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BENEFITS OF CROSSBREEDING IN COMMERCIAL HERDS

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INTRODUCTION

Crossbreeding has been likened to good intentions. Something that is not always carried out as one might like. For years, the benefits of crossbreeding have been reported and discussed. The most noted advantages of crossbreeding are heterosis (hybrid vigor) and breed complementarity. Many industry participants/groups have recognized the benefits and value of crossbreeding. As an example, consider the information that was generated and reported at the 2007 Beef Improvement Federation Annual Meeting in Fort Collins, Colorado. During the meeting, participants (in excess of 500) were provided with hand-held response devices and asked to answer a series of questions on the topic of designing the ideal beef animal. Three of the questions pertained to crossbreeding specifically. When asked if the ideal beef cow would be crossbred, 72% of the responses were yes (72% yes, 22 % maybe, 6% no). Similar results were found when participants were asked if the ideal market steer for profitability would be crossbred (76% yes, 18% maybe, 6% no) and if the ideal market steer for overall carcass value generation would be crossbred (70% yes, 20% maybe, 10% no).

Even though the benefits of crossbreeding have been well documented and reported, there are indications that the beef industry has not embraced and applied the tool as widely as one might expect. According to the results of the 2007-08 National Animal Health Monitoring System (NAHMS) survey, when producers were asked to characterize the breed makeup of their cowherd 45% indicated they had a crossbred cowherd made up of two breeds and 24% indicated they had a crossbred cowherd made up of three breeds. Periodically, BEEF® Magazine conducts surveys to gain a better understanding of various aspects of the beef industry. Results from the 2010 Cattle Production – Genetics survey show 35% of producers characterizing their cowherds as being some type of crossbreds. In the 2014 Genetics survey, 38% of producers characterized their cowherds as being crossbred. These survey results show that a number of cow-calf operations have the potential to benefit from the application crossbreeding.

BENEFITS OF CROSSBREEDING

The most documented, discussed, and best-known advantage of crossbreeding is heterosis (hybrid vigor). Heterosis occurs when two different purebred breeds are mated together. Heterosis is the superior performance of a crossbred offspring over the average performance of the parental breeds. The percent heterosis for a trait is calculated as follows:

% Heterosis = [(crossbred average – purebred average) ÷ purebred average] x 100

Heterosis is greatest when two purebred parental animals of completely different breed backgrounds are crossed. There are different types of heterosis including individual (crossbred calf), maternal (crossbred dams), and paternal (crossbred sires). These different types of heterosis are cumulative and producers may take full advantage of the heterosis depending on the breed types used in their mating system. Heterosis can be exhibited through a variety of traits. Table 1 provides an example of the level of improvement and percent heterosis for various traits of crossbred calves.

Table 1. Individual Heterosis: Advantages of a crossbred calf.[a]

Trait	Observed Improvement	% Heterosis
Calving rate, %	3.2	4.4
Survival to weaning, %	1.4	1.9
Birth weight, lbs.	1.7	2.4
Weaning weight, lbs.	16.3	3.9
ADG, lbs./day	0.08	2.6
Yearling weight, lbs.	29.1	3.8

[a]Cundiff and Gregory, 1999 as adapted by Greiner, 2002.

Heritability is defined as the amount of variation in a trait that is due to genetic factors versus environmental factors. Heterosis for a trait is inversely related to the heritability of that trait. Therefore, lowly heritable traits (maternal ability, reproduction, longevity, survival, etc.) exhibit greater levels of heterosis than highly heritable traits (carcass, skeletal size, mature weights, etc.). Since a large percentage of the variation in lowly heritable traits is due to environmental factors, versus genetic, they respond slowly to selection. Producers can make strides in improving lowly heritable traits through the use of crossbreeding.

Another advantage of crossbreeding is breed complementarity. Complementarity can be thought of as a process of filling out or completing, mutually supplying each other's lack. In other words, complementarity offers producers the potential to compensate for a deficiency in one beef breed's trait performance with the superior trait attributes of another breed. To take advantage of breed complementarity, producers need information about the differences between breeds for specific traits. Figure 1 provides an example of the genetic trend and amount of variation that exists in maternal milk.

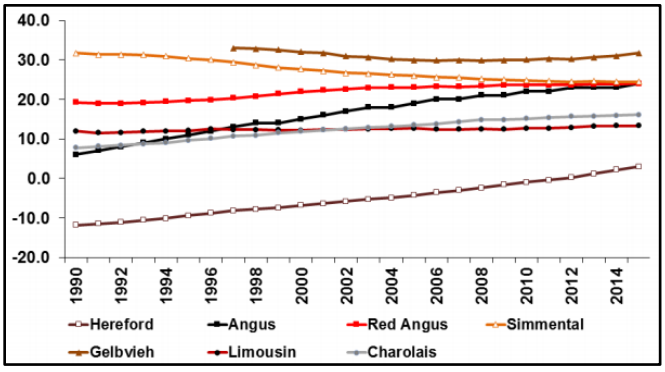

Figure 1. Genetic trends for maternal milk in the seven most widely used beef breeds (Kuehn and Thallman, 2017).

The information presented in the previous figure is valuable as producers try and match the milk production levels of their cowherds with the available resources on the farm/ranch. Another example of breed complementarity is the crossing of Continental breeds of beef cattle, which excel in beef yield, with British breeds of beef cattle, which excel in marbling. Generally these crosses result in the best of both worlds, an offspring that has optimal levels of both beef yield and quality.

APPLICATION OF CROSSBREEDING

In 2010, the results of a study/field trial (Daley and Earley, 2010) in which the impacts of crossbreeding on profitability in a vertically integrated beef operation were published. In year one of the three-year study, 400 Angus-based cows were randomly bred to 10 Hereford and 10 Angus bulls. In the subsequent two years of the study, the herd was expanded to 600 Angus-based cows and 15 bulls of each breed. These cows came out of an operation where Angus bulls had been used for over 10 years, and while there may have been some other remaining breed influences, the cows were predominantly Angus. The breeding and management of the cowherd was conducted under extensive range conditions. At weaning, parentage verification was conducted on all calves and only those calves that could be matched to a single sire were included in the analysis. Records were collected during various phases of the production cycle (pre-conditioning, weaning, feedlot, harvest) and were used to compare purebred and crossbred offspring.

Approximately one month prior to weaning, calves were weighed and pre-conditioned. At this stage of the trial, the Angus-sired calves (n=304) weighed an average of 498 pounds and the Hereford-sired calves (n=290) weighed an average of 513 pounds. Using a standard price (used throughout study) of $1.20 per pound, the Angus-sired calf value was $597.60 and the Herford-sired calf value was $615.60 resulting in an $18.00 advantage for the Hereford-sired calves. Following a short backgrounding period, 288 Angus-sired calves and 275 Hereford-sired calves were placed in the feedlot with ‘in’ weights at the feedlot of 673 and 674 pounds, respectively. During the feedlot phase of the trial, the calves were fed an average of 155 days and had ‘out’ weights in both groups of 1,232 pounds. Table 2 provides feedlot performance data and Table 3 provides the feedlot morbidity and financial information for the Angus- and Hereford-sired calves.

Table 2. Feedlot performance summary for Angus- and Hereford-sired calves.[a]

Trait	Angus-sired Calves	Hereford-sired Calves
Average daily gain (ADG), lbs./d	3.45	3.48
Conversion – as fed, lbs. feed/lbs. gain	7.41	7.05
Conversion – dry matter, lbs. feed/lbs. gain	5.52	5.25
Cost of gain, $/head	$79.77	$75.98
Percent death loss, %	1.35	1.41

[a]Adapted from Daley and Earley, 2010.

Table 3. Feedlot morbidity and financial summary for Angus- and Hereford-sired calves.[a]

Trait	Angus-sired Calves	Hereford-sired Calves
Percent morbidity, %	10.77	9.51
Hospital cost/head treated, $/head	$14.52	$12.68
Hospital cost/head placed, $/head	$1.91	$1.30
Delivered cost/cwt., $/cwt.	$119.68	$119.68
Total cost of gain/cwt., $/cwt.	$87.05	$82.68
Breakeven/cwt., $/cwt.	$105.18	$102.96

[a]Adapted from Daley and Earley, 2010.

Feed conversion between the Angus-sired calves (7.41) and the Herford-sired calves (7.05) was significant. Slight differences were found in morbidity between the two groups (10.77% for Angus-sired and 9.51% for Hereford-sired) and in hospital cost ($14.52 for Angus-sired and $12.68 for Hereford-sired). The major differences in the feedlot financial summary were found in the total cost of gain and the final breakeven cost. When all feedlot traits were combined, the Hereford sired, crossbred calves an economic advantage or value difference of $27.50 in the feedlot phase of the trial. Following the feedlot phase of the trial, the calves were harvested and carcass measurements were taken. Table 4 provides the carcass performance summary for the Angus- and Hereford-sired calves.

Table 4. Carcass performance summary for Angus- and Hereford-sired calves.[a]

Trait	Angus-sired Calves	Hereford-sired Calves
Live weight, lbs.	1,232	1,232
Hot weight, lbs.	782	782
Yield percent, %	63	63
Percent Prime, %	0.82	0.00
Percent Choice%	65.66	46.90
Percent Choice or better, %	66.40	46.90
Percent Select, %	33.00	53.00
Percent total Yield Grade 1 & 2, %	43.00	49.00
Percent Yield Grade 3, %	51.00	45.00
Percent total Yield Grade 4 & 5, %	6.00	6.00

[a]Adapted from Daley and Earley, 2010.

As the carcass characteristics of the two groups of calves were compared, only minor differences were found in carcass weight, dressing percent, and yield grade (including all trait components). However, there was a significant difference in marbling score (quality grade) which is evidenced by the greater percentage of Angus-based calves with higher quality grades. The Angus-sire calves had a 19.5% advantage in percent grading Choice or higher. This difference gave the Angus-sired calves and economic advantage or value difference of $15.60 in the harvest phase of the trial.

Overall, when the performance and financial records from the pre-conditioning (ranch), feedlot, and harvest phases of this trial were compiled, the crossbred Hereford-sired calves ($18.00 ranch advantage and $27.50 feedlot advantage) had $29.90 net value difference over the Angus-sired calves ($15.60 carcass advantage).

In the early 2000's, the University of Idaho was gifted a ranch which today is the Nancy M. Cummings Research, Extension, and Education Center (NMCREEC) near Salmon, Idaho. The NMCREEC was populated with cows that were donated by producers from across the state. The goal was to develop the herd into a homogeneous cow herd that could be used in various research activities. In 2008, decisions were made, and protocols were put in place to create an Angus x Hereford based cowherd. To maintain the breed makeup of the cowherd, females that are sired by Angus bulls are bred to Hereford sires and females that are sired by Hereford bulls are bred to Angus sires. Replacements are kept out of the resulting offspring.

From 2013 to present, Simmental influenced sires (Simmental, SimAngus) have been used in the herd to create offspring that are better suited to the marketing conditions. The use of these sires has created an opportunity to preliminarily compare different sire breeds on the Angus x Hereford cows. Table 3 contains the performance records for selected traits of the offspring produced from 2013-2018. The Simmental sired calves tended to have greater values across the board for the weight/growth traits. This may be due in part to the heterotic effect of adding a different breed to the mix. It might be a little surprising that the Simmental influenced calves had the best marbling scores of the group. As a side note, before combining the Simmental and SimAngus sires for the Simmental influenced group, a quick comparison of the sires was made. The SimAngus sires had slightly higher marbling score than the Angus sires.

Table 3. Comparison of sire breeds from 2013-2018 calf performance for selected traits.

	Performance Traits (# of records)						
Sire Breed	**Birth Weight**	**Birth Weight Adjusted**	**Weaning Weight**	**Weaning Weight Adjusted**	**Hot Carcass Weight**	**Ribeye Area**	**Marbling[a]**
Angus	82.6 (623)	89.8 (641)	567.6 (586)	607.1 (581)	868.1 (227)	13.7 (227)	608 (201)
Hereford	84.9 (360)	90.7 (359)	556.6 (339)	604.3 (339)	872.9 (114)	13.2 (114)	599 (97)
Simmental Influenced	88.9 (768)	93.5 (769)	577.4 (709)	612.0 (709)	882.0 (329)	14.2 (329)	622 (238)

[a]Marbling scores: < 300 = Standard, 300 - 399 = Select, 400 - 699 = Choice, 700 + = Prime

IMPLICATIONS

There is a great deal of work that has been done to document the effects, impacts and value of crossbreeding for beef cattle producers. These two trials show that crossbreeding can be applied by in a commercial setting under different circumstances and benefits can be achieved. Some would argue that the beef industry's needs could be satisfied with a single breed. However, as we consider the multitude of production environments, management strategies, marketing constraints, and consumer wants and needs, it is easy to see that no one breed is best for all situations. Crossbreeding is a tool that when applied properly can provide producers avenues to improve trait performance and combine the superior attributes of more than one breed to optimally match cow herds with the environment and produce offspring that meet the various industry needs and challenges.

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