SELECTING FOR EFFICIENCY

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INTRODUCTION

Why is efficiency so important to the beef industry? "Efficiency impacts unit cost of production, thereby having the potential to increase beef's competitiveness in both the domestic and global marketplace, to improve industry profitability, and to enhance long-term sustainability of the industry." (Ritchie, 2001). In simple terms, from a producer's standpoint, efficiency can make you more money by lowering costs, increasing returns, or both. But, only if measured, interpreted and implemented correctly.

BACKGROUND

In 1991 the Dave Gust family established the Circle A Angus Ranch with two main goals: 1) To produce the best genetics in the beef industry, 2) Provide service to customers in the best way possible. To Mr. Gust, the best possible genetics means producing a high quality beef product, and producing it profitably. The Gust family has remained disciplined and principled in their quest to define and produce profitable beef cattle genetics, following their motto, "Quality Beef Is Our Business." Beginning with 35 head of registered cows on 685 acres near Iberia, MO, Circle A has expanded to three locations encompassing over 25,000 acres and includes nearly 7,000 commercial females. The 700 head registered Angus herd is maintained at the headquarters near Iberia, MO along with 2000 developing heifers, the bull development facility and sale facilities. 2500 commercial cows are managed at each Circle A West near Stockton, MO, and Circle A North near Huntsville, MO. Circle A Feeders, a 5000 head, CAB licensed feedlot under roof is also operated at Circle A North. Circle A now markets over 450 bulls, 900 bred heifers, 20 registered females and 10,000 finished cattle annually.

In its infancy, to the outsider, Circle A appeared like many new, purebred operations. One of the first investments was an impressive show and sale facility and emphasis was placed on winning in the show ring. Behind the scenes, the Gust family was acquiring and developing seedstock that were to become the foundation of the entire registered and commercial operations and those seedstock were rapidly multiplied through use of artificial insemination, embryo transfer and cloning. After a short while in the purebred industry, Mr. Gust, a successful, self-made businessman, began to realize it was a zero net game. A great deal of cattle were bought and sold based on prefix or pedigree, or mutual back scratching with little regard to their actual profitability value as related to commercial beef production.

In 1996 Gust formulated the Angus Sire Alliance with the goal of measuring both the costs and returns of a sire's progeny in a real-world, commercial setting to help guide mating and selection decisions based on actual profitability. In its early stages, the Angus Sire Alliance was a membership-based organization including 51 progressive Angus breeders from 35 different states interested in improving the profitability of beef genetics. On the forefront of carcass and ultrasound data collection the Angus Sire Alliance aggressively collected feedlot and carcass data making Circle A the largest contributor of carcass data to the American Angus Association. While evaluating progeny returns was certainly an improvement over previous data, Gust quickly realized that a very critical component of measuring profitability was missing, costs. With feed comprising the vast majority of costs throughout the entire beef production industry, feed efficiency was certain to be a major driver for improved profit potential.

In 1998 Circle A constructed a feed intake research facility at their Circle A North location. The feeding research center was equipped with 96 Calan Broadbent Feeding Gates capable of collecting individual feed intake data on the progeny of 8 sires simultaneously. Shortly after beginning the feed efficiency work a partnership was formed between the Angus Sire Alliance and ABS Global to market semen on the high profitability sires. By 2003 ABS saw the advantages of providing such unique data to their customers and formed an exclusive relationship with Circle A to test promising, young Angus sires. Today, Circle A and ABS test 10-12 sires annually thorough the Sire Alliance program. The Calan gate feeding system has been replaced with a GrowSafe system capable of collecting individual feed intake measurements on 200 head simultaneously.

Since its inception, the Angus Sire Alliance has focused on progeny testing rather than individual sire testing in order to more accurately calculate the best breeding value predictors available, Expected Progeny Differences (EPDs). Dr. William Herring began calculating Circle A's in-herd EPDs for birth weight, weaning weight, weaning weight maternal, post-weaning average daily gain, marbling score, yield grade and dry matter intake for inclusion in the profitability index. Since Hazel's work first outlined genetic improvement based on selection indexes (Hazel, 1943), it has been well accepted that selection indexes are the best method for accomplishing multi-trait genetic progress based on profitability. The poultry and pork industries have used selection indexes for many years to make rapid genetic improvement; while its application to beef production has remained limited.

One limiting factor is the complication of determining the appropriate economic weights assigned to each trait. For the purpose of the Angus Sire Alliance, computer software SIMUMATE 3.0, described by MacNeil et al. (1994) was used to determine the relative economic values (REV) for each trait. The REV value is defined as the marginal change in expected profit per progeny from increasing a particular trait by one unit (Herring, 2003). There were a total of 76 production and economic variables used in the simulation model, actual means from the test groups were used when possible and book estimates and 10 year production history were used where appropriate. Table 1 shows the REV used.

Table 1. Economic weights for selection index for profit for 2001

Traits	Economic Weights	
	Actual, $ trait unit[-1]	Standardized, $
Birth weight	-1.95	-10.1
Weaning weight	.408	11.6
Post-weaning average daily gain	43.6	10.2
Daily dry matter intake	-10	-10.9
Marbling	17.2	7.2
Yield grade	-32.9	-10.0

(Herring, 2002)

POTENTIAL FOR COMMERCIAL PRODUCERS

With the new reality of corn priced at $6/bushel, and ever elevating land costs, imagine the cost savings of being able to improve feed efficiency by 10%. In Table 2, Weaber estimates the potential annual savings to the U.S. beef industry at over 1 billion dollars.

Table 2. Impact of a 10% reduction in feed intake

In Wt.	Out Wt.	Lb. Gain	ADG	DOF	RFI	Reduced Feed Intake	Feed Cost Savings	% of Fed Mix	Feed Cost Savings
Calf Feds									
600	1250	650	3.5	186	0.0	0	-		
600	1250	650	3.5	186	-2.0	-371	$31.57	34	$426,214,286
Yearling Feds									
775	1300	525	4.0	131	0.0	0	-		
775	1300	525	4.0	131	-2.0	-263	$22.31	66	$584,718,750
							Total Savings		**$1,010,933,036**

Annual fed slaughter: 27 million; Delivered feed cost: $250/ton

(Weaber, 2009)

While the obvious greatest advantage lies with the feeding sector, the economic and genetic advantages of improved feed efficiency are realized throughout the entire industry. Although not historically a perfect relationship, improved profitability for one sector eventually translates to increased profitability for all sectors. Calves known to be bred for, or out of seedstock bred for, improved feed efficiency will undoubtedly have increased value to feeders leading to higher calf prices for those genetics. Producers of such genetics will also reap greater gains on less feed during the pre and post weaning periods prior to marketing.

Although the relationship between improve feed efficiency in the feedlot and improved pasture efficiency of heifer-mates is not entirely quantified, one would surmise that a positive relationship likely exists. Dr. Monty Kerley at the University of Missouri and other researchers around the country are working on better understanding that relationship. As seedstock producers select for improved feed efficiency in feed lot cattle, we very likely

could be selecting for cows that can maintain their body condition on less inputs; allowing producers to achieve higher breeding rates, reduced feed costs, and/or higher stocking rates.

At present, genetics selected for improved feed efficiency exists in limited quantity. Several bull test stations and even a few private breeders have invested in feed intake measurement technology with most being able to provide customers with actual feed intake differences in the individual tested animals. Genomic companies offer tests to determine the presence of markers linked to feed efficiency describing varying proportions of the genetic variance. Only Circle A and ABS have gone as far as to conduct randomly mated progeny tests and collect feed intake data for over a decade and compute EPDs based on their findings. These results are available exclusively from ABS global in their AI sires and in Circle A Premium Bulls marketing through Circle A Angus. Table 4 is an example of how ABS presents this data to the beef industry.

Table 4. Angus Sire Alliance results for feed efficiency as presented by ABS Global

		Feed Efficiency Index	Feed Efficiency %Rank	ADG EPD (lb/day)	ADG %Rank	Intake EPD (lb/day)	Intake %Rank
1	BANDWIDTH	$24.52	Top 1%	+.21	Top 1%	+.13	
2	PROTÉGÉ	$22.35	Top 1%	+.17	Top 1%	-.03	
3	POWER DESIGN	$19.89	Top 1%	+.22	Top 1%	+.45	
4	MAJOR DESIGN	$18.12	Top 1%	+.15	Top 3%	+.06	
5	DAYBREAK	$15.34	Top 2%	+.16	Top 2%	+.28	
6	POUNDMAKER	$14.48	Top 2%	+.10	Top 10%	-.09	Top 25%
7	ALLIANCE I87	$13.94	Top 3%	+.09	Top 15%	-.13	Top 20%
8	NEW LEVEL	$13.17	Top 3%	+.12	Top 10%	+.12	
9	FORESIGHT	$12.07	Top 3%	+.11	Top 10%	+.11	
10	PREFERENCE	$11.39	Top 4%	+.23	Top 1%	+.98	
11	EXCEED	$10.99	Top 5%	+.08	Top 20%	-.04	Top 30%
12	SHEAR FORCE	$9.10	Top 10%	+.12	Top 10%	+.34	
13	PRECISION 1023	$8.70	Top 15%	+.15	Top 3%	+.57	
14	4 POINT 8	$8.64	Top 15%	+.04		-.19	Top 10%
15	TRAVELER 234D	$8.49	Top 15%	+.01		-.39	Top 3%
16	PRIME CUT 0145	$8.41	Top 15%	-.09		-1.08	Top 1%
17	INNOVATOR	$7.36	Top 15%	+.03		-.19	Top 10%
18	EXTRA K205	$7.28	Top 20%	+.10	Top 10%	+.30	
19	MAINLINE	$7.25	Top 20%	+.13	Top 5%	+.51	
20	ANALYST	$6.92	Top 20%	+.09	Top 15%	+.25	
21	NEW STANDARD	$6.80	Top 20%	+.03		-.16	Top 15%
22	NEW DESIGN 458N	$6.15	Top 25%	+.12	Top 10%	+.50	
23	GRAHAM 52170	$5.69	Top 25%	+.03		-.10	Top 20%
24	OBJECTIVE	$5.44	Top 30%	+.09	Top 15%	+.33	
25	RITO PRIME	$4.92		+.06	Top 30%	+.15	

(Frank, 2009)

It is important to understand the various measurements of feed efficiency, their meanings and applications. Feed conversion (or it inverse, feed efficiency) is the units of feed consumed divided by the units of animal gain over a specific time period (Herring, 2002). It is what producers commonly refer to when they say their cattle gained at 6:1, that's six pound of feed per one pound of gain. This measurement alone can be misleading and

selection for this single trait does not necessarily lead to improved profitability as Table 3 shows three groups of cattle with the same feed conversion, but differing average daily gains and feed intake levels.

Table 3. Example of cattle with feed conversion of 5.5 lb dry matter intake per lb of gain but differing growth and intake rates

Growth rate	ADG, lbs/d^{-1}	Daily DM Intake, lbs/d^{-1}
High	4.0	22.0
Medium	3.0	16.5
Low	2.0	11.0

(Herring, 2002)

Favorable feed conversion ratios can be obtained with little gain and little intake, or high gains and high intake; both not desirable for genetic improvement. To avoid these problems Koch et al. (1963) proposed using residual feed intake (RFI) as a measure of efficiency. RFI uses a regression equation including an animal's growth rate and body weight to determine the amount of feed the animal would be expected to consume. The difference between the animal's actual consumption and predicted consumption is the RFI value. Animals with a lower RFI value consumed less feed than predicted. Most producers today seeking genetic improvement in feed efficiency are using the RFI value. The Angus Sire Alliance selection index model does not use the RFI value as it uses both the average daily gain and feed intake as separate trait with their own relative economic values assigned to each.

INDUSTRY CHALLENGES

The most obvious challenge is the expense and difficulty involved in collection of feed efficiency data. Individual measurement of feed intake on bulls is a relatively reasonable collection expense, but is limited in its ability to increase the accuracy of an EPD in a similar fashion of an individual birth, weaning or yearling weight. For higher accuracy EPDs to be achieved, well designed progeny tests have to be constructed and carried out at considerable expense. A growing portion of the breeding value can be determined through use of marker assisted selection making screening for potential candidates for testing easier. However, this screening method will overlook sires that are exceedingly feed efficient due to genetic combinations not tested for in marker assisted selection. These bulls potentially have a greater genetic value as they could prove to obtain valuable genetics for which genetic tests cannot currently measure.

CONCLUSIONS

It is generally agreed that improved feed efficiency, if measured, interpreted and implemented correctly can lead to significant improvement for profitability in the U.S. beef industry. There are obvious direct benefits for the feeding sector with periphery, but still significant benefits for the commercial cow/calf producer. With high accuracy EPDs being the measuring stick for animal selection and genetic improvement, selection for improvement in the area of feed efficiency is currently limited, but growing. Commercial producers seeking improved genetics for feed efficiency will have to actively seek out genetic sources that have invested the resources in collecting such data. Bull tests, private breeders,

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universities and semen companies have invested in such data collection. Commercial producers must then determine the value of the data being presented and how they can best implement such data.

After over a decade of using progeny testing, EPDs and profitability indexing at Circle A Angus the multi-trait genetic improvement is evident. By using the in-herd EPDs described here along with in-herd EPDs for heifer pregnancy, and cow stayability, and then calculating a maternal profit index as well as the terminal profit index, significant improvements in profitability have been made in all facets of Circle A's production. Increased fertility allows cows to breed in a lower body condition score permitting the ranch to increase stocking rates while improving or maintaining breeding percentages. Feed conversion consistently runs in the mid 5:1 ratio with gains hovering around 3.5 lb/day over the entire feeding period on a very high percent co-product ration. Over the past year carcass weights have averaged 771 lbs, with a ribeye area of 12.8 sq. inches, .51 inches of backfat, averaging a 2.7 yield grade and grading 98% Choice or Prime with over 40% achieving Certified Angus Beef (CAB).

"It is often believed today that successful breeders have some sort of mysterious methods of which others are ignorant. Instead, the principles of the successful breeders have been exceedingly simple…The difficulty is not so much in knowing the principles as in applying them." - Sewall Wright (1920)

Much of the science to measure and calculate relative feed intake and profitability-based selection indexes has been known for well over half a century. Although feed costs comprise the vast majority of production expense in beef cattle, little has been done to date to select for improvement in this area. Obviously, few commercial operations, or even seedstock operations, are of the scale necessary to make the investment in collecting feed intake data feasible. However we choose to measure feed efficiency, feed intake, feed conversion, residual feed intake, or net feed intake; the result is still but one piece of the genetic selection puzzle. Until proven different, profitability-based selection indexes will still be the gold standard by which multi-trait genetic progress is made. Not only can commercial producers not manage what they don't measure, they can't manage what their genetic suppliers don't measure. Seek sources of genetics that are measuring and selecting for a variety of traits that directly affect your bottom lines.

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