STRAIGHTBRED AND COMPOSITE PROGENY'S IMPACT ON COWHERD ECONOMIC PERFORMANCE

by

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ABSTRACT

Crossbreeding has long been promoted as the preferred method of production for cow-calf producers. Unfortunately, crossbreeding can add complexity to maintain a consistent cowherd and can drive the need to purchase replacement females from outside the producer's own herd. This has led some producers to pursue straightbreeding to provide their own supply of replacements and the opportunity to more narrowly select for individuals suited to a carcass quality grid marketing system.

The subject of this thesis is a Red Angus based cowherd that breeds females to Red Angus sires in early parities. The same cowherd is bred to Simmental sires in later parities to produce a terminal F1 cross. It is the objective of this thesis to explore whether this operation's straghtbred or crossbred calf crop provides an economic advantage to the other treatment.

Mortality data were collected during pre-weaning for both steers and heifers. Mortality data were collected for steers during backgrounding and feedlot phases. Wean weights and feed conversion performance during the backgrounding phase was unavailable for use in this study. Feedlot and carcass data were captured for steers from both treatments.

The straightbred treatment showed an advantage in carcass quality. The composite treatment showed a slight advantage in mortality cost during pre-weaning and feedlot phase, and a slight advantage in feed conversion and cost per pound of gain while in the feedlot. The composite treatment showed a significant disadvantage during the backgrounding phase. The primary advantage for the composite treatment was the

difference in actual wean weights. This difference in wean weight carried over to a higher start weight during the feedlot phase. This was the driving factor in providing the composite group the economic advantage in this study and making it the more attractive production option.

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CHAPTER I: INTRODUCTION

Most beef industry experts recommend utilizing crossbreeding to maximize profits. This can add complexity to some operations in the form of maintaining herds for source genetics. Many producers maintain a straightbred herd instead of using crossbreeding for this reason.

The pork industry often utilizes crossbreeding by maintaining closed herds. The large herds in commercial pork production use crossbred maternal focused females bred to terminal boars. In contrast, most dairy herds are exclusively Holstein genetics because the breed has far superior milk yields in comparison to other dairy breeds.

As the United States beef industry has transitioned to more of a quality based grid system at the packer, it has led to many producers questioning the long held practice of using Continental (reference appendix A for a list of industry terms) breeds to improve carcass yield. The concern from many is that the improved yield is being offset by decreased quality. The purpose of this study is to estimate value gained or lost through two production options. As such, this study consists of a limited cost-benefit analysis for both programs.

The operation studied utilizes two production systems. One production system consists of a straightbred Red Angus herd focusing on carcass quality. The second production system uses crossbred production to benefit from heterosis by breeding Simmental bulls to Red Angus females to produce an F1 calf with a focus on improved yield and cost of gain.

It is the intent of this thesis to evaluate these two production options utilizing the same management. This will be evaluated from birth to harvest because these cattle have retained ownership through the feedlot phase.

Conceptually, the idea this study is exploring has large potential for the beef industry. The possibility of maintaining a straightbred herd without sacrificing performance is intriguing because it would eliminate complexity for some producers. For larger cow-calf operators, it would eliminate maintaining as many as four internal “source” herds to produce the crossbred calves which is their primary marketing objective.

CHAPTER II: LITERATURE REVIEW

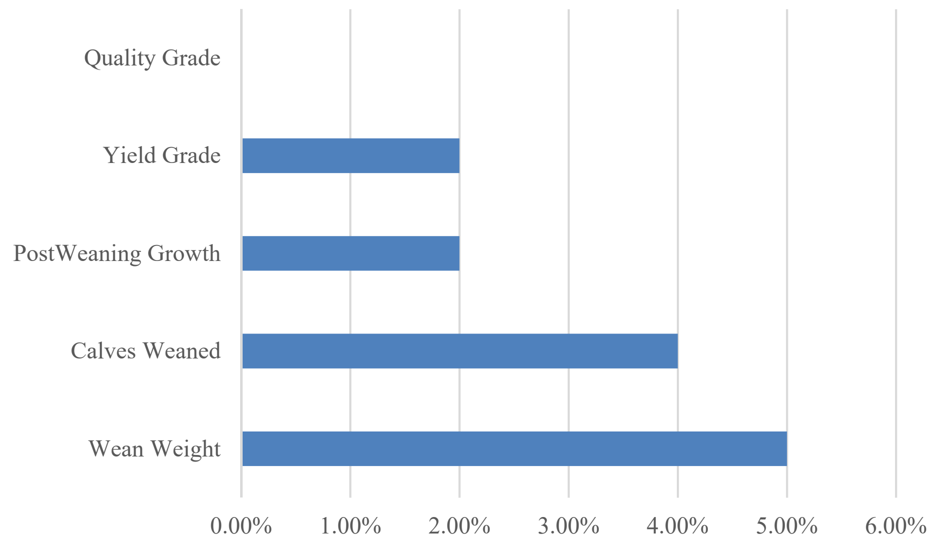
It is the intent of this literature review to examine the benefits of both straightbred and crossbred breeding programs. The literature review will also explore expected benefits and detriments of using the F1 terminal cross that the subject ranches utilize. Finally, the literature review will provide some relevant information on the significance of 205 day adjusted wean weights and why they are used to benchmark performance for cow-calf producers.

Frahm (n.d.) found in comparisons of Hereford, Angus, and Shorthorn cattle that weaning weights were improved by 10 percent for an F1 mated to a different third breed in a three breed cross as opposed to a straightbred breeding program. Differences of six and eight percent were observed in number of calves born and calves weaned when an F1 was utilized in a three breed cross. In the current study, based on Frahm's (n.d.) research it is expected that two purebreds used to make an F1 hybrid should produce a calf that has five percent improved wean weight, one percent improvement in calves born, and four percent improvement in calves weaned (Frahm n.d.). A five percent improvement in wean weight can contribute approximately $45 per calf weaned if calves are sold after weaning. Assuming a wean weight of 550 pounds multiplied by five percent, 27.5 pounds is then multiplied by an estimated $166 per cwt (Hughes 2016). A four percent improvement in calves weaned means an extra four calves are weaned per hundred cows exposed. With an estimate of $250 profit per cow exposed, this equates to $10 per cow. It is a reasonable assumption to add another $18.25 to this original $10 advantage due to the cost to maintain a cow without income. Assuming $1.25 daily to maintain the cow multiplied by 365 days, then this $456.25 per cow multiplied by four cows without income, then divided among the one hundred cows within the herd provides $18.25 One would expect that using a Simmental bull would improve wean weights even more so than the use of British breed crosses from Frahm's study. This is due to Simmental and other Continental beef breeds possessing greater potential for growth and carcass yield than British breeds.

The fact that Frahm (n.d.) found only an improvement of one percent in calves born, but four percent in calves weaned shows that his study demonstrated improved mortality rates for crossbred cattle. The use of Simmental sires in particular in a crossbreeding program is supported in another study that compared Maine-Anjou, Simmental, Chianina, and Brahman breeds as sires when mated to Angus and Hereford dams. In this study, it was found that Simmental sires had the highest survival rate of the four breeds (Williamson and Humes 1985). Cundiff (2005) found that crossbreeding improved reproduction rates by five to seven percent, and calf survival rate by three to five percent. Cundiff does clarify his statements that over half of this improvement is by using crossbred cows (Cundiff 2005). Even so, this would be expected to contribute about $5 per cow exposed when a profit of $250 per cow exposed is assumed.

Frahm (n.d.) describes that post weaning growth is improved by two percent for both F1s and the F1's progeny mixed with a third breed. Yield grade is also improved by two percent. No improvement in quality grade was seen. Frahm (n.d.) hypothesizes that a greater improvement in these traits would be seen if more genetically dissimilar breeds were used as opposed to the three British breeds (Frahm n.d.). Again, it would be expected that a Simmental bull utilized on Red Angus cows would improve yield grade more so than the two percent found in Frahm's (n.d.) British breeds. These results are summarized in Figure 2.1.

Figure 2.1 Summary of Expected F1 Performance Above Straightbred



Source: (R. Frahm n.d.)

Frahm's (n.d.) findings are supported by another study that found Simmental has been known to contribute 29.3 kg or approximately 64.6 lbs. to weaning weight when used in a crossbreeding program (Williams, et al. 2010). Assuming a price at weaning of $166 per cwt (Hughes 2016), this would contribute over $100 per head if calves are marketed at weaning. This 29.3 kg was observed in comparison to Angus; however, Red Angus is similar enough to Angus in terms of performance that this data has relevance (Cundiff 2005).

The use of a Continental and British crossbreed with both influences around fifty percent limits yield grade fours or higher that can occur with British breeds that are over finished and poor marbling that can be a concern with Continental breeds (Cundiff 2005). Although some grid marketing systems do not discount for poor yield grades, most systems will discount for a yield grade greater than three.

Weaber (2015) summarizes several other studies including Cundiff and finds that approximately 66 percent of the economic benefit of cross-breeding is due to use of crossbred cows (Weaber 2015). Weaber (2015) study also cited a deterministic model using breed averages that found that purebred systems were the least profitable among straightbred, two breed rotations, three breed rotations, rota-terminal, and four breed composite systems. This study also found that Simmental was the top breed choice for terminal crosses (Tomsen, Darnell and Nielsen 2001). Common production systems are explained in Figure 2.2.

Figure 2.2 Common Production Systems

Production Systems

- Straightbred- Purebred offspring produced from a sire and dam of the same breed. Offspring retained as replacements.
- Two Breed Rotation- Two breeds used to create an F1 hybrid that is a terminal cross. Resulting offspring not maintained as replacements.
- Three Breed Rotation- An F1 mated to a third breed. Resulting offspring mated to one of the first two breeds. Each successive generation is bred to the breed that makes up the minority of its genetic makeup. Offspring retained as replacements.
- Rota-terminal- Small percentage of herd is made up of two purebred groups of different breeds. These are mated to produce a F1 that is then mated to a terminal sire. Resulting offspring not retained as replacements.
- Four Breed Composite- Four breeds each individually comprising approximately 25% of an individual. Individual is mated to another composite with the same four breeds. Offspring retained as replacements.

Source: (Tomsen, Darnell and Nielsen 2001)

The issue of heavier birth weights and calving difficulty observed by the ranches on cows bred to Simmental sires was observed in documented research by Brandt et al. (2010). When Simmental and Angus were compared, it was found that Simmental sires contributed to greater calving difficulty and heavier birthweights than Angus or Simmental-Angus sires. That said, research does support the ranch’s decision to continue using Simmental sires on physically mature females. Brandt et al. (2010) found that Simmental provided improved wean weight and average daily gain compared to Angus both in a purebred and crossbred situation. When in a crossbreeding system, Greiner (2005) found that Simmental had the highest percent Choice of any Continental breed used in rotation with British breeds at 63.4 percent.

Some research has been more neutral towards crossbreeding, finding that sires are as effective at improving straightbred performance as they are when used in a crossbreeding system (Dunn, et al. 1970). Another study acknowledges that color of progeny is more consistent with straightbreeding (Ritchie 1998).

In an interview with Kansas State University Extension specialist Robert Weaber, he indicated that most historical research is in support of crossbred cattle and the heterosis it generates. He does concede that of the estimated $200 per head opportunity available when using F1 cows bred to a terminal cross bull that approximately a third of this $200 can be attributed to calf heterosis. He further discusses that $70 could be recouped at times using straightbred cattle given the choice/select spread and other premiums/discounts that are specific to the grid on which they are being sold (Weaber 2016). Weaber's (2016) comments regarding straightbred narrowing the gap between and potentially surpassing crossbred when quality grade is considered is supported in another study (Damon, et al. 1959).

Figure 2.3 below shows seasonal trends for the spread between choice and select. A wider spread presents more opportunity for profit on the grid for either yield oriented terminal cross cattle in the spring and early summer, or carcass quality for late summer and fall. It is the expectation that straightbred cattle with an emphasis on quality grade will be more competitive financially with crossbred cattle outside of the rush of fed cattle available in mid-summer as evidenced by the higher prices in the early or late summer.

Figure 2.3 Choice/Select Spread 2014-2016

Source: (Choice/Select Trend Charts 2016)

Lawrence, Foristall, and May (2003) found that heavier carcass weights drive profitability at a low choice/select spread. As the spread widens, quality grades have a greater impact on profitability. They also found that the negative correlation between cow weight and marbling score suggests that higher marbling scores are associated with cows with a lower maintenance cost (Lawrence, Forristall and May 2003).

Frahm (n.d.) points out that one result of cross-breeding is increased maternal cow size. Basically, an F1 hybrid will reach physical and sexual maturity earlier than the average of the dam and sire (Frahm n.d.). The use of smaller framed cows on native range is supported by findings that smaller framed cows are more profitable on native range or grazing systems (Long, Cartwright and Fitzhugh 1975).

2.1 Industry Standardization on Wean Weight

In the beef industry, adjusted wean weights are used to help account for differences in wean age and other factors. Gould (2015) elaborates on 205 day adjusted wean weights as a way to evaluate milking ability of dams and the growth potential of the progeny. The Beef Improvement Federation recommends an adjustment to 205 days and this is recognized as the industry standard. It is suggested that 205 day weights are accurate if used within a window of 160 to 250 days of age at weaning (Gould 2015).

Although breed associations differ slightly in how they arrive at their adjusted wean weights because adjustment factors vary between associations, the basic premise is the same. The goal is to account for differences in age at weaning, and adjust for the many variabilities that exist between each individual's unique circumstances. This is important for producers that sell calves directly off the cow or soon thereafter. Wean weight has a strong impact on profitability per cow for these producers because the more pounds the dam weans the larger the gross income is for that cow.

Although it is a nice baseline, there are limitations with 205 day adjusted weights that deal with differences in individual growth curves. This is minimized the closer that cattle are actually weaned to 205 days of age. Intuitively being closer to 205 days of age reduces the margin of error that adjustment estimates may introduce. The shortcomings of age adjusted models was explored by Brown, Fitzhugh, and Cartwright (1976). They found that weight is not as linear as the 205 day adjustment tries to make it. Unfortunately, they did not find an ideal solution with the modeling options they explored as most of the models were best suited for weight estimates on only a certain age range with several overestimating weights at young ages and others overestimating mature weights (Brown, Fitzhugh and Cartwright 1976).

A later study found that differences in weight can often be attributed to differences in frame size. Menchaca, et al. (1996) divided their study of Brahman cattle into three stages of growth: pre-weaning, post-weaning to 20 or 32 months of age depending on gender, and above 32 months of age for females only. They found that differences in weight in the pre-weaning stage of growth could be attributed primarily to frame size. They also found that differences in gender did not alter the pre-weaning growth curve, but that bull calves had a heavier birthweight that contributed to a heavier weaning weight (Menchaca, et al. 1996).

Overall, the literature review finds that most industry experts are in favor of crossbreeding for the economic benefits it can provide, particularly when maternal heterosis can be added to the equation. Many findings indicate that Simmental is one of the most effective Continental breeds to add to a crossbred program.

The literature review did have some neutral opinions towards a straightbred program if certain conditions were met. These conditions include retaining ownership to capture carcass premiums with a carcass quality focused breeding program, marketing when the choice/select spread is at its widest, and comparing straightbred to an F1 terminal cross without the benefit of maternal heterosis. Basically, the research would suggest that straightbred will be unable to compete against a system that possesses maternal heterosis.

The literature review also provides background on why 205 day adjusted weights are a significant barometer in the beef industry. The limitations in using the 205 day adjusted model are also given.

CHAPTER III: CONCEPTUAL MODEL

3.1 Introduction

The use of a cost benefit analysis is summarized as comparing the total costs and total benefits of a given program. If the net benefits of option A outweigh the net benefits of the next best option then option A is preferable (Layard and Glaister 1994). With this study, the metric on which net benefits are calculated will be monetary. As some economic costs will be unavailable, this will be a partial cost benefit analysis.

3.2 Background Information

The primary ranch and backgrounding location is based in southern Reno County in Castleton, Kansas. The operation overall consists of about 700 full blood Red Angus females. The first two parities are bred to Red Angus sires to provide calving ease, and allow the ranch to retain some of their own replacement heifers instead of having to purchase all replacements from outside sources. After their second calf, cows are bred to Simmental bulls to provide heterosis. The resulting F1 hybrid progeny are not kept as replacements to limit mature cow size.

Until several years ago, Castleton was the site where all cows were calved. Calving date was consistent across all females other than the heifers who started calving about a month earlier to allow an extra cycle to return to estrus. Traditionally, mature cows began calving February 5th (two year old heifers beginning approximately January 15th) and were fed a Total Mixed Ration from calving until they were put on native grass in May. Calves were weaned in September, and cows remained on native grass until approximately November. After moving the cows off of native grass, they would graze crop residue such as corn and milo stalks. Cover crops such as rye, triticale, radishes, turnips, and cowpeas were interseeded in the corn stalks after harvest. The crop residue and cover crops were grazed for several months before returning to calving pastures.

The ranch has transitioned to place females in several different groups due to availability of native range. As a result of this, some groups have had calving dates change based upon where and how the cows are maintained.

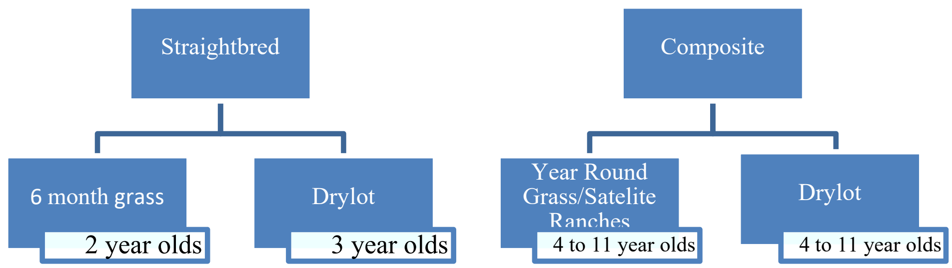
In 2015, the ranch maintained about twenty percent of the females on six month grass from May to November. Forty-five percent were maintained on native grass on two satellite ranches for the entire year. To take advantage of additional feedsources and an attractive beef market, a third group consisting of about thirty-five percent were drylotted and fed from June to August.

The heifers were bred to Red Angus bulls and were maintained and calved near Castleton, Kansas with a calving date beginning in late January. This is the only age of cow among the six month grass group in 2015.

The three year old cows also were bred to Red Angus sires and calving date began in mid-February near Castleton. This parity was placed in a drylot around June. The three year old cows were joined in the drylot group by some middle aged cows with Simmental sired offspring. The middle aged cows placed in the drylot had also began calving in mid-February near Castleton.

The remainder of the middle aged cows with Simmental sired offspring were maintained and calved on the two satellite ranches. One of the satellite ranches is located about ten miles northwest of Castleton, and the other is located about ten miles southwest of Medicine Lodge in Barber County, Kansas. To better match the growth of the grass, both of the satellite ranches began calving in March. Figure 3.1 illustrates genetic makeup of progeny, groups the cows were placed into, and age range of cows placed in each group.

Figure 3.1 Breeds of Sires and Cow Placement



All of the calves in both treatments were not implanted so they could take part in a Non-Hormone Treated Cattle (NHTC) program. This is the first year that the operation's management has marketed cattle through this program.

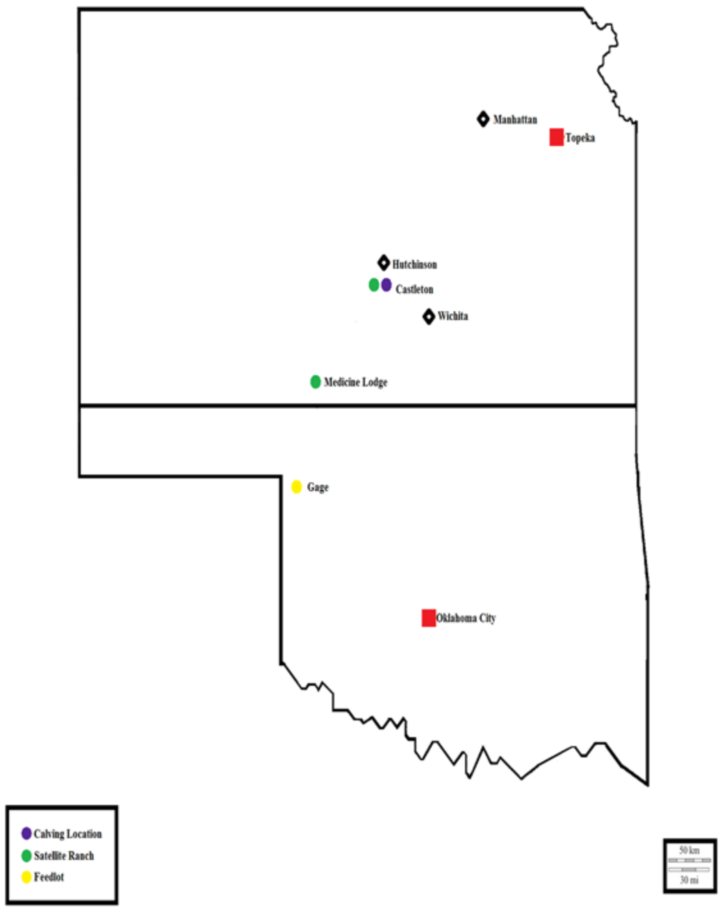
3.3 Conceptual Model Defined

After weaning, all progeny were placed in a drylot for a few weeks. Then the heifers were put on wheat pasture to graze until spring breeding. The majority of both straightbred and composite heifers were maintained on wheat as contemporaries. Both Red Angus replacements and crossbred calves are backgrounded at the same location. Steers and heifers were sorted from each other, but it should be noted that composite and straightbred calves were backgrounded in the same groups due to a limited number of backgrounding pens.

The composites were to be developed and sold as bred heifers. All straightbred and crossbred heifers that were suitable for replacements were selected for breeding; therefore, only the feedlot and carcass data for the steers will be considered. The limited number of non selects that were finished in the feedlot were not utilized for carcass or feedlot data as the selection of replacements from the population would bias the data.

Once the backgrounding phase of approximately 100 days was complete, ownership on the steers was retained and they were sent to be finished at a feedlot in Gage, Oklahoma. To compare feed conversion information and cost of feedlot gain, the steers were separated based upon breed of sire once placed in the feedlot. Figure 3.2 provides a visual map of production locations including the calving and backgrounding location located in Castleton, both satellite ranches, and the feedlot in Gage, Oklahoma.

Figure 3.2 Map of Production Locations



Calf livability data from birth to post weaning was gathered for both treatments. The objective of the livability portion of the study is to examine the differences found in mortality numbers between the straightbred and crossbred treatments, and to examine the economic impact of this difference if possible. This analysis will later be combined into the overall evaluation of the straightbred and crossbred treatments.

Wean weights were captured in the fall as the groups were placed in the drylot for backgrounding. Average weights by treatment were captured when cattle were placed into the feedlot. During the feedlot phase, cost of gains were captured.

It should be noted that calves that were sold alongside their dam as an intended culling were not included in the study. Reasons for culling, included but were not limited to, bad temperament, structural issues, late calving date, and advanced age of dam.

When cows had twins, the cow was only allowed to raise one calf. The remaining multiple birth calves were either raised as bucket calves and removed from the study or used as a foster calf to replace a calf that was lost. The deceased calves replaced by a fostered calf were excluded from the livability portion of the study, and the deceased calf was counted as a mortality. However, the fostered calves were included in all other portions of the study because they did not move between treatments; therefore, the breed of sire stayed consistent and management style would not yet have an impact because calves were fostered within two days of birth.

Profitability calculations excluded the probability of multiple births. Because the excess calves from multiple births were not identified in the study, it would be difficult to determine their economic value and for this reason it was determined to assume that each cow only gave birth to one calf. It is typical for multiple births to supply a lower birthweight calf; however, because only five individuals born as a twin remained in the study through weaning it was determined that this was not a large enough factor to consider.

3.4 Terminal Hybrid Income and Costs

Prior to 2014, the need to purchase female replacements outside of the herd (to offset not having enough purebred heifers to maintain the same size of cowherd) has been an added expense. This opportunity cost has been eliminated in recent years because the Simmental sired heifers have been developed and sold as bred heifers; however, the heifer development program may not remain the avenue for marketing the terminal cross heifers if market or range conditions no longer support it.

Based upon the literature review, the hypothesis is that carcass quality is also diminished for the composite calves which thereby leads to reduced margin when sold on a quality grid. This is expected to be offset by improvement in calf livability, feed conversion, weaning weights, and carcass yield that the Simmental sires should provide.

3.5 Purebred Costs and Income

Based upon the literature review, the expected costs associated with the purebred calves include lower wean weights, reduced livability, reduced average daily gain, and reduced carcass yield. Offsetting these expected costs, is expected improvement in carcass quality. A secondary benefit is the opportunity to select from a larger group of potential replacements. The opportunity to have higher selection standards for replacements is expected to be non-cash advantage.

It should be noted that genetic profiling is done on all of the heifers retained within the cowherd to aid in selection criteria. It was considered to analyze the economic benefit that would be provided by having the more stringent selection criteria if all female progeny were eligible to be retained as replacements. It was decided this had to be considered as a non-cash advantage because of hierarchical phenotypical scores being unavailable at time of selection. In essence, the phenotypical selection criteria has been more of a binary yes/no selection and not a continuous hierarchical type score. Due to this, some genotypically acceptable females were not retained due to being unacceptable phenotypically.

It is reasonable to assume that the genetics would improve more rapidly by being able to be more selective by having all progeny as straightbred. This will remain as a soft economic value; however, because the selection criteria is not defined clearly enough to allow a breakout of which individuals would or would not be selected to maintain a consistent herd size.

3.6 Unaccountable Differences Between Straightbred and Crossbred

The unaccountable differences that must be considered for this study include the genetic quality of the purebred and Simmental bulls. It is generally viewed as reasonable to spend more money on bulls that will have an impact on the females that are retained than on the bulls that sire terminal cross calves because the retained females will impact future generations within the herd. It is acknowledged by management that more resources are expended on procuring Red Angus bulls used for the purebred calves than the Simmental bulls used to produce the composite calves.

A second issue is generational improvement within the cowherd. Although genetic progress is slower in cattle than poultry or swine due to individuals producing fewer offspring, greater age at first estrus, and longer pregnancy term; genetic improvement should occur if suitable selection criteria are upheld. Because of this, it stands to reason that the older cows that are bred to Simmental bulls have lower genetic potential than the subsequent generations which are being bred to Red Angus bulls. Offsetting this is the fact that heifers typically have poorer production than older cows as they have nutritional needs to grow themselves in addition to their calf.

As illustrated in Figure 3.1, the impact of cow's age on progeny performance is complicated by the fact that cow ages and sire breeds are often segregated by different production options. Satellite ranches and six month grass each consisting of only one treatment makes it more difficult to evaluate whether differences in performance are related to treatment or the environment in which they were maintained.

3.7 Profitability and Cost/Benefit

The basic profitability equation is income minus costs. In our study this can be expanded to: (Live weight at harvest * price) minus preweaning mortality costs minus backgrounding mortality costs minus feedlot mortality costs minus feedlot costs.

As this is a comparison of two different options, the profitability equation will be dealt with as a cost benefit analysis. The cost benefit analysis is the same equation as profitability, but with comparisons: differences in live weight at harvest, differences in discount or premiums, differences in preweaning mortality costs, differences in backgrounding mortality, differences in feedlot mortality, and differences in feedlot cost.

It is expected that straightbred will have a lighter weight at harvest, but possess a higher carcass premium or higher price per cwt. It is hypothesized that straightbred will have greater preweaning mortality cost, greater backgrounding mortality cost, greater feedlot mortality cost, and greater cost per pound of gain.

Is should be noted that ideally the cost of gain during backgrounding would be included into profitability calculations. Unfortunately, this is an unknown cost because the straightbred and composite treatments were backgrounded together due to limited pen space.

CHAPTER IV: DATA AND METHODS

4.1 Prewean Livability

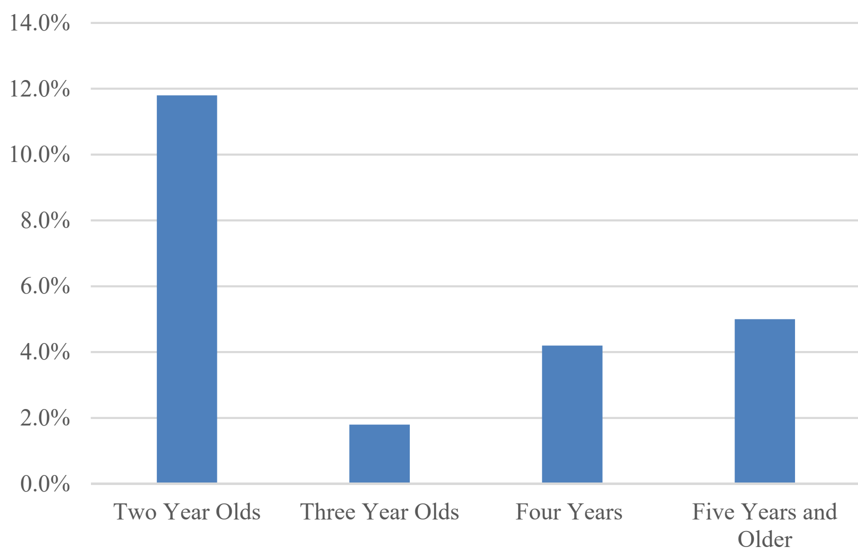
This portion of the study is best analyzed by breaking the treatments into several subsets to help account for parity differences. Calving data were recorded by caretakers upon birth of the calf. Calving date, gender of calf, and any comments were recorded when the caretaker gave the calf its birth vaccinations and an identification tag that matched its dam. At this time, birth weight was also captured for the Red Angus sired calves.

As stated before, only the first two parities within the herd were bred Red Angus. As can be expected, the heifers' progeny struggled the most with livability with 14 out of 119 calves not surviving until weaning (11.8 percent). The progeny from the second parity cows only had two out of 110 not survive to weaning (1.8 percent). In contrast, the mature cows who were bred to Simmental bulls had 19 out of 437 calves not survive to weaning (4.3%). Combined mortality for Red Angus sired calves was seven percent (16 out of 229). This compares against a national 2007 average of 6.4 percent mortality across all parities and production systems (Agriculture 2010). Another study found a slightly higher preweaning mortality rate; however, it should be expected that the increased mortality of 0.3 percent can be at least partially attributed to this study running from 1972 to 1987 and the advances in calving ease bulls that have occurred since then (Patterson, et al. 1987).

Patterson et al.'s (1987) research highlights the trend observed in the mortality data collected from all treatments. They found lower mortality was associated with the second calf, three year old cows at 4.1 percent. Heifers were significantly higher at 10.9 percent. Four year old cows had a mortality rate of 4.8 percent; five year old cows and older had a mortality rate of 5.3 percent (Patterson, et al. 1987).

With the average mortality in Patterson et. al's (1987) study at 7.5 percent for heifers and second calf cows, it is very comparable to the Red Angus sired calves at seven percent when improvements in calving ease are considered. The four year old's mortality rate of 4.2 percent is lower than expected. The five year old and older cows' mortality rate of five percent was again slightly lower than expected. Using a weighted average age of cows bred to Simmental sires, Patterson et al. (1987) would have expected a mortality rate of 5.2 percent for the crossbred calves. Although it is a slight difference, there is a larger improvement on average livability for the crossbred calves vs. Patterson et al.'s (1987) study of 0.9 percent for crossbred and 0.5 percent for straightbred. The actual mortality percentages for this thesis are presented in Figure 4.1.

Figure 4.1 Actual Mortality Percent by Cow Age (Thesis Data)



Even with the heifers included, the percent calf crop for straightbred is closer to the F1 hybrids than expected given the literature review. It was expected there would be a three percent improvement in mortality prior to weaning for the crossbred treatment (Frahm n.d.).

If the cows in the year round grass groups are excluded due to having a later calving date, and different calving location; the Red Angus sired calves remains at seven percent mortality; however, the Simmental sired calves mortality jumps to 6.8%. As further justification of excluding the year round grass groups, these cattle are also expected to benefit from better health due to more acreage available per cow and not having a congregated feeding area.

Given the information in the literature review, it was expected that the composite calves would enjoy a greater advantage, due to improved hybrid vigor. It was also expected that they would benefit from having an older dam because heifers typically have more dystocia or difficulty calving.

The similarities in mortality percentages once conditions are standardized and the year round grass treatments are excluded, were unexpected. It was assumed that the hybrid vigor, and more experienced mothers would lead to relatively significant differences between Red Angus and Simmental sired calves. Actual results were not as significant as hypothesized.

Although it is more of a qualitative analysis, it should be noted that the heifers' mortality issues appear to be a product of the heifer not quickly licking the calf clean and a dam that is generally inexperienced. This is evidenced by three dead calves among the heifers due to the amniotic sac not being licked off of the calf's head. A fourth calf died because the inexperienced dam lost track of the calf in inclement weather. It is expected that the early calving date also hurt the heifers mortality number as evidenced by the need to provide supplemental heat for nine calves during inclement weather, two of which later died.

More than anything, the livability information signals the difference that calving date can make. The group with the worst mortality (the heifers) began calving in late January, and the two groups with the best mortality began calving in March. It is assumed that warmer weather had some impact on this.

Although all groups calved on native grass, the two groups on year round grass are moved among calving pastures more often during the calving season to allow them to graze fresh dormant grass. The expectation is that doing this provided a lower pathogen volume than their counterparts who remained in one calving pasture. The year round grass cows are also fed their protein source in different areas as opposed to being fed a total mixed ration in the same place daily. Again, it is expected that pathogen volume was reduced among the year round grass groups because of this.

4.2 Adjusted Wean Weight Formulas

The 205 day adjusted wean weight is a standardization measure used to equalize differences in weight due to differences in age. For reference to what is standardized in the industry, the formula for adjusted wean weight for the Red Angus breed is given below: (Pre-Weaning Gain*205 days) + Age of Dam Additive (Red Angus Appendix 2013). Preweaning gain is supplied by: (Wean Weight-Birth Weight)/Age in Days (Red Angus Appendix 2013).

The age of dam additive is used to adjust for the expected increase in production as a cow ages. From age five to ten years, cows are at their peak production and there is no age of dam additive. From age two to four years and 11 years of age or greater, the cow is given a handicap to add to the adjusted wean weight of her progeny. Table 4.1 supplies the age of dam adjustments (Red Angus Appendix 2013).

Table 4.1. Age of Dam Adjustments

Dam Age	Bull Calf	Heifer Calf
2 years	74 lbs.	60 lbs.
3 years	38 lbs.	30 lbs.
4 years	16 lbs.	10 lbs.
5-10 years	0 lbs.	0 lbs.
11 years or more	27 lbs.	25 lbs.

Source: (Red Angus Appendix 2013)

4.3 Wean Weight Analysis

The average weaning age across both treatments was 198 days with a 28 day standard deviation. All calves were weaned within a two week window between September 26th and October 10th. Due to labor constraints, birthweights were only captured for Red Angus sired calves. With the birth weights being unavailable for the Simmental sired calves, it was decided to use regression analysis using actual data instead of using an estimated standardized birthweight for the Simmental sired calves. The regression was also selected because of the multiple management styles on the ranch (six month native grass, year round grazing, and summer drylot) to quantify performance differences between these groups.

4.4 Comparison between Red Angus 205 Day Weights and Wean Weight Analysis

The regressed weights (adjusted to 205 days of age by taking the age coefficient*205) was compared against 205 day adjusted wean weights using the equation provided by the Red Angus Association of America. This was only able to be done on the two and three year old cows as these were the only age groups that had weights recorded at birth.

Across both age groups, the regressed weights averaged 13.6 pounds less than the 205 day adjusted weights, with a standard deviation of 55.6 pounds for the difference (205 day adjusted-205 day regressed weight).

When only two year olds are considered, the regressed weights averaged 15.8 pounds more than the 205 day adjusted weights, with a standard deviation of 47.2 pounds for the difference (205 day adjusted-205 day regressed weight).

When only three year olds are considered, the regressed weights averaged 42.7 pounds less than the 205 day adjusted weights, with a standard deviation of 47.3 pounds for the difference (205 day adjusted-205 day regressed weight).

4.4.1 Regression Analysis

Actual wean weights without any age adjustments produced an average wean weight across all treatments of 516 pounds with a standard deviation of 70.6 pounds. This represented an actual average of 497 pounds for the straightbred treatment, and 528 pounds for the composite treatment.

A regression run on the data calculated wean weight as the dependent variable. The following were given as independent variables: calf's age at weaning (ageatweaning), a binary variable for cow and calf being fed in a drylot during the summer (drylot), a binary variable for being grazed on grass during the summer season (summergrass), a binary variable for being a straightbred calf (redangus), and a binary variable for a bull calf (bull).

This can also be expressed in Equation 1 by:

(1) Pounds of Wean Weight = (B_0*days of age) + (B_1*drylot binary variable) + (B_2*six month grass binary variable) + (B_3*Red Angus sire binary variable) + (B_4*bull calf binary variable) + intercept.

It is expected that calf's age at weaning will have a positive coefficient. Healthy animals gain weight as they approach physical maturity; thus, an older calf should weigh more.

Cattle fed in the drylot during the summer, or grazed on summer grass only are expected to have a negative coefficient. The ranch's management has been pleased with the wean weight comparisons for the calves raised on grass year-round as opposed to the summer drylot and only grazing native grass for six months. This is despite giving up several weeks of wean age.

The Red Angus binary variable is expected to have a negative coefficient because of improved growth of a Continental breed such as Simmental and also due to the improvement that heterosis gives. The bull calf binary variable is expected to have a positive coefficient because steers will wean at a heavier weight than heifers will.

The year round grass scenario was used as a baseline because in future years this will be the largest of the three populations within the operation. Because bull calves and Red Angus sired calves were used as binary variables, the baseline overall for the regression is a cow with a Simmental sired heifer calf maintained on native grass year-round.

CHAPTER V: WEAN WEIGHT RESULTS

The regression output and variance inflation factors are presented below. All of the coefficients are significant at the one percent level. In total, data were available for 633 observations. A regression was initially run with two variables for age of cow and age of cow squared. However, these terms introduced a significant amount of multicollinearity due to all but one cow being under age 11. Multicollinearity was further complicated because only two year old cows were among the summer grass treatment, summer grass treatment contained every two year old cow in the study, and all three year old cows were among the dry lot group. For these reasons, the age and age squared variables were eliminated from the regression. With an adjusted R-squared of 0.3799 this model has relatively good fit. Table 5.1 supplies the coefficients for the regression analysis.

Table 5.1 Wean Weight Regression Coefficients

Variable	Coefficient	P Value	Std. Error
Age at Weaning	2.07	0.00	0.1444
Drylot	-68.03	0.00	5.9909
Summer Grass	-113.57	0.00	10.6634
Red Angus	-51.56	0.00	8.5540
Bull	29.60	0.00	4.4623
Intercept	152.51	0.00	26.8754

Table 5.2 supplies the variance inflation factors. Variance inflation factors are an indicator or multicollinearity between variables in the regression. As all of these variables have a variance inflation factor between one and five, a moderate amount of multicollinearity is present in this model. This was expected due to differences in wean age for the straightbred treatment, straightbred being the only treatment grazed on six month grass, and composite being the only treatment among the year round grass groups.

Table 5.2 Wean Weight Regression Variance Inflation Factors

Variable	VIF	1/VIF
Age at Weaning	3.34	0.299223
Drylot	1.7	0.589615
Summer Grass	3.26	0.306497
Red Angus	3.35	0.298288
Bull	1.02	0.983392
Mean VIF	2.53	

From an analysis of the regression equation, it is assumed that for the producer selling calves at weaning, a terminal cross will generate an extra 51.55 pounds of wean weight. Predictions for 550 pound calves in October of 2016 land at $166 per cwt (Hughes 2016). This equates to a difference of $85.57 gross profit per head. The limited cost to maintain a cow on native grass during the summer ensures that most of this gross profit would return to the producer as net profit if calves are sold at weaning.

Although the regression model has relatively good fit, a discrepancy between the regressed wean weights and 205 day adjusted wean weights on the straightbred calves of 51.55 pounds leaves this comparison open to criticism. The multiple feeding systems for summer management also leaves the additional cost to maintain and grow the crossbred calves as an unknown, so the net profit is not known with certainty.

It is expected in a system that sells weaned calves directly off the cow that the terminal cross calves would have an advantage. Unfortunately, given the circumstances of this study we are unable to ascertain how large the advantage is to crossbred calves when selling at weaning.

CHAPTER VI: BACKGROUNDING AND FEEDLOT OVERVIEW

6.1 Backgrounding Mortality

The heifers were not included in calculations of mortality during backgrounding due to incomplete records for the replacements after they were segregated from the non-selects. Due to a questionable vaccine protocol, there were larger than expected mortality numbers during the backgrounding phase. There were 14 total mortalities for the steers during the backgrounding phase. The straightbred treatment had two mortalities out of 104 individuals (1.92 percent), and the composite treatment had 12 mortalities out of 223 (5.38 percent). Both treatments received the same vaccination protocol and were backgrounded together; therefore, there is not a hypothesis for why the composite treatment suffered greater mortality.

6.2 Feedlot Overview

At the end of the backgrounding phase, after five reject animals were sorted off of the straightbred group and sold through alternative markets, there were a total of 97 straightbred steers, and 211 composite steers placed in the feedlot. Average start weight on the straightbred treatment was 751 pounds, and average start weight on the composite treatment was 776 pounds. This was a difference of 25 pounds.

Of these groups, 96 straightbred and 209 composite steers survived to harvest. The mortality numbers were 1.03 percent for the straightbred treatment and 0.95 percent for the composite treatment.

Average finish weight for the straightbred treatment was 1263 pounds (525 pounds gained), and average finish weight for the composite treatment was 1333 pounds (557 pounds gained). Both treatments were sold over three separate marketing dates. The first marketing date was May 22 which consisted of 24 straightbred calves (25 percent) at an average weight of 1269 pounds, and 36 composite calves (17.1 percent) at an average weight of 1333 pounds. The second marketing date was July 21 which consisted of 48 straightbred calves (50 percent) at an average weight of 1267 pounds, and 92 composite calves (43.6 percent) at an average weight of 1386 pounds. The final marketing date was August 4 which consisted of twenty-four straightbred calves (25 percent) at an average weight of 1302 pounds, and 81 composite calves (38.4 percent) at an average weight of 1301 pounds.

Average daily gain was 3.05 pounds per day for straightbred and 3.13 pounds per day for composite. Feed conversion based on dry matter was 7.02 for straightbred and 6.98 for composite. Total pounds consumed per day was 21.45 for straightbred and 21.81 for composite. Cost per pound of gain was $1.0284 for the straightbred treatment, and $1.0172 for the composite.

The straightbred treatment had 26.04 percent of individuals grade prime, 73.96 percent choice, and no animals that graded select. The composite treatment had 9.61 percent of individuals grade prime, 81.74 percent choice, and 8.65 percent select.

The net profit for feedlot phase showed a net profit of $43.54 per head for the straightbred treatment, and $43.87 per head for the composite treatment. Table 6.1 summarizes the findings during the backgrounding phase and feedlot phase.

Table 6.1 Feedlot and Backgrounding Summary

	Composite	Straightbred
Backgrounding Mortality %	5.38%	1.92%
Avg. Feedlot Start Weight (Lbs.)	776	751
Avg. Finished Weight (Lbs.)	1333	1276
Feedlot Mortality %	0.95%	1.03%
Consumption Per Day (Lbs.)	21.84	21.45
Average Daily Gain (Lbs.)	3.13	3.05
Feed Conversion, Dry Matter Basis	6.98	7.02
Percent in First Marketing Date	17.1%	25.0%
Percent in Second Marketing Date	43.6%	50.0%
Percent in Third Marketing Date	34.8%	25.0%
Net Profit	$43.87	$43.54
Percent Prime	9.61%	26.04%
Percent Choice	81.74%	73.96%
Percent Select	8.65%	0.00%

It should be noted that the contracts under which both treatments were sold did not consider yield grade because these cattle were sold as NHTC. It is expected yield grade would provide an advantage to the composite treatment when sold on a traditional grid, but it is not known with certainty.

CHAPTER VII: OVERALL PROFITABILITY

The composite treatment had an average finished live weight of 1333 pounds after an average start weight of 776 pounds. Taking the 1333 pounds multiplied by the average cwt price for this treatment of $132.87 provides gross revenue of $1771.16 per head. The straightbred treatment had an average finished live weight of 1276 pounds after an average start weight of 751 pounds. The 1276 pound average finished weight multiplied by the average cwt price for this treatment of $133.69 provides gross revenue of $1705.88. Once these totals are subtracted, the net difference between gross revenues is $65.28 per head in favor of the composite treatment.

If the subsets of the composite treatment that were born on satellite ranches are disregarded for the pre-weaning mortality calculation, then the net difference on pre-wean mortality is 0.2 percent. The average wean weight of 516 pounds multiplied by expected sale price of $166 cwt, provides an expected gross price of $856.56 per head if these mortalities had survived to weaning. For the straightbred treatment, $856.56 multiplied by an increased death loss percentage of 0.2 percent provides a deficit of $1.71 per head.

The same gross price per head of $856.56 at weaning is applied to backgrounding mortality price difference. The mortalities during backgrounding occurred early, but exact mortality dates were unavailable. There is a net difference in backgrounding mortality of 3.46 percent (5.38 percent-1.92 percent). Using $856.56 multiplied by an increased death loss percentage of 3.46 percent provides a deficit of $29.64 for the composite treatment.

The average days on feed was 122 days in the feedlot for the steers subject to feedlot mortality. The 122 days is divided by average days on feed of 170 for the rest of the finished calves. This ratio is then multiplied by average finished weight to provide an expected weight of the dead steers. This weight of 1141.4 pounds is multiplied by $133.28

per cwt average price across both treatments to provide a gross cost of a post-weaning mortality of $1521.26 per head for each dead. This $1521.26 is multiplied by the difference of the post-weaning mortality rates between treatments. This difference is 0.08 percent (1.03 percent minus 0.95 percent), so $1521.26 is multiplied by 0.08 percent. This provides an incremental feedlot mortality cost of $1.22 per head for the straightbred treatment.

The overall cost per pound of gain without mortalities for the straightbred treatment was $1.0284. The overall cost per pound of gain without mortalities for the composite treatment was $1.0172. The straightbred treatment gained an average of 525 pounds per head in the feedlot phase; the composite treatment gained an average of 557 pounds per head in the feedlot phase. Multiplying $1.0284 by 525 pounds yields a gross feedlot cost of $539.91 for the straightbred treatment. While $1.0172 multiplied by 557 pounds yields a gross feedlot cost of $566.58 for the composite treatment. When $539.91 is subtracted from $566.58, the difference is $26.67. This $26.67 is a lower cost for the straightbred treatment.

The difference of gross live value between treatments is $65.28 in favor of composite. The difference between pre-wean mortality costs of $1.71 and the difference between feedlot mortality costs of $1.22 are added to this $65.28 because both are an additional cost for the straightbred treatment. The difference of backgrounding mortality cost of $29.64 is subtracted from the difference of gross live value because it is an additional cost for the composite treatment. Gross feedlot costs of $26.67 are subtracted from the gross live value because it is a lower cost for straightbred. This brings the overall net profitability to $11.90 per head in favor of composite.

This can be expressed in equation 2 by:

(2) Net Difference in Profit = Difference in Gross Live Value - Difference in Prewean Mortality Cost - Difference in Backgrounding Mortality Cost - Difference in Feedlot Mortality Cost - Difference in Gross Feedlot Cost

In the above equation, difference in gross live value is represented by average price by treatment multiplied by the average start weight for the treatment. Difference in gross live cost is provided by pounds of gain during the feedlot phase multiplied by cost per pound of gain.

Differences in cost of gain were minor between treatments. Live price favored the straightbred treatment and the carcass premiums were included in this live price. Due to this, it is apparent that the vast majority of the $11.90 per head gap can be attributed to the difference in start weight of twenty-five pounds. This advantage in start weight had been carried over from an advantage in weaning weight for the composite treatment.

The difference in backgrounding mortality of $29.64 is open to criticism because it is a sizable difference that is without a logical explanation. Without this impact, the composite treatment would have possessed a much larger advantage over straightbred of $41.54. Table 7.1 details feedlot performance and the inputs into the profitability equation.

Table 7.1 Feedlot and Carcass Profitability

	Composite	Straightbred
Prewean Mortality Cost Gap	$0	($1.71)
Backgrounding Mortality Cost Gap	($29.64)	$0
Feedlot Mortality Cost Gap	$0	($1.22)
Cost per LB of Gain	$1.0172	$1.0284
Average CWT	$132.87	$133.69
Gross Live Value per Head	$1771.16	$1705.88
Gross Feedlot Cost per Head	$566.58	$539.91
Profitability Advantage per Head	$11.90	$0

It should be noted it is expected that cost of gains during the backgrounding phase would favor the composite treatment, thereby widening this gap out farther. Unfortunately, due to the limitations of this study the economic impacts of cost per pound of gain during the backgrounding phase is not known with certainty.

Differences in costs of procuring replacement females were excluded in final calculations. Aside from some non-cash costs including time spent finding replacement heifers to purchase and buyers to market the composite heifers to, the composite heifers being sold as replacements are selling for similar value as the straightbred heifers that are being purchased for introduction into the herd. As discussed in earlier sections, the opportunity to have a higher level of selection among available females is not quantifiable value and could not be figured into the profitability equation.

When presented with the difference in net revenue between treatments, it was decided by ranch management to continue moving forward with transitioning to more straightbred production. They feel that the opportunity to select a higher quality replacement offsets the advantage of $11.90 shown for the composite treatment. Even if the advantage in backgrounding mortality for the straightbred treatment is not included in this consideration, ranch management feels the opportunity to be more selective with replacement females makes the straightbred treatment a more attractive option at this time. Ranch management will evaluate impacts of selling straightbred calves from future calf crops on a traditional grid which penalizes for poor yield grade.

It should be noted that the $11.90 advantage for composite that was present in this study is sensitive to price inputs. Current price per pound of gain based upon feed (not the total cost per pound of gain which includes other costs) is $0.9793 for straightbred and

$0.9729 for composite. When these are multiplied by an average daily gain of 3.01 pounds for straightbred and 3.08 pounds for composite, it provides a cost per day for feeding of $2.9477 for straightbred and $2.9965 for composite. When $2.9477 and $2.9965 are multiplied by the average days on feed of 170 days for straightbred and 176 days for composite, it provides a total cost of feed of $501.10 for straightbred and $527.38 for composite. The difference is a total cost that is $26.28 less for straightbred.

If grains get more expensive, it will narrow the gap between straightbred and composite. For example, if cost of feed rises by ten percent, it adjusts total cost of feed to $551.21 for straightbred and $580.09 for composite. This now provides a total cost that is $28.98 less for straightbred. Gross live value would stay the same, so the profitability gap would narrow.

In contrast if grains get cheaper, it will benefit the composite treatment. If cost of feed decreases by ten percent from current levels, straightbred becomes a total feed cost of $455.55 and $479.44 for composite. In this example, the difference is $23.89 less for straightbred. Gross live value would stay the same, but a diminished cost advantage for straightbred would provide a wider profitability gap for composite.

The individual packer's premium/discount grid also impacts this gap of $11.90. Due to the variability amongst packers' grids, this gap may widen or narrow depending on the packer. A yield focused grid would be expected to benefit the composite treatment, but a carcass quality focused grid would benefit the straightbred treatment.

If the gap between prime and choice, and the gap between choice and select both widen, it will benefit the straightbred treatment by providing a further advantage in price per cwt. If the spread among quality grades narrow, then it will provide an advantage to composite. Table 7.2 summarizes the study's overall findings below.

Table 7.2 Overall Findings in Study

	Composite	Straightbred
Actual Wean Weight (Lbs.)	528	497
Prewean Mortality Percent	6.8%	7.0%
Prewean Mortality Cost Gap	$0	$1.71
Backgrounding Mortality Percent	5.38%	1.92%
Backgrounding Mortality Cost Gap	$29.64	$0
Avg. Feedlot Start Weight (Lbs.)	776	751
Avg. Finished Weight (Lbs.)	1333	1276
Consumption Per Day (Lbs.)	21.84	21.45
Average Daily Gain (Lbs.)	3.13	3.05
Feed Conversion, Dry Matter Basis	6.98	7.02
Percent in First Marketing Date	17.1%	25.0%
Percent in Second Marketing Date	43.6%	50.0%
Percent in Third Marketing Date	34.8%	25.0%
Feedlot Mortality %	0.95%	1.03%
Feedlot Mortality Cost Gap	$0	$1.22
Percent Prime	9.61%	26.04%
Percent Choice	81.74%	73.96%
Percent Select	8.65%	0.00%
Net Profit per Head Feedlot Phase	$43.87	$43.54
Average CWT	$132.87	$133.69
Gross Revenue per Head	$1771.16	$1705.88
Gross Feedlot Cost	$566.58	$539.91
Profitability Advantage per Head	$11.90	$0

CHAPTER VIII: FUTURE RESEARCH OPPORTUNITIES

Key findings from this study include the preliminary conclusion that calf mortality is not as impacted by heterosis as some research might suggest. This needs to be researched with further replications to strengthen this finding.

It is the researcher's opinion that by far the greatest impact on calf mortality is environmental. Although it cannot be investigated using these data, reviewing the calving notes seems to suggest an inherent advantage to a later calving date and grazing cows on native grass year round.

Given the data set being unable to provide 205 day adjusted weaning weights for the crossbred calves, further research is needed to ascertain how selling calves at weaning is impacted by using a straightbred program. Weaning weights would be a greater deciding factor if ownership is no longer retained through the feedlot phase at a later date.

An opportunity exists to replicate this study on a grid system that deducts for yield grade 4's and 5's. One must keep in mind when drawing conclusions from this study that this grid did not take into account yield grade.

Replications involving heifers from both treatments for the feedlot phase would help draw more robust conclusions. Unfortunately, to do this without compromising data would involve not retaining any females as replacements so that all females could be placed in the feedlot.

The greatest opportunity for further research with this study involves more replication and greater mix among treatments. An area of weakness in this study is all young cows being bred to Red Angus bulls. Further research would ideally involve random selection of cow ages, sire breeds, and placement in the drylot, six month summer grass, and year round grass treatments. This would help mitigate generational improvement's skewing of the data that most likely impacted the current study.

Ideally, further replications would collect birth weights on all progeny allowing for 205 day adjusted wean weights. From there, the later studies would segregate treatments during the backgrounding phase to allow these costs to be captured. Smaller groups in the backgrounding and feedlot phases would provide an opportunity for greater replication of these portions of the study.

It would be worthwhile to research the impact of growth promoting implants on both treatments. Would this serve as a greater catalyst to one treatment than it does to the other? Or would implants hinder carcass quality enough that they are not a viable tool for one or both treatments when selling on a quality grid? Due to the narrowing premiums on non-hormone treated cattle (NHTC), ranch management does not expect to continue NHTC production.

Finally, it would be intriguing to evaluate two production systems with comparable quality of sires. As acknowledged earlier, the Red Angus sires faced more stringent selection criteria than their Simmental counterparts.

Overall, this study has raised more questions than it has answered. Although the gap between straightbred and an F1 terminal cross is not as wide as some research might suggest, this specific grid marketing most likely favors straightbred production as did the inability to capture cost per pound of gain during the backgrounding phase. Factors that favor a stronger case for composite than dictated in this research is the higher quality sires used for straightbred, the later calving dates for the composite calves still producing a higher weaning weight, generational improvement, and the questionable results for backgrounding mortality. This optimism for the composite treatment is tempered by the fact that none of the cows five years of age and older who are at their peak of production were in the straightbred treatment. Also in support of straightbred is the fact that none of the straightbreds got the benefit of being on year round grass. As discussed in the previous section, price of grain inputs impacts profitability of both treatments. Price of outputs which is impacted by the gap between quality grades also impacts profitability of both treatments.

Despite the questions raised and unknowns that still exist after performing this study, ranch management has been able to narrow their focus on what traits to pursue to narrow up the gap between their straightbred and composite groups. As the profitability equation showed, most of the gap was due to a heavier weight at placement in the feedlot. This heavier weight extended back to differences in weaning weight.

Based on the results of this study, the hypothesis is that mortality cost and cost per pound of gain are similar enough to keep the straightbred group competitive with the composite group. The added benefit of higher carcass quality evidenced by the higher percent choice and lack of individuals that graded select among the straightbred treatment makes this comparison even more competitive.

Although the concerns about yield grade 4s and 5s are legitimate for the straightbred treatment, this should be able to be offset by the higher quality grades these cattle received despite being marketed earlier than their composite counterparts. At this point in time, the largest barrier between equal economic performance for the straightbred treatment is the gap in wean weight. If the gap in wean weight can be narrowed, the straightbred treatment could become a better option as long as all other known factors remain constant.

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APPENDIX A

Key Terms

205 Day Adjusted Weight - A means to approximate weaning weight if all animals were weaned at the same time. 205 days is recognized as the industry standard.

Average Daily Gain (ADG) - Total pounds gained divided by number of days on feed. A measurement of performance.

Backgrounding - Refers to a transition period after weaning before being placed in the feedlot or on summer grass.

British Breeds - Breeds that typically focus on carcass quality and maternal traits. Examples include Angus, Red Angus, Hereford, and Shorthorn.

Carcass Quality - References quality grade. In order of least to greatest quality: Select, Choice, Prime.

Continental Breeds - Also known as exotic breeds. Breeds such as Simmental and Charolais that focus on yield grade, dressing percentage, average daily gain, and feed conversion.

Crossbred - Animal(s) with a genetic makeup of two or more breeds.

CWT - Cost per hundred weight. Price given in CWT can be divided by 100 to provide a cost per pound.

Dam - Mother of the offspring being referenced.

Dystocia - Difficulty calving.

F1 - Progeny of two straightbred animals.

Feed Conversion - Pounds of feed required for the animal to gain a pound of live weight. A measurement of performance.

Heritability - Numeric value of how easily traits are passed on to offspring. Higher numbers indicate higher heritability. Carcass traits are highly heritable, and reproductive traits are lowly heritable.

Heterosis - Crossbred individuals' performance that is greater than the average of the two parents.

Marbling - Intermuscular fat. Used in determining carcass quality grade.

Non-Hormone Treated Cattle (NHTC) - Cattle not implanted with natural hormones that increase growth.

Progeny - Offspring.

Sire - Father of the offspring being referenced.

Straightbred - Individuals of the same breed are mated. Synonymous with purebred and fullblood.

Terminal Cross - Crossbred individual that will not be retained as a replacement. In this thesis, this refers to the F1s that are being produced.

Total Mixed Ration (TMR) - Complete diet consisting of several or many feed ingredients fed in a mixed form.

Yield Grade - Measurement of lean saleable product from a carcass. Ranges from 1 to 5 with 1 having the most saleable product and 5 having the least saleable product.