Proc. Assoc. Advmt. Anim. Breed. Genet. 26: 475-478

SEVEN YEARS ON: WHAT HAS SINGLE-STEP BREEDPLAN MEANT FOR THE AUSTRALIAN BRAHMAN BREED?

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SUMMARY

A multi-trait single-step GBLUP (ssGBLUP) BREEDPLAN analysis that combined pedigree, performance and genomic data was first released for the Australian Brahman Breeders' Association (ABBA) in April 2017. In the seven years since, Australian Brahman breeders have embraced genotyping, with over 78,000 genotypes included in the analysis. The inclusion of this genomic information has improved the accuracy of BREEDPLAN Estimated Breeding Values (EBVs), although the improvement in EBV accuracy varies by trait and animal. Additionally, the ability to collect genomic information for use in the Brahman BREEDPLAN analysis has seen an increase in the number of young animals offered for sale with published EBVs and Selection Indexes, especially at large multi-vendor sales like the Rockhampton Brahman Week Sale.

INTRODUCTION

The BREEDPLAN analytical software (Graser *et al*. 2005) was developed by the Animal Genetics and Breeding Unit (AGBU) in the 1980s, with the first BREEDPLAN EBVs published by the Agricultural Business Research Institute (ABRI) in 1985. In the 40 years since, the BREEDPLAN model has been continually updated to incorporate new methodology and traits (Gudex *et al*. 2025). A recent development was the implementation of Single-Step BREEDPLAN evaluations in 2017 (Johnston *et al*. 2018), with over 20 Single-Step BREEDPLAN evaluations now routinely conducted by ABRI. This includes the Brahman Single-Step BREEDPLAN (Brahman ssBP) evaluation, which was the first multi-trait ssGBLUP BREEDPLAN evaluation to be released in 2017.

This paper reviews the size and composition of the Brahman Genomic Relationship Matrix (GRM) and how this has changed over the seven years since the release of Brahman ssBP in April 2017. The effect of including genomic information on BREEDPLAN EBV accuracy, and the practical implications for Australian Brahman breeders, is explored.

MATERIALS AND METHODS

The Brahman ssBP evaluation combines pedigree, performance and genomic information from ABBA in a complete multi-trait BREEDPLAN analysis of birth, growth, fertility, carcase and temperament traits. Monthly evaluations are run each year, with 18 trait EBVs reported. For the purposes of the current study, GRM data was extracted from the January 2018 and December 2024 Brahman ssBP evaluations.

The impact of genomics on EBV accuracy was examined by comparing results from the December 2024 Brahman ssBP evaluation with results from the same analysis run with genomic data excluded (BP). Data was analysed for all genotyped animals with an EBV accuracy of ≥5% in the Brahman ssBP evaluation.

To analyse the number of Brahman animals at the multi-vendor Rockhampton Brahman Week Sale (held annually in October) with BREEDPLAN EBVs available at the point of sale, the printed sale catalogues from the 2016 through to 2024 sales were examined. To avoid bias from the introduction of new EBVs during this time period (including shear force, flight time and percent normal sperm) or EBVs that were not reported in the hard copy catalogues across all years (e.g. mature cow weight), only a subset of EBVs were examined. These were birth weight, 200 day weight, 400 day weight, 600 day weight, scrotal size, days to calving, eye muscle area and rump fat.

RESULTS AND DISCUSSION

Brahman G-Matrix composition. The number of animals in the GRM has increased by 7.2 fold between January 2018 and December 2024, from 10867 animals in the January 2018 analysis to 78677 animals in the December 2024 analysis.

Interestingly, female animals are well represented in the GRM, representing 51% and 49% of animals in the GRM in January 2018 and December 2024, respectively. This is in contrast to what has been observed in other beef breeds such as Hereford, where only 16% of the animals in the GRM at the time of Single-Step BREEDPLAN implementation were female (Millen and Crook 2019). While strategies for building a reference population in other beef breeds have included a focus on strategic genotyping of influential sires (Millen and Crook 2019), the Australian Brahman breed has benefited from large-scale industry-funded projects, including the Brahman Beef Information Nucleus project and Repronomics^{TM} project (Johnston *et al.* 2017), where large numbers of females were SNP genotyped and intensively recorded for a range of reproduction traits. The inclusion of data from these projects goes some way to explaining why female animals are well represented in the Brahman GRM across time.

One significant change in composition of the Brahman GRM over time is the percentage of genotyped animals without a phenotype. In January 2018, just 14% of genotyped animals had no phenotypes; by December 2024, this had risen to 49%. While the increase in the number of genotyped animals indicates that Brahman breeders have embraced genotyping since the release of Brahman ssBP, these results also indicate an increasing trend for Brahman breeders to genotype animals without collecting phenotypic information. Given the traditionally low uptake of BREEDPLAN performance recording amongst *Bos indicus* breeders in Northern Australia, the increase in genotyping has driven an increase in the numbers of young animals with BREEDPLAN EBVs available at the point of sale (as discussed further along in this paper). However, if the proportion of animals with genotypes only (and no phenotypes) continues, this could present problems for the longevity of Brahman ssBP. This highlights the importance of large-scale industry-funded projects where animals are intensively recorded and genotyped and/or the importance of encouraging phenotype collection through extension programs.

Effect of genomics on BREEDPLAN EBV accuracies. The inclusion of genomic data in Brahman ssBP has led to an increase in EBV accuracy. Across all traits, the greatest increase in EBV accuracy has been observed for animals that had a low EBV accuracy prior to the inclusion of genomic data, while those animals with a high EBV accuracy prior to the inclusion of genomic data have experienced little to no increase in EBV accuracy (Figure 1). However, the magnitude of this increase does vary by trait (Figure 1). This is further illustrated in Table 1, which shows that, for Brahman animals with an EBV accuracy of 30% prior to the inclusion of genomic data, the average increase in EBV accuracy following inclusion of genomic data ranged from 8% (Retail beef yield) to 37% (200 and 400 day weight).

Variation in the magnitudes of increase in EBV accuracy across different traits was also observed by Johnston *et al.* 2018 when the Brahman ssBP evaluation was first implemented. Similar results were also observed following the implementation of ssGBLUP for Angus (Johnston *et al.* 2018) and Hereford (Millen and Crook 2019) populations. The difference in magnitude of the accuracy increase across traits is likely explained by both heritability and the size of the reference population for each trait. Both are likely to be the case here; collection of additional phenotypes, particularly for lowly heritable and/or poorly recorded traits, are likely to drive larger increases in EBV accuracy than currently observed. Thus, the importance of performance recording remains a key extension message for both the Brahman breed in Australia and the wider beef industry.

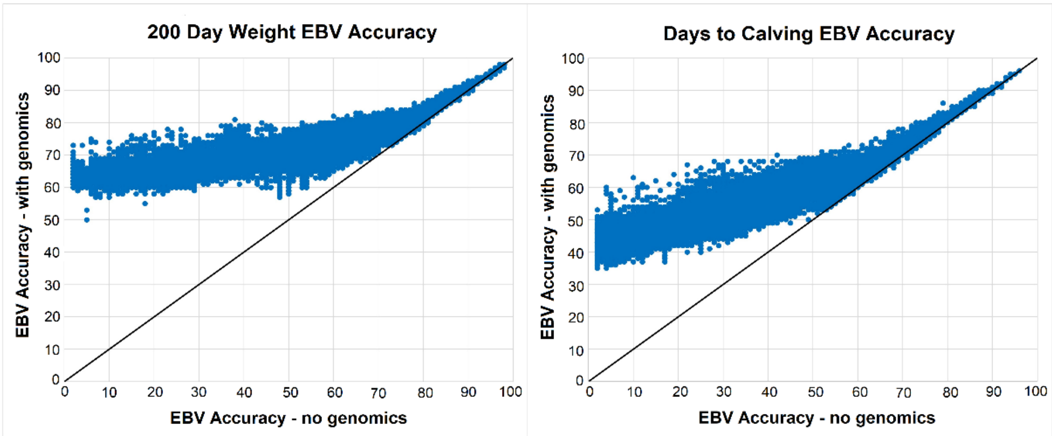

Figure 1. Changes in EBV accuracy for 200 Day Weight and Days to Calving when genomic information is included in the Brahman BREEDPLAN analysis

Table 1. Average increase in EBV accuracy when genomic information is included in the Brahman BREEDPLAN analysis, for animals that had a prior EBV accuracy of 30%

BREEDPLAN EBV	No. of animals with EBV accuracy of 30% (no genomics)	Avg. EBV accuracy (with genomics)	Avg. increase in EBV accuracy
Gestation length	2452	56	26
Birth weight	1056	63	33
200 day weight	755	67	37
400 day weight	982	67	37
600 day weight	793	66	36
Mature cow weight	1095	61	31
Milk	1726	50	20
Scrotal size	1031	62	32
Days to calving	1354	52	22
Carcase weight	1072	55	25
Eye muscle area	1156	50	20
Rib fat	1544	54	24
Rump fat	1759	54	24
Retail beef yield	2909	38	8
Intramuscular fat	2059	51	21
Percent normal sperm	1577	46	16
Flight time	783	54	24
Shear force	2301	44	14

Publication of EBVs for Rockhampton Brahman Beef Week sale animals. In 2016, the year prior to the release of Brahman ssBP, less than 20% of the sale animals (n=890) in the Rockhampton Brahman Beef Week sale catalogue had BREEDPLAN EBVs published (Figure 2). In 2024, this had increased to over 90% (n=838, Figure 2). This increase has largely been driven by the ability for Brahman breeders, following the implementation of Brahman ssBP, to conduct SNP genotyping for the purposes of obtaining Brahman ssBP EBVs. Indeed, of the 2024 sale lots, over 80% had genomic information recorded but no phenotypes. While the authors don't wish to downplay the importance of phenotypic recording for genetic evaluation, the availability of BREEDPLAN EBVs for an increased percentage of sale animals allows Brahman breeders opportunity to make more informed selection decisions and drive genetic progress in their operations.

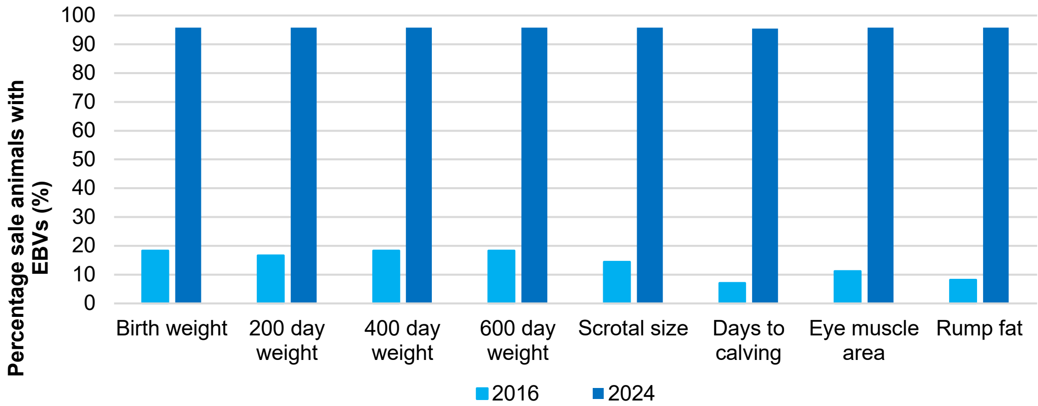

Figure 2. The percentage of animals in the Rockhampton Brahman Beef Week sale catalogues in 2016 and 2024 with birth weight, 200 day weight, 400 day weight, 600 day weight, scrotal size, days to calving, eye muscle area and rump fat EBVs available

CONCLUSIONS

Since Brahman ssBP was first released in April 2017, Brahman breeders have embraced genomic technology. There has been a rapid increase in the size of the genotyped population, which comprised 78677 animals in December 2024. The inclusion of genomic information has led to an increase in EBV accuracy, although the magnitude does vary by trait. Additionally, the ability for Brahman breeders, including those that have not traditionally collected performance information for BREEDPLAN, to conduct SNP genotyping, has led to an increase in the number of sale animals with BREEDPLAN EBVs available at the point of sale. The rapid rise in "genotyped only" animals highlights the on-going challenge of collecting phenotypic information and the importance of large-scale industry-funded research projects and extension programs for the future of the Brahman ssBP evaluation.

ACKNOWLEDGEMENTS

The authors wish to thank the Australian Brahman Breeders' Association Limited for supporting this work and providing access to their data.

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