Coordinating Sire Genetics in a Synchronized AI Program

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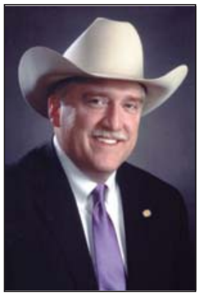
Abstract

Synchronized artificial insemination was used to inseminate cows using different types of sire genetics, including low-accuracy, calving-ease, and high-accuracy. These three sire groups were compared to calves born to cows bred using natural service. We found substantial production efficiency gains, carcass merit improvement, and economic value for calves of cows bred using a synchronized artificial insemination program with high-accuracy semen. The economic advantage of the high-accuracy sire group of calves was computed to be in the neighborhood of $40 to $80/head, relative to the natural service sire group of calves.

Introduction

Production and quality variability in the cattle value chain persists due to breed and cross-breeding variation within and across beef cow herds in addition to beef cow operator management differences. The desire for production and quality consistency has lead to many innovations in the cattle industry in an attempt to project quality, including Leptin genotyping (e.g., Devuyst et al., 2007; Lambert et al., 2006), ultrasound (e.g., Brethour, 1994), sorting (e.g., Koontz et al., 2000), and most notably, merit-based pricing for quality (Johnson and Ward, 2005). Conceptually, quality consistency in the cattle industry would develop like the pork or poultry industries. The capital costs of a fully integrated beef value chain are considerably large. All entities that have attempted to integrate have found it impossible due to the financial infeasibility of coordinating cow-calf operations, backgrounding systems, feedlots, and processing operations on a large scale, which is vital in order to capture economies of size. Even those firms that have tried to integrate between segments of the beef value chain have faced issues related to non-perfect information due to the form of management and animal quality within



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segments not within their control. Inefficiencies within the cattle production and beef marketing value chain persist due to the biological production lag for cattle, ineffective vertical flow of relevant information, and inadequate attention to end-user demand. Predictability (i.e., tighter distribution of production and quality characteristics) benefits all beef industry entities beyond the cow-calf producer. One opportunity to control quality distribution within a beef herd and across beef operations occurs through coordinating sire genetics and heifer/cow conception date within and across beef herds. The objective of this research is to investigate, for a small sample, the economic value to cow-calf producers from managing for conception date and for sire genetic quality within and across beef herds.

Fed cattle source, health, process, and genetic verification are being explored by domestic cattle producers and feeders to address customer demand and capture value. Verification methods are simple to replicate individually, allowing competition to quickly transform a niche market into a commodity market, but combining verification methods (i.e., bundled verification) impedes replication on a mass scale because of coordination costs. This raises the question, what if one was able to economically bundle or stack verification methods throughout the value chain? What value could be created by consistently coordinating the delivery of masses of similar age cattle with similar, proven genetics, raised under assured health management programs, and source verified? How could this be accomplished, while allowing cow-calf producers to maintain their independence and ability to retain a majority of the decision making?

Managing for conception date and sire genetics represents an opportunity to add value. In practice, however, coordination of artificial insemination practices and agreements by producers to use similar sire genetics have been challenging. Coordination costs represent a substantial up-front investment, and removing decision making rights from independent producers substantially limits participation. However, if producers were willing and able to provide reliable information, then the marketing of quality-differentiated feeder calves would also have value (e.g., Bulut and Lawrence, 2006; Chvosta, Rucker, and Watts; Chymis et al., 2004; Dhuyvetter, 2004.).

Hennessy, Miranowski, and Babcock (2004) indicated the benefits of improved genetic information in the agricultural industry. Stigler (1961), as well as Ladd and Gibson (1978), pointed out that there exists a cost for gathering information and a value exists for information itself. Only when the value exceeds the cost will genetic information be gathered, reported, and used to market commodities. For the current analysis, we seek to assess the value of gathering the genetic information and coordinating genetics. The cost of coordinating genetics depends on the producer or producers involved with such an alliance. For producers already keeping detailed records, additional recordkeeping costs would be minimal. Anderson, Rhinehart, and Parish (2008) estimate costs of synchronized artificial insemination including drugs, semen, and labor to be about $35.50 to $37.50 per head. Any value above these costs represents potential profits to producers that keep fairly detailed records.

Experiment Background and Prior Research

An experimental design, consisting of 328 animals in four sire groups, was developed to assess the production and marketing potential of cattle under a coordinated age, source, health, and genetic verified program. We use the term sire group throughout the remainder of the paper to differentiate between the alternative calf groups. The first calf sire group was “Natural Service,” and this sire group represents calves born to a cow/heifer bred through natural service. The conception date of the cow/heifer is generally unknown. The second sire group was “Calving Ease,” and this sire group represents calves born to animals bred using artificial insemination (AI), where the sire was selected based on expected progeny difference (EPD) scores to minimize calving problems for the heifer. The third calf sire group was “Low-Accuracy,” and this sire group represents calves born to animals that were AI bred to sires with unproven EPD scores. Accuracy measures attached to EPD values represent the level of confidence placed on the accuracy measure. A higher accuracy value indicates greater confidence that the reported EPD level will be observed. Accuracy values are dynamic and change as more information is learned about a particular sire (i.e., as more data is gathered on its progeny). The fourth sire group was “High-Accuracy,” and this sire group represents calves born to animals that were AI bred to sires with proven EPD scores. Following the Show-Me-Select Replacement Heifer Program, high-accuracy sires have accuracies greater than or equal to 0.65 for calving ease direct, 0.30 for calving ease maternal, 0.75 for weaning weight, 0.20 for carcass weight, and 0.20 for marbling EPDs. The primary calf sire group of interest for this study was the “High-Accuracy” group. For all sire groups sourced from AI bred cows, a timed and synchronized AI program was utilized.

The base lot represented a mixed lot, being a composite across all sire groups and reflected the typical commingled pen of cattle purchased through a sale barn, background system, or fed in a feedlot. This composite group was simulated based on the weighted average performance for all 328 calves: 93 Natural Service in the sire group; 36 in Calving Ease animals; 101 Low-Accuracy animals; and 96 High-Accuracy animals.

Animals originated from four different farms, with four alternative management practices. These farms represent three University of Missouri Experiment Station Farms and the MFA Incorporated experiment farm. The AI program utilized was the only similar management factor between the four farms. The female seedstock were of mixed breeds, with the highest prevalence of Angus or Angus crossbreeds. The sires, even for natural service, were of Angus breed. One natural service sire was Red Angus.

Artificial insemination, timed/synchronized

The beef cattle industry has seen rapid gains in economically desirable traits largely due to selection and broader use of genetically proven superior sires made available through AI. Recent surveys indicate, however that less than five percent of the beef cows in the United States are bred by AI, and only half of the cattle producers who practice AI use any form of estrus synchronization to facilitate their AI programs (NAHMS, 2007). The inability to predict time of estrus for individual cows or heifers in a group and the labor required for estrus detection, often make AI impractical. Available procedures to control the estrous cycle of the cow can improve reproductive rates and speed up genetic progress. These procedures include the synchronization of estrus in cycling females and the induction of estrus accompanied by ovulation in heifers that have not yet reached puberty or among cows that have not returned to estrus after calving.

There are several advantages to a successful estrus synchronization program. These include: 1) Cows or heifers are in estrus during a predictable interval, which allows for artificial insemination, embryo transfer, or other planned reproductive techniques; 2) The time required to detect estrus can be reduced, which in turn decreases labor expense associated with the breeding program; 3) Cattle will conceive earlier during the breeding period; and 4) Calves will, on average, be more age and weight uniform at weaning.

Estrus synchronization results in a shortened calving season with more uniform calves at weaning (Dziuk and Bellows, 1983). Following administration of protocols reported by Stegner et al. (2004), Bader et al. (2005), and Busch et al. (2007), the cumulative number of cows that calved within the first 30 days of the calving period was approximately 90 percent of the total number of cows that became pregnant during the entire breeding period. Reduced length of the calving season translates into a greater number of days for the postpartum recovery of the cow to occur prior to the subsequent breeding season. Records of calving dates for cows that conceived on the same day to fixed-time AI indicate that the breeding program will not result in an overwhelming number of cows calving on the same day(s) (Bader et al.).

The data examined in this study is on calves conceived through timed and synchronized AI following procedures outlined by Busch et al. (2007).

Pre-conditioning

The value of pre-conditioning feeder calves has been well researched. Busby et al. (2004) reported the positive effect on feedlot performance and quality grade from post weaning health. Thus, any activity to enhance post weaning health should have a positive benefit on fed cattle profitability. Ward and Lalman (2003)showed that pre-conditioning improves calf value beyond weight gain, particularly when uniformity and health are accounted for in value component. Dhuyvetter (2004) found positive net returns to pre-conditioning when analyzing weight gain and price change over the period of the pre-conditioning program. He acknowledged that the pre-conditioning value will vary seasonally and across years.

Feeder calves from each of the four different farms were placed into 45- to 60-day pre-conditioning program. Cattle were fed MFA Incorporated Cattle Charge at a minimum rate of 10 pounds per head per day for the first 14 days of preconditioning period. Health requirements of the pre-conditioning program included immunization for 7-way blackleg, Haemophilus somnus-two doses, (IBR, BVD, PI3, BRSV)-two doses, Pasteurella hemolytica-one dose, dewormed and treated for external parasites, implanted (optional – must record product and date if used), castrated with a knife (preferred) or verified to be a steer, and all calves must be polled or dehorned completely.

Feed conversion and average daily gain were each approximated, by sire group, based on observed pounds of feed consumed and observed weight gain. Values were computed based on an even quantity of feed allocated to each sire group. Recall, the pre-conditioning program was carried out separately for each farm.

Feedlot

At the conclusion of the pre-conditioning program, all calves were comingled and placed into pens at the University of Missouri Experiment Station feedlot located in Columbia, Missouri. Falkner (2005) emphasized indirect commingling costs (i.e., health issues from mixing cattle of different origins). However, we hypothesize that pens of feeder calves of similar genetics and of similar age from across farms will have a lower rate of health issues when commingled because of uniformity.

On two separate occasions, same sire group calves were separated and individual sire group feed efficiency and average daily gain was recorded.

Processing

Calves were marketed on six separate dates in 2006 – March 14, March 21, April 18, May 9, May 16, and May 19. Finished steers were processed at Excel in Doge City, Kansas.

Results

Study results are listed in a series of tables based on the stage of calf production and one table summarizing an economic simulation analysis. Tests of statistical importance, between alternative sire groups, are conducted only for the economic factors reported in this section. Ultimately, importance in profitability is the driving factor behind changing management. The remainder of the results section lists sub-categorical sections of calf sire group production and processing performance.

Birth

Birth date was not reported in any of the tables. Calf birthing dates ranged from January 5 through April 5, 2005. Most of the calves sourced from AI bred cows were born between January 5 and March 5. By farm, calves born to AI bred cows calved within 20 days of each other. For calves conceived by natural service, birth dates varied from January 5 to April 5. By farm, calves conceived by natural service varied in birth date by as much as 45 days.

Weaning and pre-conditioning

Summary statistics from calf production and pre-conditioning phases of the study are presented in Tables 1 and 2, respectively. Calves in the High-Accuracy sire group were often weaned at a younger age relative to the other sire groups. This represents a benefit from using proven genetics. While the Calving-Ease sire group, for which the dams were heifers, is disadvantaged relative to other groups due to the limited milking ability of first-calf heifers, this group outperformed the Natural-service group in terms of weaning weights, as did the other two AI sire groups. This result partly reflects the generally higher quality genetics of AI sires. As Anderson, Rhinehart, and Parish (2008) note, calves born of AI are heavier at weaning because they are older on average and have superior genetics.

For the pre-conditioning segment of the pilot study, two important findings were observed (Table 2). Average daily gain and feed conversion were exceptional for the High-Accuracy sire group calves. This result relates to better production performance of the calf due to proper sire EPD selection, and the age equality of the calves allows for them to uniformly compete for feed. These two factors lead to an observed pre-conditioning phase cost-of-gain that was $0.05/lb. lower than for the base sire group. The cost-of-gain savings was even larger when comparing the High-Accuracy sire group to the other sire groups.

Feedlot

McDonald and Schroeder (2003) estimate the relative ranking of factors contributing to fed cattle profitability. Important feedlot variables, beyond cost of the feeder calf, represent feed conversion, average daily gain, and corn price. Mitigating corn price uncertainty lies with hedging. Typically, feed conversion and average daily gain are attributed to the feedlot management. However, sourcing uniform lots of animals with known production performance makes possible reduction in feedlot management variability, thus, reducing feedlot's costs.

To assess and compare the feedlot performance of animals in the pilot study presented here, summary statistics for the feedyard portion of the study are listed Table 3. We also make production performance comparisons based on proprietary data. Several key factors are observed from feed-out data.

In comparing the High-Accuracy sire group calves to the industry average, some noticeable observations should be noted. While the High-Accuracy sire group calves performed well in comparison to peer sire groups in the pilot study, the comparison to the industry average was not as stark in difference. One difference was that the High-Accuracy sire group has a feedlot cost-of-gain lower than the seasonal cost-of-gain observed for the industry.

Calf days-on-feed was similar to the industry average, but this can differ by in-weight into the feedlot. Therefore, not much should be garnered from this similarity. Average daily gain for the High-Accuracy sire group was observed to be similar to the industry average. However, the High-Accuracy sire group feed conversion was nearly one pound higher than that observed for the industry. The difference in feed efficiency between the High-Accuracy calf sire group and the industry average may reflect production seasonality or breed differences.

Recall, all sire groups were subject to a pre-conditioning program. Gardner et al. (1999) found significant improvement in feedlot performance and reduced medical costs due to pre-conditioning. For the current study all calf sire groups had a reported health cost and percent sick at or below expected levels due to the pre-conditioning program. But, what about the advantage of timed/synchronized AI?

In comparison to the Natural Service calf sire group, all three AI calf sire groups were found to have a significant lower per head health cost and lower percentage of sick animals. Thus, the results presented here are consistent with the work of Gardner et al. An interesting finding from our study was the treatment cost per head and percent of treated calves for the High-Accuracy calf sire group, which performed extremely well. Only 4.17 percent of the High-Accuracy calf sire group were treated, for an average per head cost of $1.22. These numbers were very low in comparison to the other calf sire groups in the study. The good health performance for the High-Accuracy calf sire group may be due to the use of proven genetics.

Production performance predictability has significant cost savings to feedlot managers in the form of reduced labor and management costs. Production and marketing uniformity are important factors in delivering consistent quality in a cost efficient manner. Pen uniformity is an important determinant of whole pen profitability at the feedlot and processor level, and efficiency gains are obvious from a more uniform pen – less competition at the bunk, less sorting prior to selling, and better predictive power of weight level (Kovanda, Schroeder, and Wheeler, 2004). Tables 1 through 3 indicate the high predictability of feedlot performance factors for calves from cows bred using synchronization and proven genetics.

Cost of gain represents a measure of potential profitability relative to average daily gain and feed efficiency. Increasing the predictability of cost of gain makes the value of feeder calves more predictable. Furthermore, a reliable cost of gain estimate makes hedging profit margins more attractive to cattle feeders. The cost of gain for High-Accuracy animals is tightly distributed with few animals falling in the upper extreme of cost of gain.

Fewer days of age can be attractive for two reasons. Firstly, fewer days of age means a faster return on investment. Secondly, because of mad cow concerns, finishing animals in a timely manner is attractive in some market places (e.g., Japan). Over 90 percent of the High-Accuracy cattle are between 12 and 14 months of age.

Carcass Merit

Processing performance summary data was computed, by sire group (Table 4). The data highlight the superior quality of the High-Accuracy sire group calves. These animals performed well on a quality-grade basis, which ultimately will translate into more dollars for producers. The High-Accuracy calf group graded 100 percent Choice or better and 66 to 67 percent CAB or better. The aggregated sire group only yielded 36 percent CAB or better.

For the beef industry the percent of beef in the prime quality grade has remained steady over time. The same was not true for choice and select quality grades; these grades have converged from 1990 to 1997, with less beef falling into the choice category and more into the select category. From 1997 forward, the percentage of beef cattle earning the quality-grade Choice or Select has been approximately 55 and 40 percent, respectively. The beef industry continues to strive for higher quality grade cattle.

The High-Accuracy sire group had the second lowest yield grade, but six percent of the animals in the sire group were yield grade 4 (Table 4). In general, the percentage of YG4 was below the typical processing plant average for the given time of year.

Fed cattle age was an important component of profitability when looking at profitability on a per day of ownership basis. As an owner of cattle, one most likely looks to maximize daily profit across the year. The High-Accuracy calf sire group, on average, was 3/10 to one month younger at processing than the other sire group calves.

Almost 60 percent of the High-Accuracy sire group had a carcass weight between 650 and 700 pounds, and approximately 95 percent of High-Accuracy calves have a hot carcass weight between 600 and 750 pounds. This indicates a high probability of predictability and uniformity.

Economic simulation

Economic simulation was carried out for each sire group using collected production and carcass performance data. Base price as well as quality and yield grade premiums and discounts were allowed to vary over a five-year period. Feed cost represents the average cost for the period of the feed out and the corn cost is not allowed to vary. We chose to avoid making feed cost dynamic, as many other beef production factors vary seasonally and we did not want to interject feed cost production performance cross-tab correlation matrixes into the analysis without a better understanding of such relationships. Cost of calf was computed by using a three-year weighted average of Missouri calf price adjusted for the price slide following Dhuyvetter et al., 1996.

Table 5 presents partial budget analysis by sire group for cattle in the study. Revenue represents the average revenue observed using five years of base price and grid value information. Net return values are reported as $/head, $/cwt, and $/day of ownership. Net returns are computed from weaning to pre-conditioning, from weaning to slaughter, and from sale barn (post-conditioning) to slaughter.

Gross revenue per head was largest for the High-Accuracy sire group. While the High-Accuracy sire group was lighter than Low-Accuracy sire group, the higher carcass performance of the High-Accuracy calves more than offsets the weight difference when comparing revenue per head. The High-Accuracy sire group was observed to be more uniform in gross revenue performance.

Feedlot cost per head was least for the Natural Service and High-Accuracy sire group calves. The difference in the $/head cost was due to days of feed, feed efficiency, cost of calf, and treatment cost.

We computed a representative value of calves at weaning based on projected feed lot production performance and carcass merit by sire group. The values on lines W and X represent the value a cattle buyer could pay and be no better off relative to calf performance and carcass merit. For example, the line X value for the High-Accuracy sire group indicates a value of $112.48/head breakeven to the cattle buyer. The value of $5.57/cwt. below the $112.48 presents the difference between actual and able value paid. The largest discrepancy lies between High-Accuracy and Natural Service sire group calves of $13.43/cwt. ($5.57- (-$7.86)). This represents a nearly $80/head difference in value at the feeder calf age between calves with proven genetics and calves with unknown genetics. The relative difference between sire groups should hold regardless of cattle buyer profit margin.

Lastly, we conducted a Monte-Carlo simulation of the economic returns for the alternative sire groups. Using sire group averages and measures of dispersion where applicable 1,000 random draws of data were pulled for each sire group. Table 6 provides the distribution and summary statistics from the simulation results. While the average revenue per head is higher for the High-Accuracy sire group calves, as reported by the coefficient of variation the distribution of returns is also much tighter for the High-Accuracy sire group calves. A beef herd manger, involved with or considering, retained ownership will want to consider separating High-Accuracy calves to achieve consistent economic results. The Mixed sire group calves represents a typical lot of mixed genetic animals, and this comingling tends to mitigate the advantages of targeting genetics.

Conclusions

Our research analyzed whether genetic coordination and timed/synchronized artificial insemination can be used at the cow-calf production level to better predict calf feed-out efficiency and carcass traits, while simultaneously minimizing the loss of individual beef producer management decision making rights. That being understood, can genetic coordination and synchronization of breeding substitute for the differences in management decision making across beef herds?

While mixed breed female seedstock are used in this study, all of the sires are Angus. Furthermore, the analysis is based on one year of data. Thus, future research may assess whether the findings hold more broadly, as well as the potential for bundling production practices and improving genetic verification within the beef industry. There may be opportunities for producers to capture additional value by combining source, health, and process verification practices. However, further investigation is required to confirm this possibility. The information can be used to better determine enhanced feeder calf value, achieving critical mass, and providing optimal information to buyers.

Three important questions were answered regarding use of genetics and timed artificial insemination to reduce variability across calves in terms of cow-calf management, feed yard performance, and processing. Results indicate significant production performance gains and economic gains due to coordinated genetics and timed artificial insemination. An economic advantage of over $70/head was realized for feeder calves from cows synchronized bred to high-accuracy sires relative to calves from cows bred to natural service sires.

We believe the economic advantage to be a conservative estimate based on the assumptions we used. Kovanda, Schroeder, and Wheeler (2004) point out the lack of transparency in grid pricing and how the grid price may differ from the actual value available to packers. Johnson and Ward (2005) find that low quality grade carcasses were undervalued more than high quality carcasses were given premium value. We believe the high quality grade carcasses are undervalued because the true value of reliability within the beef industry is yet unknown. So, delivering predictable high quality grade carcass cattle on a reliable basis and of sufficient numbers will have high value to the beef value chain.

Two institutional limitations of this project relate to quantity needed to develop a branded beef product and to access to veterinarians trained for ultrasound cows for pregnancy. Discussion with industry personnel indicates a desire to source approximately 25,000 head per year to attract end-user interest in sourcing these animals for a branded beef program. By comparison, Missouri cow-calf producers annually produce 2.5 million calves. Seasonal delivery requires changes in calving management for a more seasonally uniform pattern. In order to adequately forecast animal availability, actual pregnancy must be determined. Ultrasound best determines pregnancy and at times fetal sex. Unfortunately, in addition to a shortage of large animal veterinarians, many existing veterinarians are not trained, nor have equipment, to ultrasound animals. The lack of ultra-sounding practitioners causes logistical challenges.

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Table 1. Weaning characteristic summary by sire group

	Natural service	Calving ease	Low-accuracy	High-accuracy	All
Number of animals	93	36	101	96	328
Weaning weight (lbs., average for sire group)	490	527	573	509	522
Weaning age (months)	6.13	7.28	7.02	6.55	6.66
Weaning age (days)	183	218	210	196	199

Table 2. Pre-conditioning performance summary by sire group

	Natural service	Calving ease	Low-accuracy	High-accuracy	All
Number of animals	93	36	101	96	328
Days Preconditioned	53.32	55.95	55.39	55.75	54.97
Average daily gain (lbs., average for sire group)^^	2.01	2.76	2.03	2.86	2.34
Cost per lb. of gain (average for sire group)^^	$0.55	$0.49	$0.54	$0.45	$0.50
Feed conversion (average for sire group)^^	6.32	5.68	6.19	5.18	5.79

^^ Out weight was computed on a shrink weight bases, or the in weight into the feedyard

Table 3. Feedlot performance summary by sire group

	Natural Service	Calving Ease	Low-accuracy	High-accuracy	All
Number of animals	93	36	101	96	328
In weight (lbs., average for sire group)	597	681	685	668	650
Days on feed (average for sire group)	178	177	163	154	165
Average daily gain (lbs., average for sire group)	2.80	2.49	2.75	2.89	2.78
Feed conversion (average for sire group)	6.55	7.49	7.14	6.91	6.93
Cost per lb. of gain (average for sire group)^	$0.49	$0.52	$0.51	$0.49	$0.50
Outs (%, average for sire group)	0.00%	5.56%	0.00%	0.00%	0.61%
Treatment cost ($/head, average for sire group)	$11.88	$3.94	$3.20	$1.22	$5.17
No. Sick (% of sire group)	39.78%	11.11%	12.87%	4.17%	17.68%

^ Does not include interest charge

Table 4. Processing performance summary by sire group

	Natural Service	Calving ease	Low-accuracy	High-accuracy	All
Number of animals	93	36	101	96	328
Hot weight (lbs., average for sire group)	646	660	690	669	664
Age (months, average for sire group	13.88	14.76	14.32	13.59	14.03
Dressing percentage (average for sire group)	59%	61%	61%	60%	60%
Quality Grade (% of sire group)					
Prime	0.00%	5.56%	4.95%	15.63%	6.71%
Choice	67.74%	80.56%	71.29%	84.38%	74.70%
Select	32.26%	13.89%	22.77%	0.00%	17.68%
Standard	0.00%	0.00%	0.99%	0.00%	0.30%
% Choice or better	67.74%	86.11%	76.24%	100.00%	81.40%
% CAB (of sire group)[a]	13.98%	55.56%	13.86%	51.04%	29.27%
% CAB and better (sire group)	13.98%	61.11%	18.81%	66.67%	35.98%
Yield grade (% of sire group)					
YG1	2.15%	0.00%	3.96%	2.08%	2.44%
YG2	60.22%	50.00%	47.52%	54.17%	53.05%
YG3	35.48%	47.22%	44.55%	37.50%	39.94%
YG4	2.15%	2.78%	3.96%	6.25%	3.96%
YG5	0.00%	0.00%	0.00%	0.00%	0.00%
Average yield grade	2.38	2.53	2.49	2.48	2.46
Ribeye area (average for sire group)	11.54	11.38	11.75	11.98	11.72

* The cattle here represent animals processed before Certified Angus Beef allowed for VG4 animals to qualify for CAB

Table 5. Economic partial budgeting for retained ownership beyond weaning

Economic partial budgeting for retained ownership beyond weaning, and for the purchase of animals from salebarn to feed out

		Natural service	Calving ease^	Low-accuracy	High-accuracy	All
Number of cattle		93	36	101	96	328
Revenue ($/cwt)						
	Price per cwt. (Average Grid)*					
	Live weight (avg.)	1098	1084	1134	1115	
	Revenue per $/cwt, dressed weight*	$143.71	$148.13	$145.05	$153.90	$147.64
	Avg. dressed weight (lbs)	646.4	660.2	690.3	669.3	664.19
A.	Revenue per head	$928.94	$977.96	$1,001.29	$1,030.01	$980.52
B.	Value of calf at weaning ($/head)	$613.68	$640.24	$670.65	$627.55	$634.45
	B1. ($/cwt.)^^	$125.24	$121.40	$117.06	$123.23	$120.95
C.	Value of calf post pre-conditioning ($/head)	$672.83	$722.19	$724.27	$714.59	$702.21
	C1. ($/cwt.)^^	$112.66	$105.93	$105.67	$106.91	$107.40
Cost ($/head)						
pre-conditioning						
D.	pre-conditioning feed cost	$58.91	$75.39	$60.81	$70.91	$64.45
E.	Interest for pre-conditioning period	$7.52	$8.31	$8.51	$8.10	$8.04
F.	Total variable pre-conditioning cost (D + E)	$66.43	$83.70	$69.32	$79.01	$72.49
Feedlot						
G.	Yardage fee ($0.39/day)	$69.61	$69.12	$63.59	$60.24	$64.54
H.	Feed cost	$162.94	$157.80	$160.74	$155.85	$158.63
I.	Treatment	$11.88	$3.94	$3.20	$1.22	$5.14
J.	Cost of calf (Three -year avg. of MO weighted avg. for relevant time period)	$672.83	$722.19	$724.27	$714.59	$702.21
K.	Interest on feedlot costs (calf cost + 1/2 other costs)	$58.61	$62.26	$62.01	$60.85	$60.35
L.	Total feedlot cost per head (G+H+I+J+K)	$975.88	$1,015.30	$1,013.81	$992.75	$990.87
M.	Total pre-conditioning cost forward (B+ D+G+H+I & interest)	$983.15	$1,017.05	$1,029.50	$984.72	$995.61
Returns *($/head)*						
N.	From weaning to post pre-conditioning (C - B - F)	$(7.27)	$(1.75)	$(15.69)	$8.03	$(4.73)
O.	From weaning to slaughter (A - M)	$(54.21)	$(39.09)	$(28.21)	$45.29	$(15.09)
P.	From salebarn to slaughter (A - L) *($/cwt)*	$(46.94)	$(37.34)	$(12.52)	$37.25	$(10.36)
Q.	From weaning to post pre-conditioning ((C - B - F)/ (weight gain))	$(6.78)	$(1.13)	$(13.94)	$5.05	$(3.68)
R.	From weaning to slaughter ((A - M) / dressed cwt.)	$(8.39)	$(5.92)	$(4.09)	$6.77	$(2.27)
S.	From salebarn to slaughter ((A - L)/ dressed cwt.)	$(7.26)	$(5.66)	$(1.81)	$5.57	$(1.56)
($/day of ownership)						
T.	From weaning to post pre-conditioning ((C - B - F)/ (pre conditioning days))	$(0.14)	$(0.03)	$(0.28)	$0.14	$(0.09)
U.	From weaning to slaughter ((A - M) / days)	$(0.23)	$(0.17)	$(0.13)	$0.21	$(0.07)
V.	From salebarn to slaughter ((A - L)/ days)	$(0.26)	$(0.21)	$(0.08)	$0.24	$(0.06)
Calf purchase breakeven price ($/cwt.)						
W.	Weaning	$114.17	$113.99	$112.14	$132.13	$118.59
	(difference from market, W-B1)	$(11.06)	$(7.41)	$(4.92)	$8.89	$(2.36)
X.	Post conditioning	$104.80	$100.45	$103.84	$112.48	$106.30
	(difference from market, X-C1)	$(7.86)	$(5.48)	$(1.83)	$5.57	$(1.10)

* Dressed weight value base price is $137.32/cwt. based on 50/50 choice/select pen of cattle. Premiums and discounts added to the base price based on actual performance of cattles for the specific sire group. Quality and yield grade premiums and discounts are based on historical USDA Agriculture Marketing Service reported values.

** Calculation includes interest charge on weaned calf value and 1/2 cost

Table 6. Distribution and statistical analysis from simulated 1,000 random draws of data between alternative sire groups

	Mean[a]	S.D.	Coefficient of Variation	Ho: HA mean = NS, CE, LA, or ML mean
High Accuracy (HA)	$65.26*	$16.13	25%	n/a
Natural Service (NS)	$21.53*	$15.56	72%	p = <0.01
Calving Ease (CE)	$53.56*	$17.47	33%	p = 0.01
Low Accuracy (LA)	$19.37*	$17.28	89%	p = <0.01
Mixed Lot (ML)	$37.05*	$16.37	44%	p = <0.01

[a] A * indicates the reported mean is statistically different from zero at the 1% level