SALEABLE BEEF YIELD AND OTHER CARCASS TRAITS IN PROGENY OF HEREFORD COWS MATED TO SEVEN SIRE BREEDS

A. L. Ewers[1], M. P. B. Deland[2], W. S. Pitchford[3], D. L. Rutley[3] and R. W. Ponzoni[1]

[1] South Australian Research and Development Institute, GPO Box 397, Adelaide, SA 5001
[2] South Australian Research and Development Institute, PO Box 618, Naracoorte, SA 5271
[3] Department of Animal Science, University of Adelaide, Waite Campus, Glen Osmond, SA 5064

SUMMARY
Carcass traits were collected from 1,219 cattle (619 steers, 590 heifers) as part of the Southern Crossbreeding Project. Seven sire breeds (Angus, Belgian Blue, Hereford, Jersey, Limousin, South Devon and Wagyu) were mated to Hereford cows producing progeny over a four year period (1994 to 1997). The traits studied were: final live weight, hot carcass weight, dressing percentage, estimated saleable beef yield, eye muscle area, P8 and rib fat depth and marbling. The Belgian Blue had significantly the highest saleable beef yield percentage (70.4), followed by Limousin (69.6), South Devon (67.1), Hereford and Wagyu (66.9), Angus (65.7) and Jersey (64.8). Angus, Jersey and Wagyu had the highest marbling scores (1.4, 1.3 and 1.2 respectively), followed by South Devon and Hereford (1.0) with Belgian Blue and Limousin lowest (0.7).
Keywords: Carcass, saleable beef yield, cattle, beef, marbling, crossbreeding

INTRODUCTION
The profitability of beef producers in Australia is being governed increasingly by their ability to meet market demand. Market specifications are primarily based on carcass weight and fat depth, but in recent times, more emphasis has been placed on other traits such as meat yield and marbling. Having a greater availability of carcass information and breed characteristics allows producers to better target specific markets and increase the competitiveness of southern Australian beef.

The generation of information on carcass attributes was a major aim of the Southern Crossbreeding Project, established at Struan Research Centre. Seven sire breeds were crossed to Hereford (Poll/Horn) cows over a period of four years (1994 to 1997) in a similar design to the Germ Plasm Evaluation Program at Clay Centre, Nebraska, USA (Cundiff *et al.* 1988). The sire breeds (Angus (A), Belgian Blue (B), Hereford (H), Jersey (J), Limousin (L), South Devon (S) and Wagyu (W)) were chosen to represent a diverse range of biological types. Note that the Hereford is the only straight bred type and the other six are all crossbreds. This paper analyses carcass traits for all cattle slaughtered throughout the 4 years.

MATERIALS AND METHODS
Animals. A total of 1,277 live calves (autumn calving) were produced over 4 years and these were weaned at approximately 250 days of age and grazed at pasture for a further 100-250 days. Heifers were then lot fed for 70-100 days and steers for 150-180 days with the exception of the 1997 drop steers, which were finished on lush, perennial, spring pasture. The total number of progeny

slaughtered over the four years was 1,219 (629 steers and 590 heifers). Ninety seven sires were represented (12 to 17 per breed), and the number of progeny per sire ranged from 2 to 32.

Slaughter Details. The main criterion determining time of slaughter for each steer and heifer group was days in the feedlot with an emphasis on minimising financial loss. Apart from the 1995 drop steers, all cattle within each steer or heifer drop were slaughtered either on the same day or within a few days. The final live weight was generally measured a few days prior to slaughter as a "full" weight whereas the 1995 drop steers were weighed after transport and an overnight fast prior to slaughter. Hot carcass weight and P8 fat depth were standard abattoir measurements taken on the slaughter chain. Eye muscle area (EMA), rib fat depth and marbling were measured in the chiller the day after slaughter by Ausmeat accredited assessors. The old marble scoring system was used for the 1994 progeny and the new scoring system used thereafter.

The 1995 drop steers were slaughtered and boned out over 5 weeks so that saleable beef yield percentage (SBY %) could be accurately measured. SBY % was measured as the total meat weight, trimmed to a minimum of 6mm fat expressed as a percentage of the cold carcass weight. This measurement was used to derive an equation to estimate SBY % using the variables P8 fat depth, EMA and breed type (Ewers unpublished). The following equation was used to estimate SBY % for all of the carcasses: SBY % = breed constant – 0.15 (P8) + 0.06 (EMA $10^{th}/11^{th}$ rib) ($R^2 = 0.73$). The breed constants are: B = 66.9, L = 66.8, H = 65.0, W = 64.9, S = 64.4, A =64.0 and J = 61.9.

The number of ribs in the fore quarter of each carcass varied from 8 to 13. Equations were developed from carcass data in this project, to compare EMA at different rib sites (Rutley, pers. comm.). All EMA were standardised to a 10 rib forequarter (FQ) measurement by dividing the 8, 9, 11, 12 and 13 rib FQ EMA by the factors 0.78, 0.91, 1.04, 1.02 and 0.95 respectively.

Statistical Analysis. The data were analysed using the MIXED procedure in SAS (1996). Animals were assigned to four birth groups depending on when they were born in the calving season (early, mid 1, mid 2, late). Day of birth was fitted as a linear covariate within each of these four groups. A total of thirty cohort groups were formed based on birth year (1994 to 1997), sex (heifer or steer), birth location (Struan or Wandilo) and post-weaning group (generally 3). Slaughter date is confounded with sex, thus is accounted for by the cohort group. Furthermore, in the 1995 steers, slaughter day was not significant for any trait, hence was not fitted in the model. Sire breed, birth group and cohort group were fitted as fixed effects in the model. Sire nested within sire breed was fitted as a random effect so sire breed effects were tested against the sire mean square (89df).

RESULTS

The sire breed, sire and cohort group effects were highly significant for all traits ($P<0.001$) and accounted for a similar amount of variation. The birth group effect was also significant but only for 3 traits (final live weight, hot carcass weight and eye muscle area). The covariate, date of birth within birth group was significant for one trait (SBY %, $P= 0.049$). The wide range of values for each trait shown in Table 1 confirms the diversity of biological types represented by the seven sire breeds.

Table 1. No. of observations, least squares means, phenotypic standard deviation and range

Trait	Number	Mean [A]	σ_P [B]	Range
Final live weight (kg)	1215	486	44.2	230 to 835
Hot carcass weight (kg)	1218	266.1	26.26	120.2 to 461.0
Dressing percentage (%)	1215	54.6	1.76	45.0 to 63.9
Estimated SBY (%)	1164	67.3	0.82	62.9 to73.8
Adjusted EMA (cm^2)	1165	69	8.6	41 to 129
P8 fat depth (mm)	1218	11.9	4.13	2 to 36
Rib fat depth (mm)	1185	10.5	3.66	1 to 32
Marbling score	1027	1.0	0.54	0 to 4

[A] Overall least squares mean [B] Phenotypic standard deviation

Final live weight and hot carcass weight were highly correlated (0.96) so only the values for the latter trait have been presented (Table 2). The South Devon, Angus and Belgian Blue crosses were the heaviest for both traits with Wagyu and Jersey being the lightest. The Belgian Blue and Limousin crosses ranked first and second in dressing percentage, eye muscle area and percentage saleable beef yield with the Jersey ranking last in all three traits. The percentage saleable beef yield for the Angus was also low.

Table 2. Sire breed least squares means for each trait [A]

Sire breed [B]	*Hot carc. wt*	*Dressing %*	*P8 fat*	EMA	*SBY%*	Marbling
Jersey	232.9 ± 3.9^{a}	52.4 ± 0.2^{a}	11.2 ± 0.6^{a}	60 ± 1^{a}	64.8 ± 0.1^{a}	1.3 ± 0.1^{ab}
Angus	280.4 ± 4.0^{bc}	54.6 ± 0.3^{b}	15.6 ± 0.6^{b}	68 ± 1^{b}	65.7 ± 0.1^{b}	1.4 ± 0.1^{a}
Wagyu	240.8 ± 3.5^{a}	54.5 ± 0.2^{b}	12.8 ± 0.5^{c}	65 ± 1^{b}	66.9 ± 0.1^{c}	1.2 ± 0.1^{b}
Hereford	265.5 ± 4.3^{d}	54.0 ± 0.3^{b}	13.0 ± 0.6^{c}	65 ± 1^{b}	66.9 ± 0.1^{c}	1.0 ± 0.1^{c}
South Devon	281.8 ± 3.8^{bc}	54.5 ± 0.2^{b}	10.7 ± 0.6^{a}	72 ± 1^{c}	67.1 ± 0.1^{c}	1.0 ± 0.1^{c}
Limousin	274.4 ± 3.6^{cd}	55.6 ± 0.2^{c}	11.2 ± 0.5^{a}	75 ± 1^{d}	69.6 ± 0.1^{d}	0.7 ± 0.1^{d}
Belgian Blue	286.7 ± 3.6^{b}	56.9 ± 0.2^{d}	8.9 ± 0.5^{d}	80 ± 1^{e}	70.4 ± 0.1^{e}	0.7 ± 0.1^{d}

[A] Means with a common superscipt do not differ significantly (P>0.05) from each other.
[B] The number of animals was not identical for all breeds or traits (range 125 to 215).

The two fat depth measurements (rib fat and P8), were highly correlated (0.98) so only the P8 results are presented (Table 2). The Angus cross had the greatest amount of fat, with Wagyu and Hereford being the next highest. The Belgian Blue was the leanest of all sire breeds. Angus, Jersey and Wagyu had the highest marbling scores of all the crosses, followed by South Devon and Hereford, with Belgian Blue and Limousin having the lowest score.

DISCUSSION

The results show that the breeds differed significantly in carcass characteristics and could therefore vary in their suitability for particular markets. The Belgian Blue and Limousin sire breeds were superior in producing a lean, low marbling, high yielding carcass, attributes favoured by some beef outlets. The South Devon and Hereford sire breeds produced carcasses that ranked in the middle for both saleable beef yield and marbling. Of the two, the South Devon was faster growing, producing a significantly larger carcass. The Wagyu had the same percentage saleable beef yield as the South Devon and Hereford but produced a smaller carcass that was of higher marbling score. Many would have expected the Wagyu to have the highest marbling score of all sire breeds. Early results indicate that the Angus, Jersey and Wagyu all had high levels of intramuscular fat (IMF) and differences between ranking for marbling score and IMF may be due to the fat melting point (Siebert *et al.*1999). The Angus and Jersey produced the most highly marbled beef of all the crosses but were the lowest in relation to percentage saleable beef yield. The Angus produced a heavy carcass, equal to the South Devon, with considerable muscle but excessive subcutaneous fat. The Jersey had a smaller carcass with less muscle and excess fat in relation to its size.

Figure 1 illustrates the inverse phenotypic relationship that exists between percentage saleable beef yield and marbling. The relationship was consistent with the results of the Germ Plasm Evaluation Program, USA (Cundiff *et al.* 1988). This suggests that there is little opportunity for breeders to maximise both marbling and meat yield on the basis of breed. However, since the genetic correlation between the two traits has been reported as -0.25 (Koots *et al.* 1994), there may be opportunity to improve both traits simultaneously by selection within breed.

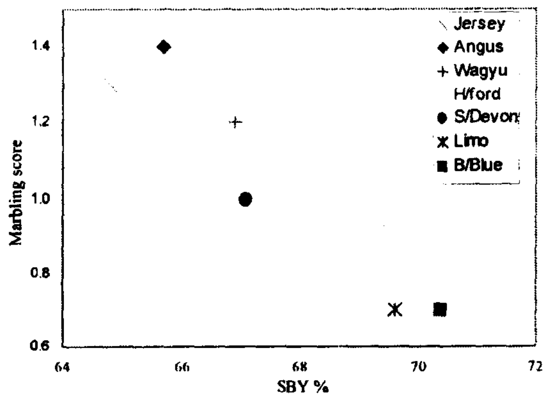

Figure 1. Relationship between marbling and SBY%.

AKNOWLEDGEMENTS

The authors thank the South Australian Cattle Compensation Trust Fund, AW & PR Davis Pty Ltd, South Australian Research and Development Institute (SARDI) and the University of Adelaide for funding the experimental work and specifically thank all staff and students involved.

REFERENCES

Cundiff, L.V., Dikeman, M.E., Koch, R.M., Crouse, J.D. and Gregory, K.E. (1988) Beef Research Progress Report **3**:3

Koots, K.R., Gibson, J.P. and Wilton, J.W. (1994) *Animal Breeding Abstracts* **62**:825

SAS Institute Inc. SAS/STATTM "User's Guide" Release 6.03 ed. Cary, NC: SAS Instit. Inc., 1996

Siebert, B.D., Pitchford, W.S., Malau-Aduli, A.E.O., Deland, M.P.B. and Bottema, C.D.K. (1999) *Assoc. Advmt. Anim. Breed. Genet* **13:** 389