SIRE BREED DIFFERENCES FOR NET FEED INTAKE IN FEEDLOT FINISHED BEEF CATTLE

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SUMMARY
Individual daily feed intake and live weights were measured on 469 beef cattle representing 9 sire breeds joined to Brahman cows. The aim of this study was to estimate sire-breed differences for daily feed intake and net feed intake (NFI; a measure of feed efficiency). Progeny of European and British breed sires were heavier at the start of the feed test, had higher growth rates and consumed more feed compared to progeny from Brahman and Belmont Red sires. Progeny from Brahman and European sire breeds had significantly lower NFI compared to progeny of Angus, Shorthorn and Belmont Red sire breeds. Hereford and Santa Gertrudis sired progeny had significantly lower NFI compared to Angus and Shorthorn sire breeds.
Key Words: Net Feed Intake, Crossbreeding, Sire-breed effects, Beef cattle

INTRODUCTION
The cost of feed is a large component of the total costs associated with beef cattle production; therefore reducing feed costs will be beneficial for beef production systems (Archer *et al.* 1999). Net feed intake (NFI) is a measure of feed efficiency, calculated as the actual amount of feed eaten by an animal, less the expected amount of feed calculated as a function of an animal's growth rate and body weight (Koch *et al.* 1963). Genetic variation has been shown to exist for this trait in beef cattle (Johnston *et al.* 2001), however limited work has been undertaken to compare the feed efficiency of different breeds of cattle (Comerford *et al.* 1991; Fan *et al.* 1995; Cundiff *et al.* 2004). The purpose of this study was to compare the daily feed intake and NFI of 9 sire-breeds.

MATERIALS AND METHODS
At the CRC "Tullimba" Research Feedlot cattle were fed a standard feedlot diet (Bindon, 2001). Using automatic feed intake recorders individual daily feed intake was recorded on 528 animals for an average of 59 days. Animals were the progeny of 9 sire breeds mated to Brahman cows and were a subset of animals produced in the Beef CRC Crossbreeding project (Upton *et al.* 2001). The number of sires per breed were 10 Angus (AA), 14 Brahman (BB), 14 Belmont Red (BR), 4 Charbray (CB), 15 Charolais (CC), 8 Hereford (HH), 14 Limousin (LL), 8 Santa Gertrudis (SG) and 7 Shorthorn (SS). Animals were produced in 2 herds in central Queensland, and were allocated at weaning into cohorts based on sex (heifer or steer), year of birth (1996, 1997 or 1998), finishing regime (feedlot or pasture) and target market weight (Japanese or Korean). Of these cohorts, 9 cohorts had feed intake recorded and were included in this study.

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Animals were removed from the analysis if they were shy feeders or became sick during the test (n=44), had an average daily gain less than 0.5kg/day (n=16) or sire-breed was unknown (n=1). Intake records from a day were removed if the quality code for data from a feeder was not equal to 1 (indicating good data), or less than 300g of feed was consumed in a day. After editing, 469 animals remained, representing 43, 73, 90, 22, 69, 33, 75, 32 and 35 animals from AA, BB, BR, CB, CC, HH, LL, SG and SS, sire breeds, respectively. All animals were F1s with the exception of Brahmans.

Traits measured on each individual included daily feed intake (DFI) = average weight of feed consumed daily during the test, entry weight (EWT) = first weight recorded on, or shortly after, test start date, average daily gain (ADG) = the regression of all weights recorded during feed test on age, feed conversion ratio (FCR) = the ratio of DFI to ADG. FCRADJ was FCR where DFI was adjusted for maintenance using the equation from Comerford *et al.* (1991). NFI was calculated for each animal as the actual DFI less the predicted DFI. Where predicted DFI for all animals were determined using PROC GLM model in SAS (SAS Institute Inc. 1989) that fitted ADG and the metabolic mid weight (Mid test Weight$^{0.73}$) as linear co-variables. Note, lower (more negative) NFI indicates an animal that consumes less feed (i.e. more efficient) than expected given its weight and gain.

Using PROC MIXED in SAS, significant fixed effects were identified for each trait using an initial model that included all effects, all 1st order interactions, and sire nested within breed was included as a random effect. Non-significant terms (P>0.05) were sequentially removed to yield the final models. Fixed effects that were considered were; cohort and market concatenated to form a single variable, breed, herd of origin, electrolyte treatment (treated or not) and age at the start (SAGE) of the feed test. The sire within breed effect was used as the error term for testing the significance of breed effects. For all traits, cohort, breed and age at the start (SAGE) of the feed test (not for ADG) were significant (P<0.05). Herd was also significant for EWT. The interactions cohort*breed and cohort*SAGE were significant for NFI, FCR and FCRADJ. Only cohort*breed was significant for EWT and cohort*SAGE for DFI. Least square means for sire breed were computed for each trait. Due to low numbers of progeny least square means were generally non-estimable for CB sires. Pair-wise sire-breed comparisons, and the standard error of the difference, were computed using the ESTIMATE function of PROC MIXED.

RESULTS AND DISCUSSION

Table 1. Raw data statistics for the edited data (469 animals)

Trait	Mean	Standard Deviation	Min	Max
Duration of test (days)	58.9	8.5	48	98
Total feed intake (kg)	701.1	146.6	375.9	1179.5
SAGE; Age at start of test (days)	593.3	48.0	458	699
EWT; Entry weight (kg)	413.6	65.6	274	646
DFI; Daily feed intake (kg)	12.0	2.3	6.4	19.4
ADG; Average daily gain (kg/day)	1.4	0.4	0.5	2.6
NFI; Net feed intake (kg/day)	0.0	1.2	-3.7	3.8
FCR; Feed conversion ratio (kg/kg)	8.9	2.2	5.2	20.1
FCRADJ; Adjusted Feed conversion ratio (kg/kg)	5.5	1.2	2.9	12.4

Animals entering the NFI feed test were on average 593 days of age with a mean weight of 414kg, consumed on average 12 kg of feed per day and grew at 1.4 kg/day. For every 1 kg of weight gained, the animals consumed on average 8.9kg of feed. When DFI was adjusted for maintenance (Comerford *et al.* 1991) animals consumed 5.5kg to gain 1 kg (Table 1).

Results in Tables 2 show that progeny of European (CC, LL) and British breed sires (AA, SS, HH) were heavier at the start of the feed test, had higher growth rates and consumed more feed compared to progeny from Brahman and Belmont Red sires. In general, sire-breed differences for FCR and FCRADJ were not significant. The progeny of Brahman and European sire breeds had significantly lower NFI compared with progeny of AA, SS and BR sire breeds (Table 3). HH and SG sired progeny had significantly lower NFI compared to AA sire breed. Limited studies compare NFI of breeds. However, Fan *et al.* (1995) reported Hereford cattle to be more feed efficient than Angus.

Table 2. Sire-breed least square means* for growth and feed intake traits (see text for abbreviation explanations) of feedlot finished steers and heifers of 9-sire breeds mated to Brahman cows

Sire-Breed	EWT	ADG	DFI	FCR	FCRADJ	NFI
BB	371.2	1.12	9.96	8.9	5.2	-0.61
CC	454.8	1.42	12.31	9.4	5.6	-0.57
LL	433.6	1.44	12.04	8.8	5.4	-0.50
HH	446.8	1.57	12.62	8.7	5.4	-0.30
SG	426.3	1.48	12.17	8.5	5.3	-0.27
BR	402.0	1.23	11.23	9.5	5.8	0.01
SS	452.6	1.52	12.98	8.8	5.6	0.16
AA	445.7	1.56	13.45	9.1	5.9	0.30
CB	NE	1.31	11.01	NE	NE	NE
Mean SED#	6.93	0.06	0.35	0.39	0.23	0.23

*** NE=Non-estimable; SED= Standard Error Difference**

Table 3. Sire-breed (see text for abbreviation explanations) differences (above diagonal*) and their standard errors (below diagonal) for net feed intake (NFI)

Sire-Breed	BB	CC	LL	HH	SG	BR	SS	AA
BB	.	-0.04	-0.11	-0.31	-0.34	**-0.62**	**-0.77**	**-0.91**
CC	0.30	.	-0.07	-0.27	-0.30	**0.58**	**-0.73**	**0.87**
LL	0.24	0.26	.	0.20	-0.23	**0.51**	**-0.66**	**0.80**
HH	0.32	0.33	0.29	.	-0.03	0.31	-0.46	**0.60**
SG	0.31	0.33	0.29	0.34	.	0.29	-0.44	**0.58**
BR	0.23	0.26	0.20	0.29	0.29	.	-0.15	0.29
SS	0.31	0.32	0.28	0.34	0.34	0.28	.	0.14
AA	0.28	0.30	0.26	0.32	0.31	0.25	0.31	.

*Bold indicates significant difference (P<0.05)

Estimated sire breed differences may be affected by the sample of sires used in the study. Upton *et al.* (2001) compared estimated breeding values (EBVs) of sires used (except for CB) with the 1997 breed mean. Project sires were generally above breed mean for 600 day EBV. LL sires were approximately breed average, however SS sires below breed mean. AA and BR sires had P8 fat EBVs greater than breed average, SS sires were breed average and all other sire-breeds below breed average. There were also differences regarding IMF% with EBVs for AA and SG sires above breed average, BB and HH below average and BR, LL and SS sires were breed average. There were no IMF EBVs for CC and most importantly no NFI EBVs were available for any breed. The differences in weight EBVs should not have affected the results for NFI because of the adjustment for weight and ADG that are made. However, because NFI is not adjusted for fatness, and NFI and fat depth are positively correlated (Robinson and Oddy, 2004) the different sampling of sires across breeds for fatness traits may have influenced the results. In addition, hybrid vigour effects were unable to be estimated from the data. Therefore, least square means and sire-breed differences presented include any heterosis generated as a result of the cross of each sire breed with Brahmans. Adjustment for hybrid vigour using existing literature estimates would be possible for the weight traits, however no estimates were available for DFI or NFI of the breeds used in this study.

CONCLUSIONS

Significant sire-breed differences exist for feed intake and feed efficiency under a feedlot test. Generally, animals sired by British sire-breeds had higher growth, were heavier entering the test, consumed more feed and were the least efficient. In contrast, the straightbred Brahmans had the lowest entry weight and growth, consumed less and had the lowest net feed efficiency.

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