Contributed paper

EBVS PREDICT PROGENY PERFORMANCE DIFFERENCES

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SUMMARY

Estimated Breeding Values (EBVs) form a key component of modern cattle breeding programs and are the foundation for genetic improvement within the Angus breed in Australia. Demonstrating the ability of EBVs to predict differences in progeny performance in a practical, real world scenario is seen as vital to ensure the continued growth in industry acceptance of EBVs.

This work explores the ability of EBVs predicted differences in progeny performance of sires entered in cohorts 5, 6 and 7 of the Angus Sire Benchmarking Program (ASBP) by comparing the expected differences in progeny performance based on EBVs with the observed differences in average progeny performance.

The study demonstrated that EBVs predicted differences in the breeding value of sires in the ASBP for birth, growth and carcase traits, and reinforces the merits of focussed adoption strategies pertaining to EBVs within the Angus genetic improvement pipeline.

INTRODUCTION

EBVs function as both a breeding and marketing tool within modern cattle breeding programs with strong adoption by Angus seedstock and commercial breeders (Angus Australia 2020). The continued availability of evidence-based support of the technology is seen as vital to ensure confidence and increased use of the technology, enabling the industry to benefit from improvements in the rate of genetic gain.

MATERIALS AND METHODS

The TransTasman Angus Cattle Evaluation includes pedigree, performance and genomic information from the Angus Australia and Angus NZ databases to evaluate Angus and Angus-influenced animals. The major components of this analysis rely on BREEDPLAN analytical software developed by the Animal Genetics and Breeding Unit (Graser *et al*. 2005).

To evaluate the ability of EBVs to predict differences in average progeny performance the EBVs of sires prior to entering the ASBP were collated as follows;

- Cohort 5 – 46 sires – March 2015 TransTasman Angus Cattle Evaluation
- Cohort 6 – 41 sires – March 2016 TransTasman Angus Cattle Evaluation
- Cohort 7 – 34 sires – March 2017 TransTasman Angus Cattle Evaluation

The average EBV difference between the highest 10 and lowest 10 sires within each cohort were calculated for each trait to determine the expected difference in average progeny performance between the two sire groups. With the expected difference, half the EBV difference, reflecting the contribution of the sire genetics to the average performance of progeny.

Performance data from the sires progeny was collected as part of the ASBP program. Calves are produced in co-operator herds, which involves the joining of approximately 2,500 females each year via fixed time artificial insemination to 40 sires. Performance measurements for birth and early growth traits are then collected on all calves, with male progeny castrated. Male progeny are grown to feedlot entry weight, before being measured for feed intake over a 70-day test period, at which point they enter a commercial feedlot finishing program. Meat quality traits were assessed in the steer carcases following slaughter, with samples taken for meat science assessment (e.g. IMF%, shear force) (Parnell *et al.* 2019).

The range of progeny number per sire for birth weight was 12 to 47, and 8 to 47 for the growth traits. The progeny number per sire for carcase traits was lower (from 4 to 27 progeny), as only male progeny were measured for these traits.

The progeny performance data for each trait was analysed through the Statistical Analysis System (SAS) to generate Least Squares Means (LSMs) for each sire, within their cohort. The LSMs were estimated using adjusted data and accounting for contemporary group as explained by Graser *et al*. (2005).

The LSMs are used to determine the observed differences between the mean progeny performance of the highest and lowest EBV sire groups. The expected differences were then compared to the observed differences to determine the reliability of the EBVs in predicting differences in progeny performance.

RESULTS AND DISCUSSION

A comparison of the average EBV differences and observed differences in progeny performance for birth and growth traits is shown in Table 1 and Table 2. When the average expected difference is compared to the average actual difference, the results demonstrate that EBVs predict differences in the genetic merit of animal's for birth weight and the growth traits. As an example, for Birth Weight, the average EBV difference between the highest 10 and lowest 10 EBV sires was 3.7kg. The EBV difference was then halved to determine the average expected difference, of 1.9kg, and compared to the average actual difference of 1.5kg.

Table 1. Comparison between average EBV difference and progeny performance for Birth Weight of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average
Average High EBV (kg)	6.1	6.7	6.0	6.3
Average Low EBV (kg)	2.6	2.7	2.4	2.6
Difference in EBV (kg)	3.5	4.0	3.6	3.7
Expected Difference (kg)	1.8	2.0	1.8	1.9
Average High LSM (kg)	38.5	38.3	38.4	38.4
Average Low LSM (kg)	37.3	36.3	37.1	36.9
Actual Difference (kg)	1.2	2.0	1.3	1.5

The results for the carcase composition traits show alignment with those seen in birth and growth traits, when the average expected difference is compared to the average actual difference. This was most evident in Carcase Weight (Table 3), Eye Muscle Area (Table 4) and Intramuscular Fat (Table 7). The results show that the expected differences in performance based on EBVs was observed in the differences in average progeny performance, apart from carcase rump fat (Table 6). The discrepancy observed for carcase rump fat may be a function of unintended abattoir effects, such as hide puller damage, leading to lower precision in measuring this trait.

The methodology enabled the ability of EBVs to predict differences between progeny performance to be assessed, but did not fully account for the effect of the low number of progeny per sire. To fully account for this effect and to fully understand the statistical significance a much larger study would need to be undertaken.

Table 2. Comparison between average EBV difference and progeny performance for 200 Day Weight of the highest 10 and lowest 10 EBV sires for this trait

	200 Day Weight				400 Day Weight				600 Day Weight			
Cohort	5	6	7	Avg.	5	6	7	Avg.	5	6	7	Avg.
Average High EBV (kg)	55.4	56.4	58.4	56.7	102.5	101.8	105.7	103.3	137.8	137.2	138.2	137.7
Average Low EBV (kg)	33.4	40.5	44.2	39.4	63.8	76.5	82.3	74.2	81.6	99.0	106.1	95.6
Difference in EBV (kg)	22.0	15.9	14.2	17.3	38.7	25.3	23.4	29.1	56.2	38.2	32.1	42.1
Expected Difference (kg)	11.0	8.0	7.1	8.7	19.3	12.7	11.7	14.6	28.1	19.1	16.0	21.1
Average High LSM (kg)	251.0	217.6	231.6	233.4	375.7	360.4	362.9	366.3	571.3	623.2	586.8	593.8
Average Low LSM (kg)	237.4	209.2	227.9	224.8	359.2	347.0	350.2	352.1	545.7	603.2	572.6	573.8
Actual Difference (kg)	13.6	8.4	3.7	8.6	16.5	13.4	12.7	14.2	25.6	19.9	14.2	19.9

Table 3. Comparison between average EBV differences and progeny performance for Carcase Weight of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average
Average High EBV (kg)	77.3	83.2	86.3	82.3
Average Low EBV (kg)	40.6	52.9	60.8	51.4
Difference in EBV (kg)	36.7	30.3	25.5	30.8
Expected Difference (kg)	18.4	15.1	12.7	15.4
Average High LSM (kg)	429.3	435.2	429.9	431.5
Average Low LSM (kg)	411.2	423.4	419.8	418.1
Actual Difference (kg)	18.1	11.9	10.1	13.4

Table 4. Comparison between average EBV difference and progeny performance for Carcase Eye Muscle Area of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average (cm^2)
Average High EBV (cm^2)	10.6	11.1	8.4	10.0
Average Low EBV (cm^2)	2.8	3.6	3.6	3.3
Difference in EBV (cm^2)	7.8	7.5	4.8	6.7
Expected Difference (cm^2)	3.9	3.8	2.4	3.3
Average High LSM (cm^2)	89.2	94.1	90.3	91.2
Average Low LSM (cm^2)	87.3	89.7	88.8	88.6
Actual Difference (cm^2)	1.9	4.4	1.6	2.6

Table 5. Comparison between average EBV difference and progeny performance for Carcase Rib Fat of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average
Average High EBV (mm)	1.9	2.1	1.8	1.9
Average Low EBV (mm)	-2.2	-1.5	-1.6	-1.8
Difference in EBV (mm)	4.1	3.6	3.4	3.7
Expected Difference (mm)	2.0	1.8	1.7	1.8
Average High LSM (mm)	18.2	14.7	15.3	16.1
Average Low LSM (mm)	15.6	14.6	12.8	14.3
Actual Difference (mm)	2.6	0.1	2.5	1.8

Table 6. Comparison between average EBV difference and progeny performance for Carcase Rump Fat of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average
Average High EBV (mm)	2.2	19.9	1.3	1.8
Average Low EBV (mm)	-2.6	-1.9	-2.2	-2.2
Difference in EBV (mm)	4.8	3.8	3.5	4.0
Expected Difference (mm)	2.4	1.9	1.7	2.0
Average High LSM (mm)	19.6	19.6	22.9	20.7
Average Low LSM (mm)	19.5	19.6	20.3	19.8
Actual Difference (mm)	0.1	0.0	2.6	0.9

Table 7. Comparison between average EBV difference and progeny performance for Carcase Intramuscular Fat of the highest 10 and lowest 10 EBV sires for this trait

	Cohort 5	Cohort 6	Cohort 7	Average
Average High EBV (%)	2.8	3.9	4.0	3.6
Average Low EBV (%)	0.5	0.9	1.4	0.9
Difference in EBV (%)	2.3	3.0	2.6	2.6
Expected Difference (%)	1.2	1.5	1.3	1.3
Average High LSM (%)	9.9	9.3	9.4	9.5
Average Low LSM (%)	8.4	7.8	7.8	8.0
Actual Difference (%)	1.5	1.5	1.6	1.5

CONCLUSIONS

The work has demonstrated that EBV differences are a predictor of differences in progeny performance for birth, growth and carcase traits. The expected difference in progeny performance calculated from the difference between the average initial EBV of the highest 10 and lowest 10 sires provided a prediction of the observed difference in progeny of the two groups of sires, assessed through the ASBP program.

Breeders should have confidence in using EBVs to identify genetics that are most aligned with their breeding objectives, as EBVs provide an indication of the genetics that sires are delivering to a breeding herd.

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