Growth Rates and Relationships Among Frame Size, Performance Traits and Scrotal Circumference in Young Beef Bulls

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Story in Brief

Hereford, Polled Hereford, Angus, Brangus and Charolais bulls showed an increase in on-test and off-test scrotal circumference as frame size increased when bulls were classified by groups according to their on-test frame size. When bulls were classified by groups according to their off-test frame size, no significant relationship between on-test or off-test scrotal circumference and frame size was observed although scrotal circumferences tended to increase as frame size increased. However, when weight was held constant, the relationship between hip height and scrotal circumference was near zero.

All breeds showed an increase in weight as frame size increased. Hereford, Polled Hereford, Angus and Brangus bulls showed an increase in off-test weight as frame size increased while Charolais bulls did not. Correlations between off-test hip height and off-test weight were moderate to high (average .56) for all breeds, while correlations between on-test or off-test hip height and average daily gain were low to moderate, averaging .14 and .33, respectively.

Overall, all breeds showed an increase in hip height growth rate as off-test frame size increased when bulls were classified into groups by their off-test frame size. However, when bulls were classified into groups by their on-test frame size, a decrease in hip height growth rate was observed as frame size increased.

Overall, no difference was observed between fat and frame size. Correlations between fat and other performance traits and scrotal measurements were generally low.

Hereford, Polled Hereford, Angus, Brangus and Charolais bulls all showed an increase in rib eye area as frame size increased. Pooled within class, correlation coefficients between rib eye area and off-test weight were high, averaging .73 for all breeds.

Introduction

With the trend in beef selection in the 1980's toward larger-framed, later-maturing bulls, many concerns have been expressed by cattlemen relative to the effect of increased size and body growth on the reproductive development and performance of the bull. Although extensive data exists on the relationship between body size and testicular growth, especially in dairy bulls, few results have been published concerning the relationship between reproductive development and skeletal size.

The purpose of this study was to evaluate the relationships between skeletal size as measured by hip height in young beef bulls and scrotal circumference, body weight, average daily gain, fat thickness and rib eye area.

Materials and Methods

This study utilized performance data and testicular measurements from Hereford, Polled Hereford, Angus, Brangus and Charolais bulls on test at Okahoma Beef, Incorporated, as outlined in the previous paper (Baker et al., 1982).

The hip height measurement was used as the basis for classifying each bull into a skeletal frame size group. The frame size classification used was based on adjusted hip height calculated as the number of days to the closest month of age multiplied by .03 in./day plus or minus the actual hip height depending on whether the actual hip height was nearer to the younger or older month of age (Hubbard, 1981). The actual classifications used in this study are presented in Table 1 and were developed from data collected on bulls (Prosser, 1978). Skeletal frame size is a classification system based on hip height at a certain age in months. In this study, hip height measurements were obtained and classified into a frame size. Data were separately analyzed for on-test and off-test frame size because some bulls changed frame size during the test period. Bulls were classified in a frame size when they went on test and remained in this group even though their frame size changed during the test. In addition, these same bulls were classified for off-test frame size and, for the purpose of analysis, were considered to be in the same off-test frame size regardless of what their actual on-test frame score was.

Table 1. Hip height measurement in inches to determine various frame sizes at different ages

Age in Months	Frame Size 1	Frame Size 2	Frame Size 3	Frame Size 4	Frame Size 5	Frame Size 6
6	35	37	39	41	43	45
7	36	38	40	42	44	46
8	37	39	41	43	45	47
9	38	40	42	44	46	48
10	39	41	43	45	47	49
11	40	42	44	46	48	50
12	41	43	45	47	49	51
13	41.5	43.5	45.5	47.5	49.5	51.5

Results and Discussion

Scrotal circumference and scrotal growth rates

When bulls were classified into groups on the basis of on-test frame size, there was an increase in on-test scrotal circumference in Hereford, Angus and Brangus bulls as frame size increased. Similar trends were observed in Polled Hereford and Charolais bulls (Table 2).

Similar trends were observed in off-test scrotal circumference of bulls based on their on-test frame size classification. Hereford and Brangus bulls showed an increase in off-test scrotal circumference as on-test frame size increased. Angus,

Table 2. Scrotal circumference least square means classified by on-test frame scores

Frame Score	2	3	4	5	6
Breed			**On-test**		
Hereford	22.9 ± .97^{d}	25.0 ± .34^{c}	26.0 ± .29^{b}	27.8 ± .55^{a}	
Polled Hereford	24.4 ± .94^{a}	25.3 ± .40^{a}	26.1 ± .41^{a}	25.7 ± .72^{a}	
Angus	27.0 ± .87^{bc}	26.7 ± .33^{c}	28.3 ± .28^{ab}	29.4 ± .76^{a}	
Brangus		26.2 ± .72^{c}	28.0 ± .56^{b}	28.7 ± .74^{ab}	29.5 ± 2.2^{a}
Charolais			24.2 ± 1.07^{a}	25.1 ± .55^{a}	26.3 ± .77^{a}
			Off-test		
Hereford	31.7 ± .78^{c}	33.3 ± .28^{b}	33.4 ± .25^{b}	35.5 ± .46^{a}	
Polled Hereford	32.2 ± .81^{a}	32.7 ± .36^{a}	33.3 ± .36^{a}	33.3 ± .61^{a}	
Angus	33.6 ± .93^{a}	34.7 ± .34^{a}	35.5 ± .29^{a}	36.4 ± .87^{a}	
Brangus		34.6 ± .59^{ac}	36.2 ± .40^{ab}	36.3 ± .55^{ab}	37.8 ± 1.6^{a}
Charolais			33.4 ± .97^{a}	34.7 ± .53^{a}	35.0 ± .71^{a}

[a,b,c] Means in the same row that do not share at least one superscript are significantly different by LSD test ($P < .05$).

Polled Hereford and Charolais bulls showed similar increasing trends in scrotal circumference as on-test frame size increased although these relationships were small (Table 2).

When bulls were classified into frame size groups on the basis of their off-test hip height, differences between scrotal circumference and frame size were generally not observed (Table 3). Thus, when bulls finished their 140-day test at approximately 12 months of age, there was little basic relationship between frame size and either on-test or off-test scrotal circumference. However, when bulls were classified into frame size groups on the basis of their on-test hip height, there was a tendency for larger-framed bulls to have larger on-test and off-test scrotal circumferences.

Table 3. Scrotal circumference least square means classified by off-test frame scores

Frame Score	2	3	4	5	6
Breed			**On-test**		
Hereford	25.6 ± 1.11^{a}	25.1 ± .46^{a}	25.8 ± .34^{a}	26.5 ± .49^{a}	
Polled Hereford		25.1 ± .40^{a}	26.3 ± .40^{a}	25.0 ± .76^{a}	
Angus		27.0 ± .42^{b}	27.4 ± .29^{b}	29.6 ± .56^{a}	
Brangus		27.5 ± .80^{a}	27.2 ± .54^{a}	29.2 ± .54^{a}	26.3 ± 2.29^{a}
Charolais			24.8 ± 1.55^{a}	25.6 ± .58^{a}	25.2 ± .82^{a}
			Off-test		
Hereford	32.8 ± .86^{a}	32.9 ± .35^{a}	33.8 ± .26^{a}	34.3 ± .38^{a}	
Polled Hereford		32.5 ± .34^{a}	33.4 ± .35^{a}	33.5 ± .65^{a}	
Angus		34.5 ± .41^{a}	35.1 ± .28^{a}	36.4 ± .52^{a}	
Brangus		35.0 ± .60^{a}	35.8 ± .39^{a}	36.6 ± .56^{a}	35.5 ± 1.70^{a}
Charolais			34.4 ± 1.23^{a}	33.9 ± .46^{b}	35.9 ± .64^{a}

[a,b] Means in the same row that do not share at least one superscript are significantly different by LSD test ($P < .05$).

Correlations between on-test hip height and on-test scrotal circumference were .43, .49, .32, .35 and .56 while correlations between off-test hip height and off-test scrotal circumference were .25, .33, .28, .23 and .12 for Hereford, Polled Hereford, Angus, Brangus and Charolais bulls, respectively. When pooled within class, correlations were calculated with weight held constant, and the correlations between hip height and scrotal circumference were near zero for all breeds. This indicates that weight, and not height, is responsible for the relationship between hip height and scrotal circumference.

The pooled-within-class correlation coefficient between scrotal circumference and on-test weight, averaged among breeds, was .62 while the correlation between off-test scrotal circumference and off-test weight, averaged among breeds, was .38. These results suggest a higher relationship between scrotal circumference and weight at 7 months of age than at 12 months of age.

Correlations between on-test scrotal circumference and scrotal circumference growth rate were highly negative, averaging -.66, suggesting that bulls with larger scrotal circumference at 7 months of age had slower scrotal growth until 12 months of age. However, correlations between off-test scrotal circumference and scrotal circumference growth rate were positive, averaging .39, suggesting that bulls with larger testicles off-test had a faster scrotal growth rate during the testing period. Therefore, measurement of scrotal circumference at yearling time may be a better indication of scrotal growth than a weaning measurement.

Body weight and performance traits

The larger framed, taller bulls were also the heaviest bulls on-test, regardless of breed (Table 4). Hereford, Polled Hereford and Angus bulls showed an increase in on-test weight of 222, 139 and 167 lb, respectively, as frame size increased from 2 to 5. Brangus bulls showed a similar increase of 208 lb as frame size increased from 3 to 6, and Charolais bulls increased 127 lb as frame size increased from 4 to 6. Correlations between on-test hip height and on-test weight averaged .67 for all breeds.

The larger framed, taller bulls on-test also tended to be the heavier bulls off-test, regardless of breed. Hereford, Polled Hereford, Angus and Brangus bulls showed an increase in off-test weight of 132, 118, 176 and 131 lb, respectively, as frame score increased from 3 to 6. Little difference was noted for yearling

Table 4. Body weight least square means classified by on-test frame scores

Frame Score	2	3	4	5	6
Breed			On-test		
Hereford	474 ± 25^d	546 ± 9^c	633 ± 7^b	696 ± 14^a	
Polled Hereford	491 ± 23^c	535 ± 10^c	578 ± 10^b	630 ± 18^a	
Angus	550 ± 21^c	586 ± 8^c	652 ± 7^b	717 ± 19^a	
Brangus		587 ± 14^d	637 ± 6^c	676 ± 14^b	795 ± 43^a
Charolais			634 ± 37^b	692 ± 19^b	761 ± 27^a
			Off-test		
Hereford	927 ± 32^d	1013 ± 13^c	1079 ± 10^b	1145 ± 14^a	
Polled Hereford		999 ± 12^b	1077 ± 12^a	1117 ± 23^a	
Angus		1054 ± 15^c	1118 ± 10^b	1218 ± 19^a	
Brangus		1066 ± 21^c	1080 ± 14^c	1197 ± 20^{ab}	1231 ± 60^a
Charolais			1253 ± 71^a	1204 ± 26^a	1287 ± 37^a

[a,b,c,d] Means in the same row that do not share at least one superscript are significantly different by LSD test ($P < .05$).

weights of Charolais bulls of different frame size.

Pooled-within-class correlation coefficients between on-test hip height and average daily gain for Hereford, Polled Hereford, Angus, Brangus and Charolais bulls were .00, .36, .25, .21 and -.10, respectively, suggesting little relationship exists between initial frame size and average daily gain on test. Correlations between off-test hip height and average daily gain were somewhat higher, averaging .33, but still low in terms of relationship.

When bulls were classified into groups on the basis of on-test frame size, there were no significant differences in average daily gain as on-test frame size increased, regardless of breed. However, when bulls were classified into groups by their off-test frame size, average daily gain increased as frame size increased from 3 to 6 for Polled Hereford, Angus and Brangus bulls, but not for Hereford or Charolais bulls. Hereford and Charolais bulls possibly would have shown the same relationship if these bulls had been taken to an older end point because the smaller framed bulls would be physiologically older. Thus, they would be more mature in their growth curve and gaining less weight.

Hip height growth rate

Hip height growth rate was similar for all breeds from approximately 7 to 12 months of age (.0328 in./day) (Table 5).

Table 5. Hip height growth rate least square means classified by on-test and off-test frame scores

Frame	2	3	4	5	6
Breed			**On-test**		
Hereford	.0359 ± .002^{a}	.0337 ± .001^{ab}	.0322 ± .001^{ab}	.0288 ± .001^{c}	
Polled Hereford	.0365 ± .002^{a}	.0331 ± .001^{ab}	.0299 ± .001^{abc}	.0309 ± .002^{c}	
Angus	.0389 ± .002^{a}	.0368 ± .001^{ab}	.0322 ± .001^{c}	.0305 ± .002^{c}	
Brangus		.0344 ± .002^{a}	.0319 ± .001^{a}	.0303 ± .002^{a}	.0295 ± .005^{a}
Charolais			.0383 ± .003^{a}	.0342 ± .002^{a}	.0310 ± .002^{a}
			Off-test		
Hereford	.0292 ± .002^{b}	.0310 ± .001^{b}	.0315 ± .001^{b}	.0351 ± .001^{a}	
Polled Hereford		.0310 ± .001^{a}	.0318 ± .001^{a}	.0358 ± .002^{a}	
Angus		.0303 ± .001^{b}	.0351 ± .001^{a}	.0368 ± .001^{a}	
Brangus		.0282 ± .002^{ac}	.0324 ± .001^{ab}	.0350 ± .002^{ab}	.0380 ± .005^{a}
Charolais			.0309 ± .004^{a}	.0324 ± .002^{a}	.0374 ± .002^{a}

^{a,b,c} Means in the same row that do not share at least one superscript are significantly different by LSD test ($P<.05$).

When bulls were classified into groups on the basis of their on-test hip height, there was a constant decline in hip height growth rate as frame size increased from 2 to 6. Larger framed bulls at the beginning of the test period grew more slowly in hip height than did smaller framed bulls to the completion of the 140-day test or approximately 12 months of age.

When bulls were classified into groups on the basis of their off-test hip height, all breeds showed an increase in hip height growth rate as frame size increased. Thus, bulls of larger frame size at 12 months tended to grow faster in hip height from 7 to 12 months of age than did bulls of smaller frame size, denoting differences in the physiological maturity and growth pattern of the bulls.

Differences in hip height growth rate between bulls classified by on-test and off-test frame size may possibly be explained by three points. First, the bulls went on test in varying degrees of condition, and there was no way to accurately measure preweaning effects of the dam, environmental conditions and (or) management of the bulls prior to arrival at the test station. Thus, bull calves that were on a higher plane of nutrition prior to arrival were possibly larger in their skeletal development due to preweaning influences but did not grow in height as rapidly as smaller framed calves in poorer body condition on arrival. Secondly, the physiological ages of the calves were different; thus, some bulls were simply earlier maturing in their growth pattern than others. Finally, there were no means of confirming the true birth date of all bulls.

These results suggest that a 12-month yearling hip height measurement is the best future indicator of hip height growth since maternal preweaning influences should have less drastic effects on frame size.

Fat thickness and rib eye area

There were no significant differences in fat thickness as frame size increased in any breed (Table 6). Correlations between fat thickness and all traits measured were generally low and not significant. All bulls in this study were fed similar high-energy rations and were of a fairly constant age on completion of test; therefore, little difference in fat deposition at the 12th rib would be anticipated at different frame sizes.

Table 6. Fat thickness and rib eye area least square means classified by off-test frame scores

Fat thickness					
Frame score	2	3	4	5	6
Breed			On-test		
Hereford	.31 ± .05[a]	.39 ± .02[a]	.39 ± .02[a]	.39 ± .02[a]	
Polled Hereford		.45 ± .02[a]	.44 ± .02[a]	.37 ± .04[a]	
Angus		.45 ± .02[a]	.45 ± .02[a]	.45 ± .03[a]	
Brangus		.44 ± .04[a]	.40 ± .02[a]	.45 ± .03[a]	.45 ± .10[a]
Charolais			.20 ± .05[a]	.20 ± .02[a]	.23 ± .03[a]
Rib eye area					
Hereford	12.1 ± .4[c]	12.5 ± .2[c]	13.0 ± .1[b]	13.7 ± .2[a]	
Polled Hereford		11.9 ± .1[b]	12.8 ± .1[b]	13.5 ± .3[a]	
Angus		12.9 ± .1[c]	13.5 ± .1[b]	14.4 ± .2[a]	
Brangus		12.6 ± .2[c]	12.6 ± .1[c]	13.4 ± .2[ab]	14.3 ± 1.5[a]
Charolais			15.1 ± 1.6[a]	14.9 ± .3[a]	15.3 ± .4[a]

[a,b,c] Means in the same row that do not share at least one superscript are significantly different by LSD test ($P<.05$).

When bulls were classified by off-test frame size, rib eye area increased as frame size increased in Hereford, Polled Hereford, Angus and Brangus bulls, but not in Charolais bulls. Correlations between off-test weight and rib eye area averaged .74 for all breeds, while correlations between off-test height and rib eye area averaged .47. However, when weight was held constant, the correlations between off-test hip weight and rib eye area were generally very low. Therefore, most of the relationship between hip height and rib area is probably due to weight.

Conclusions

Weaning and yearling frame size, as denoted by on-test and off-test hip heights, have marked influence on scrotal circumference, on-test weight, final weight, average daily gain, and rib eye area.

Hip height growth rates were similar for all breeds from weaning to yearling. However, a yearling hip height measurement is probably a more accurate growth indicator since maternal preweaning influences should have less drastic effects on frame size.

Literature Cited

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Factors Related to Ram Fertility During May and June

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Story in Brief

A flock of 160 Rambouillet ewes was purchased to combine with existing ewes to create 10 test groups to be used to measure the breeding effectiveness (aggressiveness and fertility) of rams. Two rams that showed little response in testicular circumference to the season of the year and two rams that responded strongly were tested to determine if this measurement was related to ram effectiveness in May and June. Three pairs of twin rams were used to determine if subjecting rams to reduced light for about 2 months before the breeding season would affect breeding effectiveness. One ram of each pair was subjected to reduced light, and one received normal light prior to the May-June breeding season. The rams selected to be more fertile on the basis of testicular size made considerably more matings and therefore sired more lambs than those thought to be less fertile, but so few rams were tested that cautious optimism prevails about the possibilities of using this procedure. The rams that were subjected to only 8 hours of light daily before breeding produced slightly higher conception rates than rams exposed to normal light, but the evidence that this was due to restricted light is inconclusive.

Introduction

Successful fall lambing is the result of an effective late spring (May-June) breeding season. Many sheepmen who attempt to lamb their ewes during the fall