ANATOMY OF A CALF CROP

Doug Zalesky
Extension Beef Cattle Specialist
West River Research and Extension Center

Introduction

Webster's dictionary defines anatomy as "an act of dividing anything corporeal or intellectual to examine its parts; analysis." A given calf crop is composed of more than just the calves themselves and is impacted by numerous factors. The purpose of this paper is to take a hard look at what most of these factors are and how they impact the calf crop in terms of the amount of variation that exists within that crop of calves. The major focus will be on genetics and management, as they represent the two factors that impact the amount of variation that exists in a calf crop the most.

The 1995 Beef Quality Audit identified ten quality concerns for the beef industry. Of the ten identified, low uniformity and consistency was listed as one of those quality concerns. The challenge for most producers then becomes how to improve uniformity and consistency within their herd. Often times this challenge is taken to mean that we have to produce "peas-in-a-pod" calf crops. The reality, however, is that such a thought process is unrealistic in the beef industry. Beef is not produced in confined and controlled environments like other competing meats. Production occurs under a wide diversity of environments. Each environment provides a unique set of resources and at the same time a unique set of requirements regarding the type of cattle that will fit and work in that given environment.

Genetic Diversity

At last count the number of breeds recognized or registered in the United States totaled 101. That in itself indicates that opportunity exists in the beef industry for variation to occur. In comparison to other livestock species that is significantly more breeds. The question then is, does the industry need all of those breeds? Many would say that is why we have such a problem with variation and lack of uniformity and consistency. Others would argue that because the industry produces its product in such a wide variety of environments it is necessary to have genetic variation in breed types to fit those varying environments. Who's right? Maybe both are to a degree. It is true that because of the variation in environments that beef is produced we do need variation in cattle to fit those environments. However, if indiscriminate use of breeds occurs in breeding programs, then the large variation in genetics can cause problems. On the other hand, if discriminate use of breeds, based on strengths and weaknesses of each breed, are used in well planned breeding programs then variation in breeds can be extremely beneficial. The real challenge for the beef industry and individual producers then, is to use and manage the variation in genetics available for their use to produce cattle that not only fit their environment and resources but also results in a beef product that satisfies the beef consumer.

Dr. Jim Gosey, University of Nebraska, once shared with me a philosophy that he uses to help beef producers in their operations. His ideas are ones that I believe can be used as guidelines for each and every producer, commercial or seedstock, and if used can go along way in dealing with variation. He suggests the following: 1) develop a uniform cow herd with genetics that fit your environment and resources, 2) utilize bulls that fit the market, and 3) manage variation in your herd to your advantage.

Throughout the remainder of this paper we will review how genetics and management can impact variation in a calf crop and will discuss ways in which variation can be minimized and managed to a producers advantage.

Factors that affect uniformity/variation in a calf crop.

Genetics. The amount of or lack of uniformity within a calf crop is ultimately determined by the amount of or lack of uniformity in the cow herd and bull battery. If large amounts of variation exist in one or both the cow herd and the bulls, then one can expect the same in the calf crop. It is important to realize at the same time that even in herds where only one breed is used (seedstock or commercial) variation will exist. Research has shown that variation for most traits exist as much within breeds as is does between breeds. The challenge then with single breed breeding programs is as great as with multiple breed breeding programs.

Variation is impacted by differences in genetic potential for about all traits; frame size, birth weight, weaning weight, yearling weight, scrotal circumference, milk production, reproduction and carcass traits. Within a given set of cows, the genetic potential that each cow will pass on to her calf will vary and with variation in bulls used to breed those cows, additional variation is contributed. Again, differences in all of these traits can exist within as well as between breeds. One of the genetic tools developed in recent years to describe the genetic potential for an individual is Expected Progeny Differences (EPD). This tool also can serve to illustrate the amount of variation that exist within a breed. Table 1 illustrates averages and ranges for birth weight, weaning weight and yearling weight EPD's from a breed's sire summary.

Table 1. Averages and Ranges for BW, WW and YW EPD's - Active sires.

Trait	Average	Low	High
Birth weight, lb	**3.7**	**-8.0**	**14.9**
Weaning weight, lb	**26**	**-28**	**74**
Yearling weight, lb	**45**	**-35**	**125**

As indicated in the previous table, genetic potential varies considerably even within a breed for these traits. Other traits such as mature cow size, measured as either mature weight or mature height can vary significantly. Table 2 illustrates the averages and ranges for mature cow size EPD's from a breed sire summary.

Table 2. Averages and ranges for mature cow size EPD's for listed sires.

Trait	Average	Low	High
Mature weight, Ibs	**.oo**	**-64**	**76**
Mature height, in	**.37**	**-1.6**	**2.6**

Again, these numbers serve to illustrate the amount of variation that does exist within breeds. Cow type or size is an additional genetic parameter that can add variation to a calf crop. The same holds true for breeding bulls.

It is easy to see that genetic potential is highly variable and that one can envision how genetics can be used positively to control variation or how it can be misused to increase variation in a calf crop.

Management. Many producers often overlook the role that management decisions play in determining the amount of variation that exists in a calf crop. I'm remeinded of something a producer friend shared with me not long age that I think applies. He said "the problems we have in the beef industry, and we do have some, are not going to be solved with the same line of thinking that we used to create them. He went on to say "that a lot of those problems can be solved by changes in management thinking."

Following the discussion above on genetics, one can see how decisions on cow herd development and bull selection can impact it. One also can envision how decisions on breeding programs (straightbreeding, crossbreeding) may impact the amount of variation. But other decisions can also impact the amount of variation that exist in a calf crop. One important management decision that impacts the amount of variation is the choice for length of calving season. To illustrate the impact of length of calving season on variation within a calf crop for weaning weight, data from three calf crops will be utilized. The data are taken from CHAPS (Cow Herd Appraisal Performance Software) records from these herds. Table 3 summarizes the information from these three herds.

Table 3. Average weaning weights by 21 day calving intervals for three calf crops varying in length of calving season.

Ranch	Weights during each period					
	Early	lst21	2nd21	3rd21	4th21	Late
A	842	701	668	643	561	474
B	475	518	499	482	0	0
C	572	563	552	502	0	0

The above table nicely illustrates the impact of length of calving season on the amount of variation in a calf crop for weaning weight. In evaluating the amount of variation that exists in each herd as a result of length of calving season, the weights for the Early group will be considered as outliers and not used. Ranch A, which has a longer, more strung out calving season has a range in weaning weights of 701- 474 lbs., with a difference of 227 lbs. With a 120 day calving season that equals about 1.90 Ibs. per day of variation. For Ranch B the range is 5 18 - 482 with a difference of 36 lbs. In a 60 day calving season, accounting for 0.6 lbs. per day. Ranch C ranges from 563 - 502 lbs. In a 60 day calving season for a difference of 61 lbs. and 1.0 lbs. per day. These data serve to illustrate that as length of calving season is increased, the amount of variation is also increased. Larger amounts of variation for weaning weight in the calves makes management of the calf crop to your advantage more challenging.

Once variation is present in a calf crop, as long as all calves are managed the same through slaughter, that variation will exist. Yearling weights as well as slaughter weights for that group of calves will contain variation as well. Table 4 demonstrates the amount of variation that existed on a group of calves at weaning and at slaughter.

Table 4. Averages and ranges for weaning and slaughter weights in a contemporary group of steer calves.

Trait	Average	Low	High
Weaning weight, lbs.	529	464	622
Slaughter weight, lbs.	1146	1004	1298

The variation seen at weaning time does not disappear, but continues through slaughter. In addition, more variation due to genetics enters the picture after weaning for such traits as average daily gain and the variation in this group of calves became larger.

Management decisions regarding development or selection of breeding programs can impact variation in a calf crop. Whether the breeding program is straightbreeding, crossbreeding or the use of composites, decisions made can help to control variation or can add variation to a calf crop. When either one or both the cow herd and breeding bulls contain large amounts of variation in frame size, the resulting calf crop will reflect that variation. If strengths and weaknesses of breeds are not considered in mating programs and breeding programs are not carefully planned, variation can become larger. Indiscriminate selection of bulls and replacement heifers (and/or cows) based solely on individual performance with no knowledge of genetic potential can lead to increased variation.

Variation due to genetics and management combined. To this point we have discussed how genetics and management can independently impact variation in a calf crop. Lets look at a group of steer calves produced at the SDSU Cottonwood Research Station in 1994 and see how genetics and management together impact the final carcass merit of this group of calves. These calves were born in a 60 day calving season, with three different sires represented. Table 5 presents some of the averages and amount of variation for traits in this calf crop.

Table 5. Averages and variation for Cottonwood Station calf crop.

Trait	Average	Variation
Weaning weight, lbs.	**554**	**129**
Slaughter weight, lbs.	**1149**	**462**
Carcass weight, lbs.	**695**	**302**
Age at slaughter, days	**402**	**119**
Backfat, in.	**.40**	**.50**
REA, sq.in.	**12.1**	**6.6**
Yield Grade	**2.7**	**2.6**
% Choice	**82**	**Std - Ch**

The data indicates that significant amounts of variation existed in these steer calves. Some of that variation due to management and some to genetics. The amount of variation due to genetics is

reflected more in traits expressed by individuals after weaning. Let's now look at a breakout of the three sires (Table 6) represented in these calves for carcass traits, to get an idea of variation that may have been contributed by the bulls.

Table 6. Averages for selected carcass traits of three sires used in Cottonwood Station calf crop.

Trait	Sire A	B	C
Age, days	**401**	**464**	**407**
Backfat, in.	**.43**	**.50**	**.43**
REA, sq.in.	**12.7**	**11.9**	**12.3**
Yield Grade	**2.8**	**3.2**	**2.8**
% Choice	**43**	**91**	**86**

Some obvious differences exist between these three bulls in terms of genetics that are passed on to their offspring. When randomly mated to a set of cows the variation is present in the calves. If that set of cows also contains a large amount of genetic variation for these traits, then the amount of variation in the calf crop is magnified.

Let's go one step further and conduct a comparison of this group of calves against the "target" or optimum carcass identified in the 1995 beef quality audit and also determine what percentage of this group of steers meet the "specs" or falls out (Table 7). This type of comparison becomes more meaningful when a producer retains ownership of his calves and sells them "in the meat" or if they are sold on a formula or grid pricing basis. Any of these methods of selling fed cattle can certainly be considered at least a step closer to a "value-based" marketing system. Within any of those marketing methods are discounts for those cattle not meeting "specs" and in some instances premiums for those exceeding the "specs". If viewed from that standpoint, variation can be economically detrimental to the producer and his potential profit if appropriate management is not applied.

Table 7. A comparison of the 1995 Beef Quality Audit and Cottonwood Station calf crop.

Trait	95 NBQA Specifications	Cottonwood Calf Crop	% not meeting specs
Carcass wt., lbs.	**600-850**	**695**	**8.3**
Backfat, in.	**<.50**	**.40**	**23.3**
REA, sq.in.	**11-15**	**12.1**	**15.0**
Yield Grade	**3.5**	**2.7**	**8.3**
% Choice or better	**62**	**82**	**18.0**
Meets all specs and grades choice			**46.7**

As the data indicates, the average for the calf crop looks good, but a breakdown and comparison to the quality audit specifications further demonstrates that **Variation is the Problem.**

Controlling Variation in a Calf Crop

The question is often asked whether one can eliminate variation in a calf crop. Often that question is probably misstated and should ask if one can control or minimize variation. One certainly cannot eliminate variation but it can be minimized and managed in ways that are beneficial to the producer. The following will include some discussion of ways to minimize and manage variation in a calf crop, both from a genetic standpoint and a management standpoint.

To begin the discussion of this it may be good to think about the guidelines discussed in the introduction, 1) develop a uniform cow herd with genetics that fit your environment and resources, 2) utilize bulls that fit the market and 3) manage variation in your herd to your advantage.

Genetic considerations. During the past several years, selection for growth traits has resulted in increased mature size. In many environments and with many resource bases, the resulting increase in mature size has not matched well with the production environment. Many producers have often struggled with mismatches of genetics and resource base. The result has been many herds that vary greatly in mature cow size, and subsequently more variation in calf crops. Identification of the optimum mature size for a given operation is an essential step in beginning to control variation genetically. Once that size has been determined, breeding programs can be tailored to meet that size goal. If optimal size is present, then selection of bulls and

replacement heifers to maintain that size is required. If large amounts of variation for mature size is present then a different course of action is necessary. Sorting of the cow herd into similar cow size categories and subsequent breeding of cows to appropriate frame size bulls can result in minimizing the amount of variation in the calf crop. At the same time selection of replacement heifers will need to be directed towards the size goal you have set.

Selection of breeding bulls plays an important role in controlling or minimizing variation. If you are a commercial producer, it is important to have an understanding of what your market place is and the traits that are important for that market. If you are selling at weaning time, then obviously weaning weight is one of the more important traits for your operation. If you are retaining ownership beyond weaning then other traits become important as well. The selection pressure that one puts on bulls for specific traits is dependent upon the market place. Often, producers strive for a balance in many traits, as single trait selection is not usually advisable. Important for the commercial producer, is to put together as uniform a group of breeding bulls for whatever traits are important to his operation as possible. The more uniform the bulls, the less variation will exist in the offspring. Seedstock producers, need to understand their customers needs and ultimately select bulls with traits that will fulfill those needs. Unlike commercial producers, seedstock producers generally have customers with various needs. It is not uncommon for seedstock producers to have more genetic variation in their cattle in an effort to meet the needs of all their customers.

In both seedstock and commercial operations, the use of EPD's can be extremely beneficial in controlling or minimizing variation. Their use can significantly aid in developing a battery of bulls that is uniform and in production and/or selection of replacement females. They also are useful in developing breeding programs as they can serve to evaluate strengths and weaknesses in breeds. Selection of breeds and/or individual animals to compliment strengths and weaknesses can be accomplished with EPD's.

Management Considerations. Three areas of management deserve discussion with regard to impacts on variation in a calf crop. These include type of breeding programs, length of calving season and management of calves after weaning.

Commercial producers have options in terms of types of breeding programs. When developing or planning any program, an understanding of the potentials for how each might work to minimize or control variation is important. The types of programs include; straightbreeding (single breed), crossbreeding (multiple breeds) and in recent years the use of composites. In all instances, sound planning and proper evaluation of strengths and weaknesses of individuals and/or breeds can help considerably in minimizing variation.

Single breed or straightbreeding programs is one of the more simple systems to use. It's major disadvantage is the loss of heterosis or hybrid vigor gained in crossbreeding. In terms of controlling variation it does offer a significant advantage over crossbreeding in that evaluation of strengths and weaknesses is easier since it is within a single breed. Current tools such as EPD's are reported in such a way that comparison of individuals should only occur within a breed and subsequently minimizing variation should be more easily accomplished in this type of breeding

program. However, indiscriminate or unplanned breeding schemes, even in this type of program can result in increased variation as well.

Crossbreeding programs take on another level of complexity in terms of controlling variation, since between breed as well as within breed variation must be addressed. The main advantage of crossbreeding programs is the resulting heterosis or hybrid vigor that is realized in these multiple breed programs. A main disadvantage is the increased amount of management that may be required especially as the number of breeds in the program increases, so does the number of breeding pastures. Selection of the optimum crossbreeding program (two-breed, three-breed, etc.) should be determined by the level of management available in the operation. In crossbreeding programs the emphasis is more on evaluating the genetic strengths and weaknesses of the breeds used and how they compliment each other. Each breed needs to contribute to the program by either adding to a desired goal or at least compensate for a weakness in one of the other breeds.

More recently, the use of composite breeds has been suggested as a means to simplify management requirements of crossbreeding programs and yet take advantage of the hybrid vigor offered in multiple breed breeding programs. The use of composite bulls represents a major paradigm shift for many. While composite bulls cannot perform miracles or offset poor management, they do offer a means to solve production/management problems and optimize production in a wide variety of environments. Some of the benefits of using composite bulls are: 1) simplifies management since only one breed type is maintained, 2) optimizes breed composition to match environments and markets, 3) can maintain reasonable levels of heterosis, and 4) allows flexibility to use future composites that may better target product or environment. Currently challenges exist for use of composite bulls. They include: 1) identifying composite seedstock sources that are sufficiently documented for a specific environment or market, 2) overcoming traditional thinking thereby allowing development of databases from field data for economically important traits, 3) the misconception that composites generate more variation than traditional use of purebred sires, 4) lack of composite EPD’s or alleged low-accuracy EPD's on composite cattle and 5) getting beyond the “our-breed-can-do-it-all” mentality of some breeds while appreciating the need for a viable purebred seedstock segment. Progeny of composite bulls follows a normal distribution and is no more variable than purebred bulls of the same parental breeds. Composites have the potential to offer much to the commercial producer.

As was illustrated earlier in this paper, length of calving season can significantly impact the amount of variation that exists in a given calf crop. As the length of the season increases so does the amount of variation for traits like weaning weight. Each operation must determine the optimum length of its calving season based on factors such as available labor. In order to maintain a yearly calving interval on a given set of cows, it is evident that length of the calving season certainly cannot extend beyond 80 days. At lengths less than 80 days, probability of maintaining that yearly interval is increased as well as reduction in variation. Additionally, if calving season length appears to be optimum for a given operation, other management opportunities may exist to further reduce the amount of variation through the birth of more calves earlier in the calving season. Obtaining 80% plus calves during the first 42 days of the season may be yet another means to reduce variation, even in an already shortened season.

Following weaning, sorting of the calf crop into more uniform groups is a management decision that can allow a producer to manage that variation to his advantage. Even though variation is put in place during the calving season, producers are not restricted to management of that entire group of calves as one entity. It is not uncommon to see a set of calves representing an entire calf crop managed the same from weaning to slaughter. Because of the variation that existed at weaning and the additional genetic variation that became evident after weaning, at the time of slaughter the variation is greater, with some calves being fed too long, some just right and some not enough. The structure of the industry's current marketing system would impose discounts on those that were overfed and underfed. Efficiency under such a management system is questionable and contributes to the overall problem of lack of uniformity and consistency that exists in the industry. Flexibility through sorting at weaning, for the commercial producer, allows a producer the opportunity to make that variation work to his advantage instead as a curse that he should accept and live with.

Summary

It is evident that many factors contribute to variation in a calf crop. Independently genetics and management contribute to the variation and together they contribute the largest proportion to that variation. Because it is not possible to completely eliminate variation in a calf crop, it in no way means it has to be an accepted part of the business that nothing can be done about.. Variation can be controlled and minimized and can be managed in ways that it actually becomes a benefit and not a liability. Tools, both in the area of genetics and management exist to aid in the control and management of variation. EPD's, selection, planned breeding programs, length of calving season and sorting into more uniform groups are just some of the tools available to control and manage variation. Even though great amounts of variation exist in the beef industry, it is that same variation, both within and between breeds that allows this industry to produce in a wide variety of environments. It is also this same variation that when uncontrolled or unmanaged can cause significant problems in production of the ultimate product, beef for the consumer. The challenge for the industry is not to continue to suffer because we have a lot of variation, but rather to use the tools that are available to control and manage that variation in a manner that is beneficial to the beef producer and the beef consumer.