EVALUATION OF THE ANGUS BREEDPLAN IMF% EBV IN 100d-FED ANGUS x HEREFORD STEER PROGENY

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SUMMARY

The Angus BREEDPLAN IMF% (intramuscular fat %) EBV was evaluated in 320 100d-fed Angus x Hereford steer progeny of 25 sires. Results showed using the EBV to select among sires would significantly increase marbling scores and IMF%, and that this was unaffected by growth regime to feedlot entry or by whether slaughter was at a constant age or weight. For the production system studied, Angus breed average IMF% EBV level was associated with MSA-scale marbling scores of 1.6 and 1.5, and IMF% levels of 4.6 and 3.9 in 'fast' and 'slow' grown steers (0.71 and 0.48 kg/d, respectively). The ability of the sire IMF% EBV to explain differences among individual steers was low but in line with expectation. The same expectation limits how effective any EBV can be in sorting individual animals of a breed for a management or marketing purpose.

INTRODUCTION

There is an ongoing need for the performance of EBVs to be 'proven' in industry data, as this is important to all adoption of genetic evaluation and for achieving faster rates of genetic gain in the beef industry (Upton *et al.* 2007). Because production systems and components of genetic evaluation (e.g. data recording accuracy, traits recorded, parameter estimates used) can differ among breeds, the need extends across breeds, traits and time. Here, the Angus BREEDPLAN IMF% (intramuscular fat %) EBV is examined for its ability to predict marbling and IMF% differences in 100d-fed Angus x Hereford steer progeny, a production system where Meat Standards Australia (MSA) marbling scores are often only 1 to 2 (McKiernan *et al.* 2005). We relate Angus IMF% EBV level to phenotype level to provide breed benchmark information for valuing marbling improvement in breeding objectives (Barwick and Henzell 2003); and we briefly comment on the percentage of phenotypic variation that an EBV can be expected to explain.

MATERIALS AND METHODS

Data. Records for marbling on an MSA scale (MSA-MS; scored 0 to 6, but with 0.1 divisions within each score) and a USDA scale (USDA-MS), and chemical IMF% (IMF) were available for up to 320 steer progeny of 25 Angus sires from an experiment in south-western New South Wales described by McKiernan *et al.* (2005). Only Angus-sired progeny from the experiment were used. Two records for each of MSA-MS and USDA-MS, and three for IMF, were considered outliers for being more than 3 s.d. from their contemporary group mean, and were excluded from analyses.

Experiment design. Steers by Angus sires of a range of genetic potential were bred by AI from Hereford cows over 5 year-seasons from 2000 to 2002. Steers were grown from weaning to feedlot entry (~400 kg) under 'fast' or 'slow' growth regimes. Unadjusted mean growth rates for Angus-sired steers of the two growth regimes were 0.71 and 0.48 kg/d. There were 2 management groups

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for each growth regime. Steers were 100d-fed in 5 slaughter groups, using 1 or 2 feedlot pens per group. Marbling scoring was carried out by MSA graders, with 1 or 2 graders per slaughter group.

Angus sire EBVs. BREEDPLAN IMF% EBVs are computed from breed database data and include adjustment to a 300 kg carcass (Graser *et al*. 2005). The BREEDPLAN IMF% EBVs for Angus sires here were calculated in November 2008. The present steer data did not contribute to the calculated EBVs. The average level of IMF% EBV for all 2007-born animals in the Angus database (the current young age group) was taken to be a relevant estimate of the current Angus breed average level of IMF% EBV. This breed average level of IMF% EBV was 0.8.

Statistical analyses. Analyses were carried out with PROC MIXED in SAS (SAS Inst., Cary, NC). MSA-MS, USDA-MS and IMF were each analysed at a constant slaughter age (within growth regime) and at a constant slaughter weight (within growth regime), by including either an age or liveweight covariate deviated from growth regime means. Initial models also included slaughter group, growth regime, management group within growth regime, pen within slaughter group, grader within slaughter group (only for MSA-MS and USDA-MS) and first-order interactions, with sire as a random effect. Growth regime and slaughter group jointly defined year-season. Heritabilities were estimated from final sire models, obtained by systematically omitting non-significant ($P > 0.05$) effects. These models included slaughter group and growth regime, and grader within slaughter group for MSA-MS and USDA-MS.

Regressions on sire IMF% EBV were evaluated by adding sire IMF% EBV, its interaction with growth regime, and the sire IMF% EBV quadratic effect to the above models, with sire excluded. Non-significant effects were again omitted. The MSA-MS, USDA-MS and IMF associated with an IMF% EBV level of 0.8 were predicted from these final models. Residuals from final models, excluding sire IMF% EBV and sire, were also derived for analysis both as individual steer phenotypes and as sire progeny means. Sire IMF% EBV was the only effect fitted in these further analyses, which were used to assess the percentage of phenotypic variation explained.

Table 1. Summary of data for 100d-fed Angus x Hereford steers, and for Angus sire IMF% EBVs

Variable	N	Mean	s.d.	Minimum	Maximum
Age at slaughter (d)	317	668	92	497	843
Liveweight (kg)	320	644	52	498	802
Carcass weight (kg)	320	359	30	267	451
Carcass P8 fat depth (mm)	320	18.8	5.0	9	36
MSA-scale marbling score	318	1.4	0.4	0.2	2.8
USDA-scale marbling score	318	357	50	230	560
Chemical IMF%	263	4.1	1.5	1.1	9.8
Sire IMF% EBV	320	0.50	0.91	-1.19	1.76
Sire IMF% EBV accuracy (%)	320	83.4	9.0	64	97

RESULTS AND DISCUSSION

A summary of the data is in Table 1. Other results are in Table 2. Heritabilities for MSA-MS, USDA-MS and IMF (0.38 to 0.48) were in the range usually observed for these traits; and variances for the same traits defined at different slaughter end-points were very similar.

Table 2. Sire IMF% EBV regression coefficients[1,2] (± s.e.) for MSA- and USDA-scale marbling scores and chemical IMF% at a constant age[3] (A) or weight[4] (W) in 100d-fed Angus x Hereford steers; and sire model estimates of variances and heritabilities.

Trait	MSA-MS		USDA-MS		Chemical IMF%	
Regression	A	W	A	W	A	W
Sire IMF% EBV	0.120*** (±0.022)	0.109*** (±0.022)	15.80*** (±2.78)	14.33*** (±2.73)	0.399*** (±0.085)	0.363*** (±0.083)
σ^2_P	0.129	0.123	2129	2016	1.68	1.59
σ^2_G	0.062	0.056	904	766	0.80	0.74
h^2	0.48	0.46	0.42	0.38	0.47	0.46

[1] *** indicates P < 0.001

[2]Pooled regressions; individual regressions for steer growth regimes did not differ (P > 0.05)

[3]At 600 and 751d for 'fast' and 'slow' steer growth regimes, respectively

[4]At 634 and 657 kg for 'fast' and 'slow' steer growth regimes, respectively

Breed benchmarks. Model predictions showed Angus sires of breed average IMF% EBV (ie. 0.8) were associated with age-constant steer progeny MSA-MS levels of 1.6 and 1.5 score, USDA-MS levels of 377 and 367 score, and IMF levels of 4.6 and 3.9 % when grown to feedlot entry at 0.71 kg/d and 0.48 kg/d, respectively. These predictions are specific to the 100d feedlot-fed production system studied, including to the joining of sires to Hereford cows.

Regressions on sire IMF% EBV. Pooled regressions on sire IMF% EBV were significant (P < 0.001) for each of MSA-MS, USDA-MS and IMF, whether these traits were defined at a constant age or constant weight (Table 2). This confirms the Angus IMF% EBV as a criterion for genetically improving marbling and IMF for the production system examined. It shows that the EBV is expected to be effective irrespective of the growth regime of steers and of whether slaughter is at a constant age or weight. There were no significant (P > 0.05) quadratic effects or differences in sire IMF% EBV regressions between growth regimes for any trait.

The regression coefficients for sire EBV on progeny performance were not significantly different from the usual expectation of 0.5 for IMF traits (Table 2), the traits that were expected to be closest to the EBV target trait (Johnston *et al*. 1999). Note that the 0.5 expectation applies only when the progeny trait is exactly the same as that for which the EBV was derived.

Ability to explain differences in sire progeny means. The percentage of variation among sire progeny means that was explained by sire IMF% EBV, at a constant age or weight, respectively, was 47.0 and 38.5 % for MSA-MS, 53.5 and 48.3 % for USDA-MS, and 41.4 and 29.2 % for IMF. These percentages are influenced by the accuracies of the IMF% EBVs that were available for sires, and which were relatively high (Table 1). The sizeable percentages of variation explained nonetheless are support for the use of the Angus IMF% EBV in sire selection.

Ability to explain individual steer differences. Sire IMF% EBV explained only a low percentage of the phenotypic variation among individual steers (e.g. 8.0 % for age-constant MSA-MS; Figure 1). Since the maximum percentage that a sire EBV, by itself, can explain is ¼ h^2 (x 100), or here 12%, this result is not surprising. The maximum percentage that can be explained occurs when the EBV has perfect accuracy and is for exactly the same trait as that predicted. When there are EBVs for individual steers (which might usually have lower accuracies than the EBVs of sires), the maximum percentage the EBV can explain is h^2 (x 100). Again, this maximum is expected only when the EBV has perfect accuracy and is for exactly the trait predicted. These maxima also

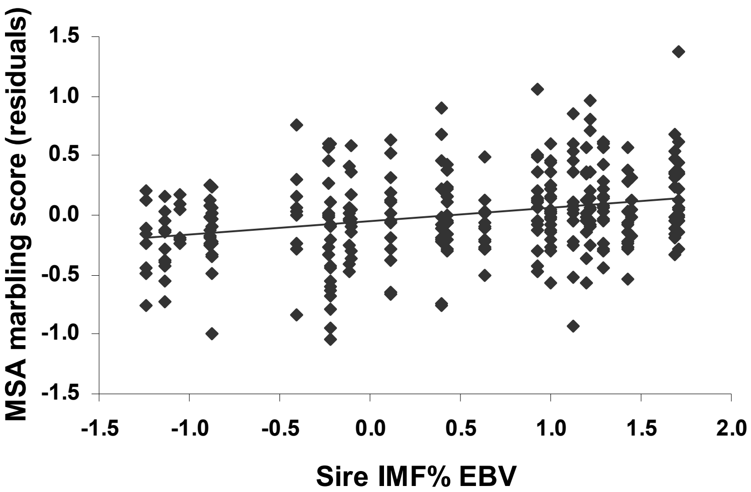

Figure 1. Residual phenotypic variation in individual steer age-constant MSA marbling score, plotted against sire IMF% EBV. The regression explains 8.0 % of the variation.

broadly indicate the limits that exist on the use that can be made of any EBV for sorting individual steers of a breed for a management or marketing purpose.

CONCLUSIONS

- Angus IMF% EBVs can be used to select among sires to increase marbling and IMF% in 100d-fed Angus x Hereford steer progeny. This result is unaffected by the growth regime of steers from weaning to feedlot entry.
- Angus breed average marbling score and IMF% benchmarks were able to be assessed for the production system examined, which included the joining of sires to Hereford cows.
- There was a lower ability of the sire IMF% EBV to explain differences among individual steers, but this was in line with expectation. The same expectation limits how effective any EBV can be in sorting individuals of a breed for a management or marketing purpose.

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