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POST-WEANING GROWTH IN BEEF AND DAIRY CROSSBRED STEERS

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SUMMARY

A study was performed to evaluate post-weaning growth of 78 steers sired by straight-bred Hereford bulls (HH) over: straight-bred Angus dams (HHxAA, n=25), Angus-cross-Friesian dams (HHxAF, n=21); Angus-cross-Jersey dams (HHxAJ, n=21) and Angus-cross-Kiwicross (Friesian-Jersey) dams (HHxAK, n=11). The steers were divided into two groups for slaughter at 666 days of age (n=38) and at 763 days of age (n=40). Live weight (LWT) was measured monthly from weaning (168 days) to slaughter. Rib fat depth (RF) and body condition score (BCS; 1-5 scale) were measured every three months from weaning, and height at withers (HT) was measured at 12, 18 and 24 months of age. A longitudinal mixed model was used to compare breed group and slaughter season as main effects. At weaning, HHxAF steers were heaviest (237.4±1.4 kg), whilst HHxAK and HHxAJ were similar and intermediate to the other two breed groups (228.8±1.8 kg and 225.6±1.4 kg, respectively) and HHxAA steers were lightest (209.7±1.3 kg). At 21 months of age, HHxAF steers (555.6±7.5 kg) remained heavier than HHxAK and HHxAJ steers (515.8±5.4 and 520.7±4.1 kg, respectively), but HHxAA steers (532.6±6.6 kg) were similar (P>0.05) to all other breed groups. There were no differences (P>0.05) among breed groups for RF and BCS. Breed-group differences for HT existed at 12 and 18 months but not at 24 months of age. Measurements of LWT were strongly phenotypically correlated over time, and moderately phenotypically correlated with measurements of BCS and HT made at the same age.

INTRODUCTION

The use of beef-cross-dairy heifers as breeding cows in beef herds can increase the weight of calf weaned compared with straight-bred beef cows (Hickson *et al.* 2011). Weight of calf weaned is commonly used as an indicator of cow productivity, however, the ultimate product produced in the beef industry is a finished steer ready for slaughter rather than a weaned calf. Beef-cross-dairy breeding cows are likely to have inferior direct genetics for growth and finishing compared with beef straight-bred cows; the increased weaning weight of their calves is likely the result of the cow's increased milking ability rather than the calf's own growth potential. Therefore, the effect on the growth of the calf of being born to a beef-cross-dairy dam compared to a straight-bred beef dam should be examined right up to slaughter at around 2 years of age, rather than just in the pre-weaning period.

The objective of this study was to evaluate post-weaning performance of live weight, rib fat, body condition score and height at withers in four breed-groups of beef and dairy-crossbred steers using random regression models.

MATERIALS AND METHODS

Animals and measurements. Heifers of four breed groups: straight-bred Angus (AA), Angus cross Friesian (AF), Angus cross Jersey (AJ), and Angus cross Kiwicross (Friesian-Jersey and Jersey-Friesian; AK) were bred to straight-bred Hereford (HH) bulls at 16 months of age in December 2009. Male progeny were castrated at approximately 6 weeks of age, and were weaned from their dams at an average age of 168 days. The breed groups of the steers were: HHxAA (n =

25), HHxAF (n = 21), HHxAJ (n = 21) and HHxAK (n = 11). Prior to weaning, steers were grazed alongside their dams in four herds based on calving date of the dam and balanced for breed group. From weaning until 581 days of age, all steers were grazed in one herd under commercial management at Massey University's Tuapaka farm (15 km east of Palmerston North, New Zealand). At day 581, steers were allocated to either the 666-day or 763-day slaughter group, based on live weight (the heavier animals were allocated to the 666-day group) so that half of each breed group was included in each slaughter group. Steers slaughtered at 763 days of age (n=40) were moved to Massey University's Riverside farm (10 km north of Masterton, New Zealand) at day 581, where they grazed in one herd until slaughter. Steers slaughtered at 666 days of age (n=38) remained in one herd at Tuapaka until slaughter.

Live weight (LWT) was measured monthly from weaning (168 days average age) until slaughter. Rib fat depth (RF) was an ultrasound measurement of subcutaneous fat depth over the *M. longissimus* between the 12th and 13th ribs and was measured by the same commercial ultrasound technician each time. Body condition score (BCS) was assessed on a scale of 1-5 (1=emaciated, 5=obese) by one technician from weaning to 1 year of age, and another technician (trained by the first technician) from 15 months until slaughter. Rib fat depth and BCS were recorded every three months from weaning until slaughter. Height at withers (HT) was measured at 12 and 18 months of age for all steers and at 24 months of age for steers slaughtered at 763 days of age.

Statistical analyses. Data were analyzed using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). A repeated measures mixed model with unstructured and heterogeneous residual variance was used to assess the effects of rearing herd, breed group and slaughter group.

Random regression models using a Legendre orthogonal polynomial (Kirkpatrick *et al.* 1990) of 1st order $Y_t = \alpha_0P_0(x)+\alpha_1P_1(x)$ for RF and BCS, and 2nd order $Y_t = \alpha_0P_0(x)+\alpha_1P_1(x)+\alpha_2P_2(x)$ for LWT and HT, were used to examine the fixed effects of breed and slaughter season, where: $P_0(x)=1$; $P_1(x)=x$; $P_2(x)=½(3x^2-1)$; and $x=[2(t-t_{min})/(t_{max}-t_{min})]-1$ represents the standardised unit of time from -1 to 1 from weaning to slaughter; Y_t is the measurement for each trait at age t, t_{min} is age at weaning and t_{max} is the greatest age recorded from weaning (Schaeffer 2004).

RESULTS

Variation in LWT increased as the animals became heavier. Steers from the HHxAF breed group were the heaviest until 18 months of age (P<0.05; Table 1), and were heavier than the HHxAJ and HHxAK steers at both slaughter ages. Steers from the HHxAA breed group were lighter (P<0.05) than all other breed groups at weaning and 9 months of age, after which they were similar (P>0.05) to the HHxAJ and HHxAK steers. By 21 months of age, HHxAA steers were also similar (P>0.05) to HHxAF steers. Furthermore, by 21 months of age, there was no difference for LWT between HHxAA and HHxAF steers. Steers from the HHxAF and HHxAA breed groups grew 5% faster (P<0.05) than HHxAJ and HHxAK steers, which had similar growth performance. Rib fat depth and BCS were similar for all breed groups throughout the experiment. Height of HHxAF steers was greater (P<0.05) than for HHxAA and HHxAJ steers at 12 and 18 but not 24 months of age.

Table 2 reports the phenotypic correlations of LWT with itself and the other traits across the different ages of measurement. All LWT measurements were strongly correlated with each other, although the correlation was less at 24 months of age than at other ages – probably the result of these correlations being based on only the 40 steers that were slaughtered at 24 months, and because the steers were considerably fatter at 24 months of age, indicating they had moved into a finishing phase of growth. Rib fat depth was moderately positively correlated with LWT up to 18 months of age, but it was not correlated after that. Body condition score was correlated with LWT at the same age throughout the experiment, and BCS at 12 and 15 months of age were correlated

Table 1. Least squares means ±SE for live weight, rib fat, body condition score and height for steers from Hereford bulls over: Angus dams (HHxAA), Angus-cross-Friesian dams (HHxAF), Angus-cross-Jersey dams (HHxAJ), and Angus-cross-Kiwicross dams (HHxAK).

Age (months)	HHxAA	HHxAF	HHxAJ	HHxAK
		Live weight (kg)		
weaning	209.7±1.3[c]	237.4±1.4[a]	225.6±1.4[b]	228.8±1.8[b]
9	264.9±3.7[c]	297.9±3.9[a]	280.2±3.7[b]	285.9±4.3[ab]
12	331.8±3.8[b]	362.3±3.8[a]	340.3±3.1[b]	343.3±2.9[b]
15	398.7±4.4[b]	426.7±4.7[a]	400.4±3.0[b]	400.8±2.7[b]
18	465.7±5.4[b]	491.1±5.9[a]	460.6±3.3[b]	458.3±3.8[b]
21	532.6±6.6[ab]	555.6±7.5[a]	520.7±4.08[b]	515.8±5.4[b]
24	599.6±7.9[ab]	620.0±9.3[a]	580.8±5.0[b]	573.3±7.4[b]
		Rib Fat depth (mm)		
9	2.49±0.13	2.58±0.15	2.71±0.16	2.82±0.24
12	3.12±0.11	3.20±0.15	3.37±0.15	3.28±0.25
15	3.75±0.11	3.82±0.15	4.03±0.17	3.75±0.29
18	4.38±0.12	4.43±0.18	4.69±0.19	4.22±0.33
21	5.01±0.15	5.05±0.21	5.35±0.23	4.68±0.38
24	5.64±0.18	5.67±0.24	6.01±0.26	5.14±0.42
		Body condition score (1-5 scale)		
9	2.64±0.07	2.81±0.08	2.59±0.08	2.59±0.11
12	2.91±0.05	3.02±0.06	2.83±0.06	2.81±0.08
15	3.17±0.04	3.23±0.05	3.06±0.05	3.03±0.07
18	3.40±0.04	3.45±0.06	3.29±0.05	3.24±0.08
21	3.69±0.06	3.66±0.07	3.52±0.06	3.46±0.10
24	3.95±0.08	3.88±0.09	3.76±0.09	3.68±0.13
		Height at withers (cm)		
12	114.3±0.60[c]	118.3±0.58[a]	115.7±0.57[bc]	118.1±1.17[ab]
18	125.1±0.48[b]	128.3±0.62[a]	125.4±0.48[b]	127.7±1.37[ab]
24	135.8±0.74	138.3±1.10	135.1±0.86	137.3±1.83

[a,b,c] within row, least squares means with different letters are different ($P<0.05$)

with LWT during the previous 6 months. Height at withers was generally positively correlated with LWT throughout the experiment.

DISCUSSION

Steers from the three dairy-crossbred dams received similar, generous quantities of milk prior to weaning (Hickson *et al.* 2011), thus differences in their LWT at weaning likely reflected differences in their genetic potential for growth. In contrast, the lesser milk yield of straight-bred Angus dams could have restricted the growth to weaning of the HHxAA steers. Once in the post-weaning environment where all steers had the same feed availability, the growth of the HHxAA steers was greater than the other breed groups, perhaps reflecting compensatory gain that allowed them to reach LWT that was not different to any of the other breed groups by slaughter. The relative LWT of the maternal lines indicates that the genetic potential for LWT of the HHxAA and HHxAF steers would be similar (Hickson *et al.* 2011). There is limited literature detailing the post-weaning growth of calves born to beef-cross-dairy cows, so it is valuable to document that the advantage in LWT at weaning of calves from the dairy-type dams was lost by 21 months of age.

Beef-cross-dairy cows have been shown to have lesser body condition than straight-bred beef cows (Hickson *et al.* 2011), but there were no effects of breed group on RF or BCS of the steers in this study, presumably because the steers were of at least 75% beef breeds.

Table 2. Phenotypic correlation coefficients for live weight with rib fat, body condition score and height at various ages for steers from Hereford bulls over: Angus dams (HHxAA), Angus-cross-Friesian dams (HHxAF), Angus-cross-Jersey dams (HHxAJ), and Angus-cross-Kiwicross dams (HHxAK).

	Live weight at age (months)						
	Weaning	**9**	**12**	**15**	**18**	**21**	**24**
Live weight at age (months)							
9	0.93						
12	0.84	0.94					
15	0.54	0.66	0.75				
18	0.56	0.64	0.70	0.74			
21	0.59	0.70	0.78	0.80	0.88		
24	0.25	0.32	0.32	0.62	0.53	0.68	
Rib fat at age (months)							
9	0.33	0.32					
12	0.29	0.29	0.22				
15	0.33	0.38	0.38	0.15ns			
18	0.18ns	0.24	0.23	0.08ns	0.34		
21	0.01ns	0.12ns	0.14ns	0.00ns	0.21ns	0.11ns	
24	0.07ns	0.10ns	0.18ns	0.02ns	0.00ns	0.05ns	0.12ns
BCS at age (months)							
9	0.39	0.48					
12	0.27	0.35	0.41				
15	0.20ns	0.26	0.33	0.37			
18	0.05ns	0.11ns	0.14ns	0.26	0.37		
21	0.00ns	0.06ns	0.12ns	0.22ns	0.23	0.31	
24	-0.33ns	-0.24ns	-0.12ns	0.10ns	-0.13ns	0.05ns	0.33
Height at age (months)							
12	0.67	0.72					
18	0.39	0.42	0.41	0.47	0.47		
24	0.187ns	0.29ns	0.38	0.36	0.29ns	0.47	0.33

Correlations are significant at the P<0.05 level unless indicated with ‘ns’ (non-significant)

REFERENCES

Hickson R.E., Kenyon P.R., Lopez-Villalobos N., Laven R.L., Fraser K.R., Balcomb C.C.,and Morris S.T. (2011) *Proc. Soc. Sheep and Beef Cattle Veterinarians of the New Zealand Veterinary Association Annual Conf.* 4.22.1

Kirkpatrick M., Lofsvold D. and Bulmer, M. (1990) *Genetics* **124**: 979.

Schaeffer L.R. (2004) *Livestock Production Science* **86**: 35.