BEEF CATTLE RESEARCH UPDATE

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Predictability of Feedlot Cattle Growth Performance

Predicting performance is vital to management and marketing decisions in commercial feedlots. However, due to the limited information available at the start of the feeding period predicting performance is a challenge. Sex and initial weight are typically the only two factors known with certainty when cattle start on feed. Information on background and breeding are potentially available but are generally less reliable. Recent Texas Tech University research evaluated relationships between initial weight, sex, and performance using 3,363 pen records collected over 4 years from 3 commercial feedlots in the Texas Panhandle.[1] Initial weight ranged from 500 to 994 lb in this database. With adjustments for sex, regression on initial weight accounted for 72, 46, 82, 81, and 22% of the variation in dry matter intake, average daily gain, final shrunk weight, hot carcass weight, and feed to gain ratio, respectively. These results suggest that initial weight has considerable value in predicting growth performance by feedlot cattle.

I conducted a similar analysis on 4,767 pen records from beef steers and 4,789 pen records from beef heifers that closed out from 2001 through 2005 at the three Hitch Enterprises feedyards. The steer data showed that initial weight accounted for 57, 23, 41, and 5% of the variation in dry matter intake, average daily gain, final sale weight, and feed efficiency, respectively. The initial weight of these steers ranged from 372 to 1010 lb with an average of 710 lb. The heifer data showed that initial weight accounted for 59, 24, 55, and 5% of the variation in dry matter intake, average daily gain, final sale weight, and feed efficiency, respectively. The initial weight of these heifers ranged from 309 to 1047 lb with an average of 641 lb.

Breed and Heterosis Effects for Growth and Carcass Traits in Cattle

Recent University of Georgia research analyzed the results of crossbreeding studies published from 1976 to 1996 in an effort to calculate direct and maternal breed and heterosis effects for several growth and carcass traits.[2] Depending on the trait, the number of studies analyzed ranged from 31 to 78 and the number of records (means) ranged from 352 to 646. Direct and maternal breed effects were based on the major breeds reported in the published studies which included Angus, Hereford, Shorthorn, Charolais, Limousin, Gelbvieh, Simmental and Brahman cattle. The Angus breed had the largest number of observations represented in the data and was used as the base breed. Direct breed effects refer to the influence of the breed composition of the individual on the trait of interest and maternal breed effects refer to the influence of the breed composition of the dam on the trait of interest.

A summary of direct and maternal breed effect solutions for birth weight, weaning weight, and postweaning body weight (BW) gain relative to Angus are listed in Table 1. Direct breed effects for birth weight were greatest for the four Continental breeds (Charolais, Limousin, Gelbvieh, and Simmental - average of 16.9 lb) and Brahman cattle (18.1 lb). Maternal breed effects for birth weight were minimal for all breeds except Brahman (-15.9 lb). These researchers noted that this result is not surprising since Brahman cattle are known to have a low maternal effect for birth weight. Direct breed effects for weaning weight were greatest for Simmental (61.7 lb) and Gelbvieh (59.8 lb). Shorthorn (-8.9 lb) and Brahman (-6.9 lb) breeds had effects less than that of Angus indicting that these breeds have slower preweaning growth rates. Charolais (47.6 lb) and Simmental (34.9 lb) had the greatest effect on postweaning gain while Brahman had a big negative effect (-39.4 lb) on postweaning gain.

Table 1. Means for direct and maternal breed effects as deviations from Angus for birth weight, weaning weight, and postweaning BW gain.

	Birth Weight, lb		Weaning Weight, lb		Postweaning BW Gain, lb
Breed	Direct Breed Effect	Maternal Breed Effect	Direct Breed Effect	Maternal Breed Effect	Direct Breed Effect
Angus	0.0	0.0	0.0	0.0	0.0
Hereford	6.7	0.6	9.4	-25.2	15.0
Shorthorn	5.3	-1.7	-8.9	2.6	5.7
Charolais	19.8	1.7	53.6	21.1	47.6
Limousin	13.4	1.0	25.1	1.1	6.7
Gelbvieh	14.9	4.0	59.8	63.6	21.1
Simmental	19.6	-0.1	61.7	30.9	34.9
Brahman	18.1	-15.9	-6.9	14.6	-39.4

Adapted from Williams et al., 2010.

Direct breed effects for carcass weight, ribeye area, fat thickness, and marbling score relative to Angus are shown in Table 2. As would be expected, the continental breeds produced the heaviest carcasses (average breed effect of 86 lb) with Charolais having the greatest effect on carcass weight (118 lb). Similarly, the continental breeds had the greatest effect on ribeye area (average of 2.2 sq. in.). The British breeds tended to have more positive effects on fat thickness as compared to the Continental breeds (average of -0.3 in.) and Brahman (-0.2 in.). The breed effects on marbling score were all negative compared to Angus. The effects were most negative for Continental breeds (-1.1) and the Brahman breed (-1.4).

Table 2. Means for direct breed effects as deviations from Angus for carcass weight, ribeye area, fat thickness, and marbling score.

Breed	Carcass Weight, lb	Ribeye Area, sq in	Fat Thickness, in	Marbling Score[1]
Angus	0.0	0.0	0.0	0.0
Hereford	-4.2	-0.33	-0.06	-0.58
Shorthorn	-8.5	-1.26	-0.01	-0.11
Charolais	117.7	2.27	-0.30	-1.00
Limousin	54.9	2.70	-0.32	-1.42
Gelbvieh	90.9	2.12	-0.35	-1.14
Simmental	78.3	1.75	-0.33	-1.01
Brahman	-14.3	-0.64	-0.20	-1.39

[1]Marbling score was measured from practically devoid (2.0 to 2.9) to abundant (10.0 to 10.9).
Adapted from Williams et al., 2010.

These researchers calculated direct and maternal heterosis effects for five types of crosses: British X British (crosses between Angus, Hereford or Shorthorn), British X Continental, British X Zebu (Brahman), Continental X Continental, and Continental X Zebu. A summary of the individual and maternal heterosis effect for birth weight, weaning weight, and postweaning BW gain for these various types of crosses are listed in Table 3. Individual heterosis effects for birth weight and weaning weight were greatest for British X Zebu (5.4 and 51 lb, respectively) and Continental X Zebu (4.4 and 57.2 lb, respectively) crosses. The heterosis effect for postweaning gain for the Continental X Zebu cross was unexpectedly low (3.3 lb) considering that this cross had the greatest effect for all other growth traits. These researchers reported that about 40% of the studies used to calculate the Continental X Zebu heterosis effect came from crossbreeding studies performed at the Meat Animal Research Center in Clay Center, Nebraska and the remainder of the studies were carried out in the hot humid Southeastern states, which are more ideal for Brahman cattle. They also noted that the means from the Nebraska studies were on average 88 lb less and were based on

a larger number of gain observations compared with those in the Southeast. Thus, these researchers suggested that a large number of Brahman cattle contributing records to this analysis were unable to gain BW at their optimum level in the cooler climate of Nebraska, which consequently led to a reduced heterosis estimate.

Table 3. Means for individual and maternal heterosis effects for birth weight, weaning weight, and postweaning BW gain.

	Birth Weight, lb		Weaning Weight, lb		Postweaning BW Gain, lb
Cross Type	Individual Heterosis	Maternal Heterosis	Individual Heterosis	Maternal Heterosis	Individual Heterosis
British x British	2.0	1.3	18.1	18.4	13.9
British X Continental	1.5	1.8	12.8	16.3	17.4
British X Zebu	5.4	3.4	50.8	48.7	32.4
Continental X Continental	1.4	2.5	7.7	34.5	20.1
Continental X Zebu	4.4	2.4	57.2	23.5	3.3

Adapted from Williams et al., 2010.

Individual heterosis effects for carcass weight, ribeye area, fat thickness, and marbling score are shown in Table 4. The heterosis effects for carcass weight and ribeye area were greatest for British X Zebu (93 lb and 1.02 sq. in., respectively) and Continental X Zebu crosses (54 lb and 0.69 sq. in., respectively). There was little heterosis for fat thickness and marbling score.

In summary, this meta-analysis of crossbreeding studies clearly illustrates that heterosis is significant for growth traits, particularly for British X Zebu and Continental X Zebu crosses. It was noted that findings from other studies have also shown that heterosis is greatest for Zebu crosses.

Table 4. Means for individual heterosis effects carcass weight, ribeye area, fat thickness, and marbling score.

Breed	Carcass Weight, lb	Ribeye Area, sq in	Fat Thickness, in	Marbling Score[1]
British x British	22.8	0.37	0.04	0.17
British X Continental	29.0	0.41	-0.01	0.06
British X Zebu	92.7	1.02	0.08	0.09
Continental X Continental	36.3	0.49	0.00	-0.05
Continental X Zebu	54.3	0.69	0.06	0.30

[1]Marbling score was measured from practically devoid (2.0 to 2.9) to abundant (10.0 to 10.9).
Adapted from Williams et al., 2010.

[1] Galyean, M. L., N. DiLorenzo, J. P. McMeniman, and P. J. Defoor. 2010. Predictability of feedlot cattle growth performance. J. Anim. Sci. 88 (E-Suppl. 2): 178 (Abstr.).

[2] Williams, J. L., I. Aguilar, R. Rekaya, and J. K. Bertrand. 2010. Estimation of breed and heterosis effects for growth and carcass traits in cattle using published crossbreeding studies. J. Anim. Sci. 88: 460-466.