Relationships of Hip Height Measurements with Growth and Carcass Traits of Crossbred and Angus Cattle

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Story in Brief

Hip heights were measured on 286 three-breed cross calves at weaning, yearling and slaughter time and on 199 Angus calves at yearling time to study the relationships of hip height with growth, feedlot performance and carcass traits when cattle are slaughtered at an anticipated grade of low choice.

Correlations between hip height and weaning, yearling and slaughter weight averaged .56. Yearling hip height (YHT) was more closely associated with feedlot ADG in crossbred cattle than was weaning hip height (WHT), .29 vs .14. The correlation of YHT with feedlot ADG was higher in Angus (.46). Hip height at slaughter (SHT) was not associated with rate of gain in the feedlot ($r = .02$). The correlations for Angus YHT with slaughter age and days on feed ($-.32$ and $-.33$) suggested taller Angus cattle at yearling time generally reached low choice with fewer days in the feedlot and were thus younger at slaughter. This relationship was not nearly as strong in the crossbred cattle (respective correlations of $-.04$ and $-.05$). Correlations of hip heights with carcass traits were generally low with a tendency for correlations to be higher in Angus cattle. Hip height was more highly correlated with carcass weight-per-day (averaged .31) than for other carcass traits.

Prediction equations were developed for feedlot ADG, days on feed, slaughter weight and rib eye area based on weight and hip height measurements. Comparisons among prediction equations were based on comparing coefficients of determination (R^2) which indicate the proportion of the variation in the predicted trait that is accounted for by the respective prediction equations. On average of crossbred and Angus groups, the order of predictability was slaughter weight ($R^2 = .78$), feedlot ADG ($R^2 = .66$), days on feed ($R^2 = .41$) and rib eye area ($R^2 = .23$). In general, weight was a more reliable predictor that hip height and combining hip height with weight yielded little practical improvement in predictability.

Introduction

Since the early 1900's, there has been considerable change in the concept of profitable type of beef cattle. The large, late maturing animal gave way to a smaller, earlier maturing type. More recently the trend has reversed with larger, later maturing cattle being favored. Several experiments have been conducted to compare performance and carcass traits on cattle of different breeds or types utilizing linear measurements. Few reports have been specifically con-

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cerned with the relationships between body measurements recorded early in life and subsequent growth, feedlot performance and carcass traits. This study was conducted to determine the correlations of hip height with growth, feedlot performance and carcass traits of three-breed cross and Angus calves when slaughtered at an estimated low choice carcass grade and to develop prediction equations for certain growth, feedlot performance and carcass traits using weight and height measurements.

Materials and Methods

The crossbred calves involved in this study were produced during the spring of 1980 as part of an extensive crossbreeding study currently in progress at the Oklahoma Agricultural Experiment Station to evaluate lifetime productivity of various two-breed cross cows. In 1979 Hereford × Angus reciprocal cross, Simmental x Angus, Simmental x Hereford, Brown Swiss x Angus, Brown Swiss x Hereford, Jersey x Angus and Jersey x Hereford cows were randomly mated to Charolais and Limousin bulls to produce 131 bull and 155 heifer calves. For purpose of this particular study, the data were combined and analyzed as four crossbred dam groups: Hereford x Angus reciprocal crosses, Simmental crosses, Brown Swiss crosses and Jersey crosses.

The Angus calves were part of a selection study initiated in the early 1960's to compare the response to selection for increased weaning or yearling weight. At the termination of the selection project four bulls per line were selected based on the respective selection criteria from the 1978 calf crop and randomly mated to all cows to produce 98 heifer and 101 bull calves during the spring of 1980.

Crossbred and Angus calves remained with their dams on native range without creep feeding until weaning at an average age of 205 days. Immediately after weaning all calves were placed in the feedlot and fed ad lib a corn based finishing ration. All calves were individually removed from the feedlot and slaughtered when an estimated low choice carcass grade was attained.

For the crossbred cattle, hip height was measured at weaning and adjusted to 205 days (WHT), at yearling and adjusted to 365 days (YHT) and at slaughter time (SHT). Hip height was measured only at yearling time (YHT) for the Angus calves. In all cases, the hip heights involved in the analyses were the average of two measurements taken on each individual.

Weaning and yearling weights were adjusted to 205 days and 365 days, respectively, and weights for Angus calves were also adjusted for age of dam. Age of dam adjustments were not necessary for crossbred calf weights because all cows were mature. Slaughter weights were taken at the time individual animals were removed from the feedlot for slaughter as they attained an anticipated low choice carcass grade.

Results and Discussion

Correlations of hip measurements with growth and feedlot traits are presented in Table 1. These correlations have been adjusted for breed of sire, crossbred dam group and sex of calf for crossbred cattle and for sex of calf and age of dam for Angus cattle. Positive moderate to high correlations were

Table 1. Correlations of hip height measurements with growth and feedlot traits[a,b]

	Weaning weight	Yearling weight	Slaughter weight	W-Y ADG	W-S ADG	Slaughter age	Days on feed
Crossbred:							
WHT	.70**	.50**	.45**	.11	.14*	−.05	−.05
YHT	.53**	.57**	.53**	.35**	.29**	−.04	−.05
SHT	.36**	.32**	.59**	.14*	.02	.40**	.35**
WYGTH	−.20	.17**	.04	.39**	.28**	−.22**	.01
WSGTH	−.23**	.09	.05	.31**	.32**	−.27**	.00
Angus:							
YHT	.51**	.68**	.59**	.53**	.46**	−.32**	−.33**

*P<.05, **P<.01.
[a]W = weaning, Y = yearling, S = slaughter, HT = hip height, GTH = growth in hip height.
[b]Correlations adjusted for breed of sire, crossbred dam groups and sex of calf for crossbred cattle and sex of calf and age of dam for Angus cattle.

observed for weaning height (WHT) and yearling height (YHT) with weaning, yearling and slaughter weight (average .56), suggesting that taller cattle at weaning or yearling were generally heavier at all ages. A correlation of .59 was observed between slaughter height (SHT) and slaughter weight, however, correlations were lower between SHT and weaning and yearling weight (averaged .34). The correlation between YHT and feedlot ADG was higher in Angus (.46) than in crossbred cattle (.29). The low correlation between SHT and rate of gain between weaning to slaughter (.02) indicated that taller cattle at slaughter was not related with gaining ability in the feedlot. The correlations for Angus YHT with slaughter age and days on feed (−.32 and −.33) suggested that taller Angus cattle at yearling time generally attained low choice carcass grade in shorter feeding periods and thus were younger at slaughter. This relationship was not nearly as strong in the crossbred cattle (−.04 and −.05). In crossbred cattle, the correlations between SHT and slaughter age and days on feed (.40 and .35) indicate that taller cattle at slaughter tended to be in the feedlot longer and thus were older at slaughter. Correlations of growth in height from weaning to yearling (WYGTH) and weaning to slaughter (WSGTH) with feedlot ADG (averaged .30) and slaugher age (averaged .25) suggest that cattle that grew faster in height were generally gaining and attained slaughter condition at a younger age.

Correlations between hip height measurements and carcass traits are presented in Table 2. Angus cattle tended to have higher correlations of hip height with carcass traits than crossbred cattle. Among carcass traits, hip height was more strongly related to carcass weight per day (average .31). Taller cattle at weaning, yearling and slaughter time were generally associated with larger rib eye areas (average correlation .18). Taller yearling Angus cattle tended to have higher dressing percentage (.23) and lower cutability (−.15). The low, non-significant correlations observed with the remaining carcass traits suggested that when cattle are slaughtered at a constant degree of finish, hip height is mostly unrelated to carcass traits.

Prediction equations for feedlot daily gain, days on feed, slaughter weight and rib eye area are presented in Tables 3, 4, 5 and 6, respectively. The values in the upper part of the tables are partial regression coefficients and thus represent the expected change in the predicted trait for each unit change in that particular trait in the prediction equation. For example in Table 3, equation

Table 2. Correlations of hip height measurements with carcass traits[a,b]

	Carcass wt/day	Rib eye area	Cutability	Dressing percent	Marbling	Single fat	Carcass conformation
Crossbred:							
WHT	.36**	.10	−.05	−.04	−.08	−.02	.01
YHT	.40**	.14*	−.10	−.05	−.10	.04	.03
SHT	.17**	.26**	−.03	.01	.04	.01	.02
WYGTH	.15*	.01	−.05	−.07	−.11	.08	−.05
WSGTH	.18**	.07	−.03	−.03	−.04	.10	.03
Angus:							
YHT	.62**	.23**	−.15	.23**	−.03	.08	.01

*P<.05, **P<.01.
[a]W = weaning, Y = yearling, S = slaughter, HT = hip weight, GTH = growth in hip height.
[b]Correlations adjusted for breed of sire, crossbred dam groups and sex of calf for crossbred cattle and sex of calf and age of dam for Angus cattle.

Table 3. Prediction equations for feedlot daily gain[a]

	Crossbred cattle								
	Weaning age equations			Yearling age equations			Angus cattle equations		
Trait	1	2	3	4	5	6	7	8	9
Weaning weight	.001*	.001*	—	−.005**	−.005**	—	−.003**	—	—
Weaning hip height	.022**	—	.041	.041	—	−.066*	—	—	—
Yearling weight	—	—	—	.005**	.005**	—	.004**	.002**	.003**
Yearling hip height	—	—	—	.026	—	.128**	.028	.023	—
R^2[b]	.34	.34	.34	.73	.73	.40	.58	.52	.52

*P<.05, **P<.01.
[a]Partial regression coefficients included only for the traits of interest. Prediction for an individual animal would also require the appropriate coefficients for crossbred group and sex for crossbred cattle and age of dam and sex of calf for Angus cattle.
[b]R^2 = coefficient of determination which represents the proportion of the variation in the trait being predicted that is accounted for by the respective prediction equations.

1, feedlot average daily gain is predicted by .001 (weaning weight) + .022 (weaning hip height). The .001 indicates that for each pound heavier in weaning weight an individual average daily gain is expected to increase by .001 lb/day and each inch increase in hip height is expected to increase average daily gain by .022 lb/day. In order to complete the prediction of feedlot average daily gain for an individual it is necessary to also include appropriate coefficients for crossbred group and sex of calf for crossbred cattle and age of dam and sex of calf for Angus cattle. These partial regression coefficients are included solely to indicate the form of the respective prediction equations and will not be discussed further.

Comparisons between different prediction equations can be made by comparing the respective coefficients of determination (R^2), which represents the proportion of the variation in the predicted trait that is accounted for by the respective prediction equations. The most useful prediction equation is the one that accounts for the largest proportion of the variation in the predicted trait. Considering the average for crossbred and Angus cattle, the order of predictability among traits considered was slaughter weight ($R^2 = .78$), feedlot ADG ($R^2 = .66$), days on feed ($R^2 = .41$) and rib eye area ($R^2 = .23$).

In crossbred cattle, the predictability of feedlot daily gain based on traits measured at weaning (Table 3) was low ($R^2 = .34$). Equations 2 and 3 indicated that weaning weight and WHT were about equally useful in predicting feedlot daily gain ($R^2 = .34$) and there was no improvement by including both (equation 1). At yearling time, weaning and yearling weights were more useful predictors of feedlot daily gain (equations 5, $R^2 = .73$) than WHT and YHT (equation 6, $R^2 = .40$). Including hip height measurements with weight measurement did not improve predictability (equation 4, $R^2 = .73$).

In Angus cattle, yearling weight alone (equation 9, $R^2 = .52$) was as good a predictor of feedlot daily gain as yearling weight and YHT (equation 8, $R^2 = .52$) and nearly as good as the equation which also included weaning weight (equation 7, $R^2 = .58$).

In general, predictability of days on test (Table 4) is low with at best only 46 percent of the variation in days on test being accounted for by the prediction equation (equation 7). At weaning time in the crossbred cattle weaning weight (equation 2, $R^2 = .25$) was a better predictor of days on test than WHT (equation 3, $R^2 = .21$). Combining weight and height yielded little improvement (equation 1, $R^2 = .26$) at yearling time, weaning and yearling weight (equation 5, $R^2 = .32$) was a better predictor than WHT and YHT (equation 6, $R^2 = .21$). Combining weight and height yielded little improvement (equation 4, $R^2 = .35$). In Angus cattle yearling weight (equation 9, $R^2 = .45$) was a better predictor than in crossbred cattle, but as with the crossbred cattle, including YHT did not improve predictability (equation 8, $R^2 = .46$).

Prediction equations for slaughter weight of cattle slaughtered at an anticipated grade of low choice is presented in Table 5. Both weight and height appear to be very useful as predictors of slaughter weight. At weaning time, weaning weight (equation 2) and WHT (equation 3) are equally useful as predictors of slaughter weight ($R^2 = .68$). Combining weight and height resulted in little improvement (equation 1, $R^2 = .70$). At yearling time a similar pattern existed with weight being more useful as a predictor than hip height with little practical improvement from combining both weight and hip height in a prediction equation.

Table 4. Prediction equations for days on feed[a]

	Crossbred cattle								
	Weaning age equations			Yearling age equations			Angus cattle equations		
Trait	1	2	3	4	5	6	7	8	9
Weaning weight	−.211**	−.14**	—	.007	.05	—	.020	—	—
Weaning hip height	3.73*	—	−1.36*	.300	—	−.46*	—	—	—
Yearling weight	—	—	—	−1.87**	−.16**	—	−.211**	−.203**	−.173**
Yearling hip weight	—	—	—	4.16*	—	−1.07*	2.29*	2.33*	—
R^2[b]	.26	.25	.21	.35	.32	.21	.46	.46	.45

*P<.05, **P<.01.

[a]Partial regression coefficients included only for the traits of interest. Prediction for an individual animal would also require the appropriate coefficients for crossbred group and sex for crossbred cattle and age of dam and sex of calf for Angus cattle.

[b]R^2 = coefficient of determination which represents the proportion of the variation in the trait being predicted that is accounted for by the respective prediction equations.

Table 5. Prediction equations for slaughter weight[a]

	Crossbred cattle								
	Weaning age equations			Yearling age equations			Angus cattle equations		
Trait	1	2	3	4	5	6	7	8	9
Weaning weight	.73**	1.02**	—	−.14	.05	—	.50**	—	—
Weaning hip height	14.43**	—	32.03**	5.69	—	6.09	—	—	—
Yearling weight	—	—	—	.76**	.83**	—	.26**	.46**	.61**
Yearling hip height	—	—	—	9.61*	—	30.98**	10.90**	11.69**	—
R^2[b]	.70	.68	.68	.80	.79	.70	.75	.72	.70

*P<.05, **P<.01.

[a]Partial regression coefficients included only for the traits of interest. Prediction for an individual animal would also require the appropriate coefficients for crossbred group and sex for crossbred cattle and age of dam and sex of calf for Angus cattle.

[b]R^2 = coefficient of determination which represents the proportion of the variation in the trait being predicted that is accounted for by the respective prediction equations.

In general, predictability of rib eye area (Table 6) is very low with only 24 percent of the variation in rib eye area being accounted for by the best prediction equation (equation 4) which combines all weight and height measurements available at yearling time. As with the other traits, weight is a more useful predictor than hip height and there is little practical improvement in predictability from including hip height with weight.

In general, these data suggest that although there appears to be some association of weaning and yearling hip height with growth, feedlot and carcass traits, it is not as strong as weaning and yearling weight. Consequently, weight was a more reliable predictor than hip heights, and combining hip heights with weight in prediction equations yielded little practical improvement in predictability.

Table 6. Prediction equations for rib eye area[a]

	Crossbred cattle								
	Weaning age equations			Yearling age equations			Angus cattle equations		
Trait	1	2	3	4	5	6	7	8	9
Weaning weight	.037*	.007**	—	.027**	.001	—	.009**	—	—
Weaning hip weight	−.148	—	.138**	−.152	—	.013	—	—	—
Yearling weight	—	—	—	.004**	.005*	—	−.0002	.003*	.004**
Yearling hip height	—	—	—	.021	—	.147	.035	.048	—
R^2[b]	.20	.18	.15	.24	.21	.15	.22	.15	.15

*P<.05, **P<.01.

[a]Partial regression coefficients included only for the traits of interest. Prediction for an individual animal would also require the appropriate coefficients for crossbred group and sex for crossbred cattle and age of dam and sex of calf for Angus cattle.

[b]R^2 = coefficient of determination which represents the proportion of the variation in the trait being predicted that is accounted for by the respective prediction equations.