate.

Selection for longevity. If longevity is measured by a single number (such as the age at which a given cow leaves the breeding herd), then, almost by definition, longevity is low in heritability. This does not mean, however, that genetic effects on longevity are not important. Since productive longevity is closely related to fertility, I think it is useful to simultaneously consider genetic effects on fertility.

It is well recognized that fertility traits are low in heritability. As with longevity, this does not mean that genetic effects on fertility are not important. Many years ago, Tom Cartwright wrote a short article titled "Heredity Must be Important in Cow Fertility." He used it for class notes, and it may have been printed in a magazine, but I'm not sure about that. In the article, he discussed that, although we know that fertility traits are low in heritability, there are obvious (and major) genetic effects on fertility. Some of the genetic differences in fertility include breed differences, the higher fertility in crossbreds compared to purebreds (hybrid vigor or heterosis), and the lower average fertility in highly inbred cattle (inbreeding depression).

It is tempting to assume that everyone that reads this will understand how there can be large genetic effects on a trait that is low in heritability, but, since the term heritability is so widely mis-used, I think it is necessary to give some explanation. If a trait is high in heritability, a particular animal's performance for the trait will give a good indication of its genetic merit (breeding value or transmitting ability) <u>in relation to other animals in the same breeding population.</u>

There can be (and are) large average genetic differences between different breeds or crosses for traits that are low in heritability. There can also be large genetic differences between individual animals within a breed for traits that are low in heritability, but it is difficult to make genetic improvement based on individual animal performance.

It has been stated that most of the "fallout" has already happened by the time a cow is four years old. That is, if a heifer gets bred as a yearling, breeds back as a two year old and again as a three year old, most of them will stay productive up until about ten years of age. If all cows are culled that fail to wean a calf, genetic prediction based on the proportion should be effective in increasing the proportion that stay productive to nine or ten years of age. The differences among breeds and crosses in their ability to stay productive to more advanced ages, indicate, to me, that even more can be done if we place enough emphasis on longevity.

Remember that selection response is negatively related to selection response. However, both accuracy and intensity of selection for longevity requires that cows be given the

opportunity to express their inherent ability for the trait. As discussed under the section on reproductive performance, selection of old bulls out of cows that stay productive to advanced ages provides the opportunity to place emphasis on longevity. Selection and use of young bulls out of old cows, as a continuous process, seems to be a logical approach.

Summary and conclusions. There are definitely genetic differences associated with the components of productive longevity. The commercial producer can take advantage of crossbreeding and breed differences. Hopefully the seedstock industry will provide improvements in individual breeds and herds as well.

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