

THE RELATIONSHIP AMONG TRAITS MEASURED IN A BEEF PERFORMANCE TESTING PROGRAM AND THEIR EFFECT ON SALES PRICE

Mark Johnson¹, J.R. Kropp², C.A. McPeake² and D.S. Buchanan²

Story in Brief

Performance data were collected on 1183 Angus, 519 Hereford and 601 Polled Hereford bulls completing a 140-day test at Oklahoma Beef, Inc. from 1981 to 1987. On-test weight, hip height and scrotal circumference were collected on all bulls. Off-test measurements of weight, hip height and scrotal circumference, as well as ribeye area and rib fat as measured by scanogram, were obtained. The objective of the study was to determine relationships among measurements of growth and other performance traits of bulls tested in a central bull test station. In addition, performance records on 448 bulls tested and sold at Oklahoma Beef, Inc. from 1983 to 1987 were used to determine the influence of performance measurements on the selling price of performance tested bulls. On-test height and on-test weight were strongly correlated to off-test height and weight. However, average daily gain during test was poorly correlated with on-test height or weight. Ribeye area was strongly correlated to all weight traits, but fat thickness was poorly correlated to all traits. In each breed, off-test weight and off-test height were the highest correlated traits with selling prices. Less than 40% of the variation in selling price was accounted for by performance criteria.

(Key Words: Beef, Cattle, Performance Testing.)

Introduction

In order to increase herd productivity, and hopefully, profitability, cattle producers need to emphasize economically important traits (fertility, growth, maternal traits and carcass merit) in their selection programs. Since sire selection is responsible for most of the genetic improvement in a particular herd, sound choices of potential herd sires are of utmost importance. Evaluation and comparison of bulls from a variety of breeders managed in

¹Graduate Student ²Professor

different environments may make herd sire selection very difficult. One method of decreasing some of the variation among bulls, especially during the post-weaning phase, is central bull testing. Central bull test stations provide both purebred and commercial cattlemen an opportunity to compare and evaluate bulls managed under common nutritional and environmental conditions.

In light of the current selection trends in the beef cattle industry toward larger framed cattle with greater growth potential, buyers need to understand relationships among performance measurements of growth and other economically important traits as they evaluate bulls for their particular breeding program. In addition, it may be helpful for potential buyers to know the extent to which various performance traits have contributed to selling price in the past.

The objectives of this study were to evaluate the relationships among measurements of growth and other performance traits as well as to determine the influence of performance measurements on the selling price of performance tested beef bulls.

Materials and Methods

Performance data were collected on 1183 Angus, 519 Hereford and 601 Polled Hereford bulls completing the 140 day test at Oklahoma Beef, Inc. during the period from 1981 to 1987. The bulls, approximately 7 to 8 months of age upon delivery to the test station, were allowed a two-week warm-up prior to starting the official gain test. Initial measurements of hip height, weight and scrotal circumference were taken on all bulls. Upon completion of the 140-day test, final measurements of hip height, weight, scrotal circumference, rib fat thickness and ribeye area were obtained. Ribeye fat thickness and ribeye area were estimated with a scanogram manufactured by the Ithaca Company, Ithaca, New York. Hip height growth rates and average daily gains were calculated by using on-test and off-test measurements.

Performance records were correlated with sale prices of 448 bulls that sold from 1983 to 1987 to determine the influence of various performance traits on the selling price of performance tested beef bulls. Variables included were off-test measurements of hip height, weight, average daily gain, rib fat, ribeye area and scrotal circumference along with the sale price of 208 Angus, 94 Hereford and 146 Polled Hereford bulls that sold in eight Oklahoma Beef, Inc. All Breed Performance Tested Bull Sales from 1983 to 1987.

Sale catalogs were available to buyers prior to each sale. The catalogs included identification of each bull, a two-generation pedigree, birth date and owner. Since the fall sale of 1985, expected progeny differences of each bull's

sire were also available if reported within the respective breed sire summary. Performance data reported in each catalog were: on-test weight, off-test weight, adjusted yearling weight, adjusted yearling height, scanogram measurements of ribeye area and ribeye fat, scrotal circumference, average daily gain and weight per day of age. In addition, the number of bulls within each test group as well as an index of on-test performance were included. The index was a composite score with basically three traits considered: average daily gain, weight per day of age and adjusted yearling weight.

The relationship among selling price and performance traits were evaluated by calculating the correlation between price and performance traits. Contributions of each trait to selling price for each breed were independently evaluated by using a multiple regression procedure to obtain partial regression of price on each performance trait. These regressions were obtained simultaneously for all the traits after accounting for variation due to year. The trait that contributed the least in each breed was removed from consideration and the analyses were repeated until only those traits that made significant contributions to selling price remained. In this way traits were ranked by magnitude of effect.

Table 1. Correlation coefficients among various performance traits.

Trait	1	2	3	4	5	6	7	8	9
On-test height (1)	1.00								
On-test weight (2)	**	1.00							
Off-test height (3)	**	**	1.00						
Off-test weight (4)	**	**	**	1.00					
Average daily gain (5)	**		**	**	1.00				
Height daily growth (6)	**	**	**	**	**	1.00			
Scrotal circumference (7)	**	**	**	**	**		1.00		
Ribeye area (8)	**	**	**	**	**		**	1.00	
Rib fat (9)	**		**	**	**	**	**	**	1.00

**Significance level ($P < .01$).

Results and Discussion

Phenotypic correlation coefficients associated with the performance traits measured during the study are presented in Table 1. On-test height and on-test weight were strongly and positively related to off-test height and off-test weight, indicating that taller, heavier bulls at the beginning of the test were also taller, heavier bulls at the end of test. However, average daily gain during the test was weakly correlated with on-test height and on-test weight. Taller, heavier bulls at the beginning of the test tended to grow at a slower rate in hip height than smaller framed bulls, as indicated by a negative correlation of $-.30$. Average daily gain was most highly associated with off-test weight ($r = .57$).

Ribeye area or muscling was strongly correlated to all weight traits, especially off-test weight ($r = .71$). However, degree of fatness as indicated by ribeye fat thickness was not strongly correlated to any trait.

Scrotal circumference was also positively correlated to all growth traits. Even though the correlations were small, heavier and taller bulls tended to have larger scrotal circumference measurements.

Table 2. Angus least squares means by year.

	1981	1982	1983	1984	1985	1986	1987
Number of bulls	212	221	235	190	134	118	73
On-test height (in)	43.6	43.9	44.2	44.6	45.2	45.9	46.0
Off-test height (in)	48.2	48.7	48.9	49.5	50.2	50.8	51.1
On-test weight (lb)	600	601	623	632	644	672	694
Off-test weight (lb)	1119	1135	1139	1183	1173	1226	1269
Average daily gain (lb)	3.70	3.81	3.67	3.94	3.78	3.96	4.11
Height daily growth (in)	.032	.034	.034	.035	.036	.035	.036
Scrotal circumference (cm)	----	37.26	37.29	38.1	37.44	37.70	38.86
Ribeye area (sq in)	13.2	13.1	13.8	13.4	13.5	14.1	----
Rib fat (in)	.42	.42	.43	.44	.41	.41	.24

The least squares means for Angus, Hereford and Polled Hereford bulls are presented in Tables 2, 3 and 4, respectively. From 1981 through 1987, the height and weight of bulls entered in the OBI Test Station in all three breeds increased appreciably, indicating an emphasis by breeders entering bulls in the test toward larger bulls. Off-test hip height increased over 2.5 in in all three breeds, while off-test weight increased over 139 lb. Average daily gain tended to increase slightly over the seven years; however, ribeye area and ribeye fat remained relatively constant. A slight trend for increased ribeye area during the later years of the study was noted. The hip height growth rates noted in all three breeds were similar to recommended adjustment factors by Beef Improvement Federation.

Correlations among the various off-test performance traits and selling price are presented in Table 5. With the exception of rib fat, all were significant and of favorable direction. Measures of off-test weight and height had the strongest correlation to selling price, although only moderate in value at .49 and .47, respectively. Relationship of rib fat and scrotal circumference to selling price was extremely weak. Moderate to low correlations between

Table 3. Hereford bulls least squares means by year.

	1981	1982	1983	1984	1985	1986	1987
Number of bulls	147	123	65	72	58	49	5
On-test height (in)	44.1	44.6	45.3	45.2	45.9	45.7	45.8
Off-test height (in)	48.7	49.3	49.7	49.9	50.8	50.5	51.2
On-test weight (lb)	634	648	662	680	709	701	687
Off-test weight (lb)	1093	1136	1173	1178	1247	1220	1242
Average daily gain (lb)	3.28	3.48	3.65	3.54	3.85	3.72	3.96
Height daily growth (in)	.032	.033	.032	.033	.035	.034	.038
Scrotal circumference (cm)	35.77	35.99	36.51	36.41	36.48	36.58	37.24
Ribeye area (sq in)	12.6	13.1	13.9	13.5	13.6	13.9	-----
Rib fat (in)	.31	.31	.28	.39	.44	.43	.44

Table 4. Polled Hereford bulls least squares means by year.

	1981	1982	1983	1984	1985	1986	1987
Number of bulls	123	117	115	77	63	46	60
On-test height (in)	42.9	44.0	44.9	44.9	45.8	46.4	45.4
Off-test height (in)	47.8	48.7	49.5	49.9	50.6	51.1	50.5
On-test weight (lb)	538	615	641	639	688	686	641
Off-test weight (lb)	1037	1113	1150	1165	1205	1237	1176
Average daily gain (lb)	3.56	3.56	3.63	3.76	3.70	3.94	3.83
Height daily growth (in)	.035	.033	.033	.036	.034	.033	.037
Scrotal circumference (cm)	----	34.96	35.55	36.33	36.62	35.87	36.07
Ribeye area (sq in)	12.4	12.7	13.4	13.4	13.8	13.9	-----
Rib fat (in)	.43	.43	.43	.40	.39	.41	.30

Table 5. Correlation coefficients between sales price and off-test traits.

Weight	Price .49**
Height	.47**
Ribeye area	.37**
Rib fat	.05
Scrotal circumference	.10*
Average daily gain	.32**

*Significance level: (P < .05).

**Significance level: (P < .01).

ribeye area and average daily gain with selling price were .37 and .32, respectively. Since the larger framed, heavier bulls tended to sell for the higher prices, breeders readily recognized the importance of frame and height. Therefore, the trend by breeders to emphasize on-test height and weight when entering bulls in the test station can be easily explained by the association of these two traits and subsequent selling price.

Table 6 presents the impact that a per unit change in each trait had on selling price. Only off-test weight and off-test height made significant contributions to selling price in the Angus and Hereford bulls, while average daily gain also contributed significantly in the Polled Hereford breed. Ribeye area, ribeye fat and scrotal circumference did not significantly contribute toward the variation in selling price in any breed. A 100 lb differential in off-test weight was associated with a \$233, \$258 and \$172 difference in selling price in the Angus, Hereford and Polled Hereford bulls, respectively. Even more pronounced was the importance of height. A one inch change in final height off-test was associated with a change in selling price of \$182, \$176 and \$195 in Angus, Hereford and Polled Hereford, respectively. The row headed

Table 6. Partial regressions of sale price on off-test traits.

Number	Angus 208	Hereford 94	Polled Hereford 146
Weight (\$/lb)	2.33**	2.58**	1.72*
Height (\$/in)	182.00**	175.56**	194.51**
Ribeye area (\$/sq in)			
Rib fat (\$/in)			
Scrotal circumference (\$/cm)			
Average daily gain (\$/lb)			285.53*
R ² b	.37	.38	.40

^aChange in price per unit change indicated for each trait.

^bProportion of variation in price accounted for by traits having coefficients for that breed.

*Significance level: (P < .05).

**Significance level: (P < .01).

R^2 indicates the proportion of the variation in selling price that can be attributed to the performance traits indicated. In this study, only 40% of the selling price variation in the Polled Hereford breed could be accounted for by off-test height, off-test weight and average daily gain. Off-test height and off-test weight accounted for 38% and 37% of variation in selling prices of the Angus and Hereford bulls, respectively. The additions of other factors into the model did not increase the percentage of the variation accounted for by the various performance traits.

A simple ranking of the traits obtained through these analyses is given in Table 7. These rankings indicate that measures of growth, most notably off-test height and weight generally had the greatest effect on selling price. Frame size has been a trait of major economic importance, primarily due to demand for larger, heavier, more efficient cattle. Breeders realized the significant impact of frame on selling price and simply tested larger framed, heavier bulls each year.

It is important to note that both sale order and the physical appearance of the bulls on sale day may have had a profound effect on these results. Certain bulls have phenotypic characteristics which may lead to an increase or decrease in price on sale day. The extent to which visual appraisal is used to determine price is unknown but may be quite large. In addition, certain pedigrees and bloodlines as well as expected progeny difference values of a bull's sire may have a significant impact on the selling price of performance tested beef bulls. The reputation of the breeder and his/her business relationships with potential customers may also have a significant bearing on selling price.

Table 7. Ranking of off-test traits in order of importance as contributors to sales price.

Number	Angus 208	Hereford 94	Polled Hereford 146
Weight	2	2	2
Height	1	1	1
Ribeye area	6	4	4
Rib fat	5	6	6
Scrotal circumference	4	5	5
Average daily gain	3	3	3