AUSTRALIAN WAGYU ASSOCIATION™

WAGYU TECHNICAL
UPDATE

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MAJOR IMPROVEMENTS TO AWA WAGYU BREEDPLAN

THREE SIGNIFICANT IMPROVEMENTS

1. **UPDATED GENETIC PARAMETERS WERE IMPLEMENTED**
2. **CHANGED BREEDPLAN MODEL TYPE TO ACCOMMODATE HETEROSIS EFFECTS FROM CROSSBRED DATA**
3. **AN ADDITIONAL ~ 8,000 CROSSBRED PROGENY CARCASE RECORDS WERE INCLUDED**

In March 2022, three significant improvements (listed above) were implemented for the Wagyu BREEDPLAN analysis.

This article discusses the updated genetic parameters while the ***crossbred data now used in Wagyu BREEDPLAN article*** focuses on the last two improvements.

Undertaking genetic analyses to estimate breeding values (EBVs) for Wagyu cattle is a key service provided by the Australian Wagyu Association for its members. This genetic analysis (AWA Wagyu BREEDPLAN) occurs monthly, so that new performance records and genomic information can be included in the analysis and EBVs as members submit it to the AWA. Newly registered animals are also included in each new monthly analysis, allowing members to use this information for their selection and management decisions for these new calves.

AWA Wagyu BREEDPLAN has become the genetic evaluation for the global Wagyu Sector, with members in more than 20 countries registering animals and providing data. This has created the largest global Wagyu database of pedigree information, live animal data, carcase data, and genomic DNA information which is used to calculate the genetic merit of approximately 200,000 Wagyu cattle for 14 different production traits and 4 Wagyu selection indexes.

NEW WAGYU GENETIC PARAMETERS USED IN AUSTRALIAN WAGYU ASSOCIATION WAGYU BREEDPLAN

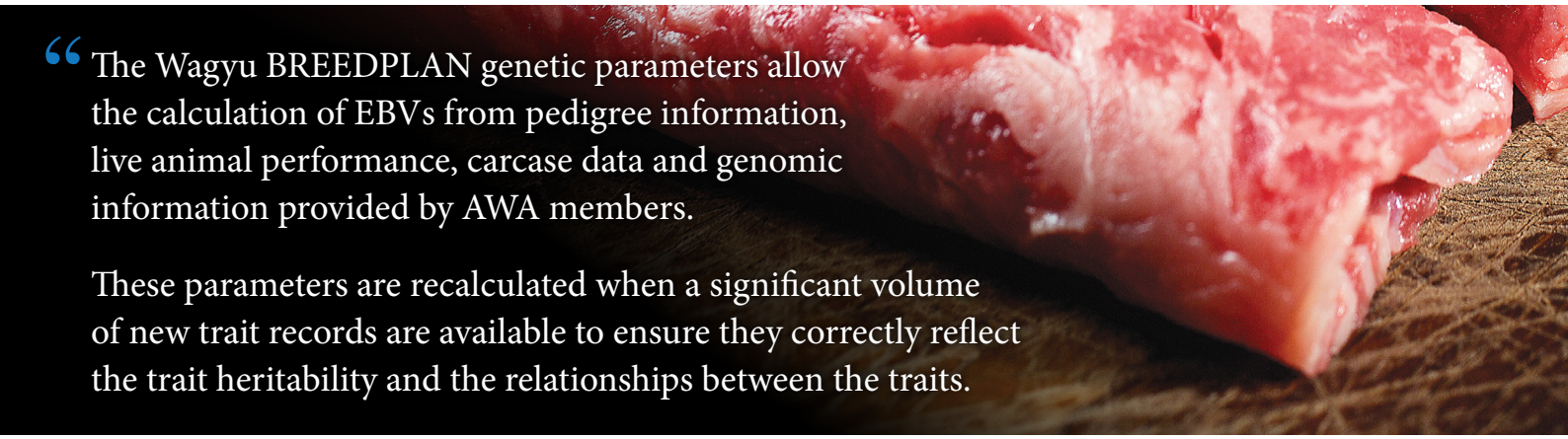
At the heart of Wagyu BREEDPLAN is a statistical model that uses all the supplied data to calculate the best statistical estimate of the genetic merit of animals for the reportable Wagyu traits. This statistical model uses "Genetic Parameters" which define the relative genetic contribution to each observable trait and the relationships between traits.

For any Wagyu production trait (eg. Birth Weight), there is a proportion of an animal's phenotype (observed birth weight) that is a result of its genetics (heritability – how much of the trait is heritable) and a proportion that is due to the environment (non-genetic – how much the trait is influenced by the environment).

The maternal nutrition available to the foetus during gestation i.e. the non-genetic effect, accounts for more than 50% of the ultimate Birth Weight of the calf with the other proportion being attributed to genetics.

As with Birth Weight, other weight/growth traits are also partly determined by genetics (heritabilities of about 30-40%) and these traits tend to be related to each other.

For instance, if an animal has a high 400 day weight (DWT), it tends to rank highly for 200 and 600 DWT as well. These relationships between traits are referred to as genetic correlations.



> "The Wagyu BREEDPLAN genetic parameters allow the calculation of EBVs from pedigree information, live animal performance, carcase data and genomic information provided by AWA members.
>
> These parameters are recalculated when a significant volume of new trait records are available to ensure they correctly reflect the trait heritability and the relationships between the traits.

Figure 1 shows the trends for accumulated numbers of trait records from 2015 to 2022, demonstrating the significant increase in performance recording conducted by AWA members over that period. The number of new records included more than 13,000 new records for carcase traits and 20,000 records for growth traits.

As shown in Figure 1, the Wagyu BREEDPLAN Genetic Parameters were last updated in 2018 by the independent research group – the Animal Genetics and Breeding Unit (AGBU) based at the University of New England. This update was undertaken prior to implementation of Single Step Wagyu BREEDPLAN which enabled the use of genomic information in the Wagyu BREEDPLAN analysis. The AGBU undertake all research and development for BREEDPLAN.

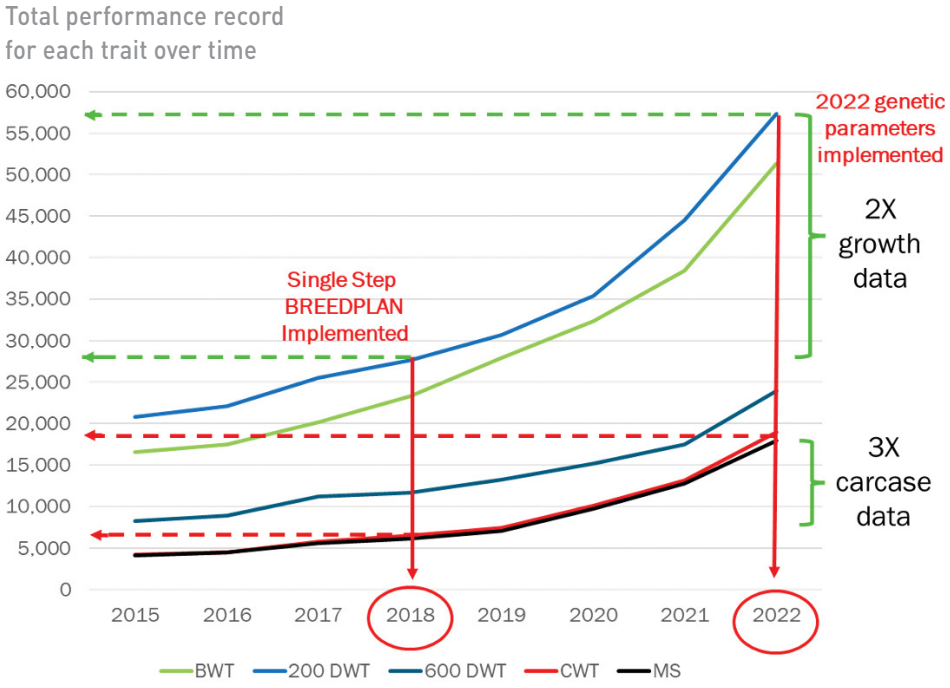
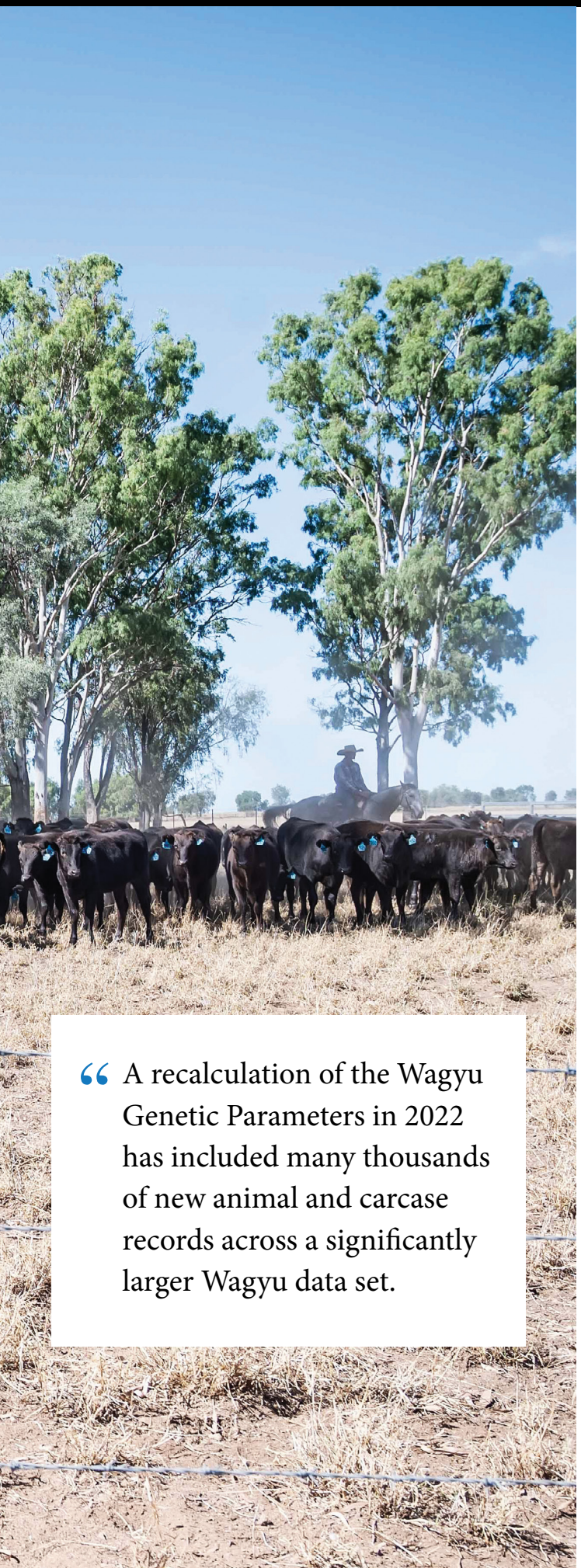


FIGURE 1
AWA additive performance recording trends over time



> A recalculation of the Wagyu Genetic Parameters in 2022 has included many thousands of new animal and carcase records across a significantly larger Wagyu data set.

CALCULATION OF NEW WAGYU GENETIC PARAMETERS FOR AWA WAGYU BREEDPLAN

Genetic Parameters are scientific descriptors of the influence of genetics on each trait (how much variation in the trait is due to genes) and the relationships between traits (some traits are genetically linked to each other – like growth rate and carcase weight). Based on the large volume of additional data submitted between 2018 and 2022, the AGBU undertook the research work to deduct new genetic parameters.

The AGBU have now completed a 2022 recalculation of the Wagyu Genetic Parameters which has included many thousands of new animal and carcase records across a significantly larger Wagyu data set. The 2022 Wagyu BREEDPLAN Genetic Parameters are significantly superior to the prior 2018 parameters and are now used within AWA Wagyu BREEDPLAN analyses commencing March 2022.

NEW WAGYU TRAIT HERITABILITIES

Heritability is expressed as a proportion from 0 to 1, with the following general ranges:

Low heritability
0 to 0.2 heritability: traits are not strongly driven by genetics (< 20%)

Moderate heritability
0.2 to 0.4 heritability: traits are moderately driven by genetics (up to 40%)

High heritability
0.4 to 0.6 heritability: traits are strongly driven by genetics (> 40%)

The newly calculated Wagyu Genetic Parameters were compared to the old (previously used in Wagyu BREEDPLAN) genetic parameters in Table 1. It was determined that the carcase traits and camera traits had moderate to high heritabilities while the heritabilities for the MIJ-30 camera traits were also high.

New genetic variances and heritabilities were higher than the previously implemented values for all BREEDPLAN traits, with one exception - the heritability of 600 DWT decreased from 0.57 to 0.46.

There was not enough new records to allow the calculation of new parameters for Mature Cow Weight (MCW), Gestation Length (GL), Days to Calving (DTC), Carcase Rib Fat (CRF) or Carcase Retail Beef Yield (CRBY). The genetic parameters for these traits remain the same as used in the old BREEDPLAN model.

Of note in Table 1 is the increase in heritability of Carcase Eye Muscle Area (EMA) and Carcase Marble Score (CMAU). The new BREEDPLAN Genetic Parameters indicate significantly higher contributions from genetics on these traits.

The analysis also determined there is now a higher amount of Genetic Variance than there was previously. This is important to Breeders, as the new BREEDPLAN analysis will result in more genetic range (EBV spread) within these traits to select animals from.

The increase in genetic variation, change in heritabilities and the redefined relationships between traits have resulted in changing EBVs for some Wagyu animals.

TABLE 1
Old and New Wagyu BREEDPLAN genetic parametres

OLD BREEDPLAN			
TRAIT	GENETIC VARIANCE	PHENOTYPIC VARIANCE	HERITABILITY
Growth traits			
BW	5.55	15.95	0.35
200D	76.13	466.91	0.16
400D	230.52	853.80	0.27
600D	649.80	1142.09	0.57
MCW	900.00	2200.00	0.41
Ultrasound scanned traits			
HP8	0.66	2.22	0.30
HRF	0.33	1.09	0.30
HEMA	8.86	25.50	0.35
BP8	0.37	1.16	0.32
BRF	0.12	0.64	0.19
BEMA	13.98	34.04	0.41
Reproductive traits			
GL	5.64	27.10	0.21
SS	2.42	5.11	0.47
DTC	38.34	543.45	0.07
Carcass traits			
CWt	664.18	1328.37	0.50
CP8	11.03	32.44	0.34
CRF	4.85	10.84	0.45
CEMA	17.95	52.81	0.34
CRBY	2.87	4.79	0.60
CMAU	1.04	3.26	0.32
CCFI	0.08	0.29	0.28
CCMP	15.02	34.43	0.44

NEW BREEDPLAN			
TRAIT	GENETIC VARIANCE	PHENOTYPIC VARIANCE	HERITABILITY
Growth traits			
BW	5.14	15.95	0.35
200D	111.51	466.91	0.16
400D	251.95	853.80	0.27
600D	557.82	1142.09	0.57
MCW	-	-	-
Ultrasound scanned traits			
HP8	0.82	2.25	0.37
HRF	0.47	1.06	0.44
HEMA	11.88	25.53	0.47
BP8	0.34	1.03	0.33
BRF	0.13	0.61	0.22
BEMA	13.72	32.32	0.42
Reproductive traits			
GL	-	-	-
SS	2.48	4.77	0.52
DTC	-	-	-
Carcass traits			
CWt	611.76	1221.40	0.50
CP8	12.48	29.76	0.42
CRF	-	-	-
CEMA	1.48	70.32	0.46
CRBY	-	-	-
CMAU	1.48	2.49	0.59
CCFI	0.08	0.23	0.35
CCMP	15.06	32.42	0.46

IMPACT OF NEW GENETIC PARAMETERS ON WAGYU BREEDPLAN EBVS

The following figures show the impact of the changes to the Wagyu BREEDPLAN Genetic Parameters on the EBVs of 900 fullblood Wagyu Sires.

Figure 2 shows that the relationship between the Old EBV and the New EBV for the 400 Day Weight (400 DWT) trait is >98%. The range in EBVs from minimum to maximum is very similar. The average EBV accuracy for the 400 DWT EBV increased slightly from 80% to 81% for these sires. The average 400 DWT EBV of these sires increased slightly from 12.4 to 12.6 kg in the New analysis.

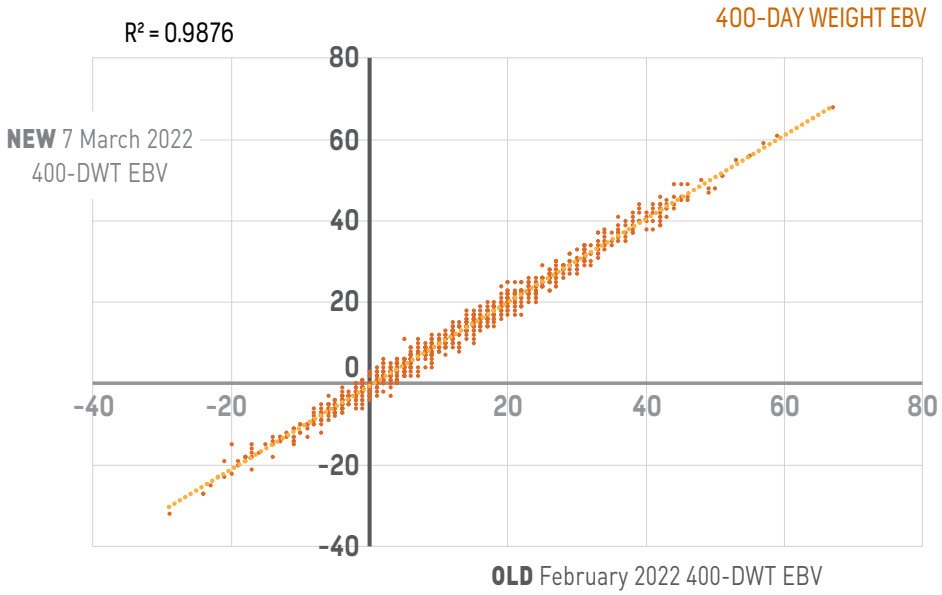


FIGURE 2
Old vs New 400 DWT EBV - 900 Sires with 0 new progeny

Figure 3 shows that the relationship between the Old EBV and the New EBV for the Carcase Weight (CWt) trait is >97%. The range in EBVs from minimum to maximum has increased slightly.

The average EBV accuracy for the CWt EBV increased slightly from 79% to 80% for these sires.

The average CWt EBV for these sires was the same (10.9kg) in both analysis.

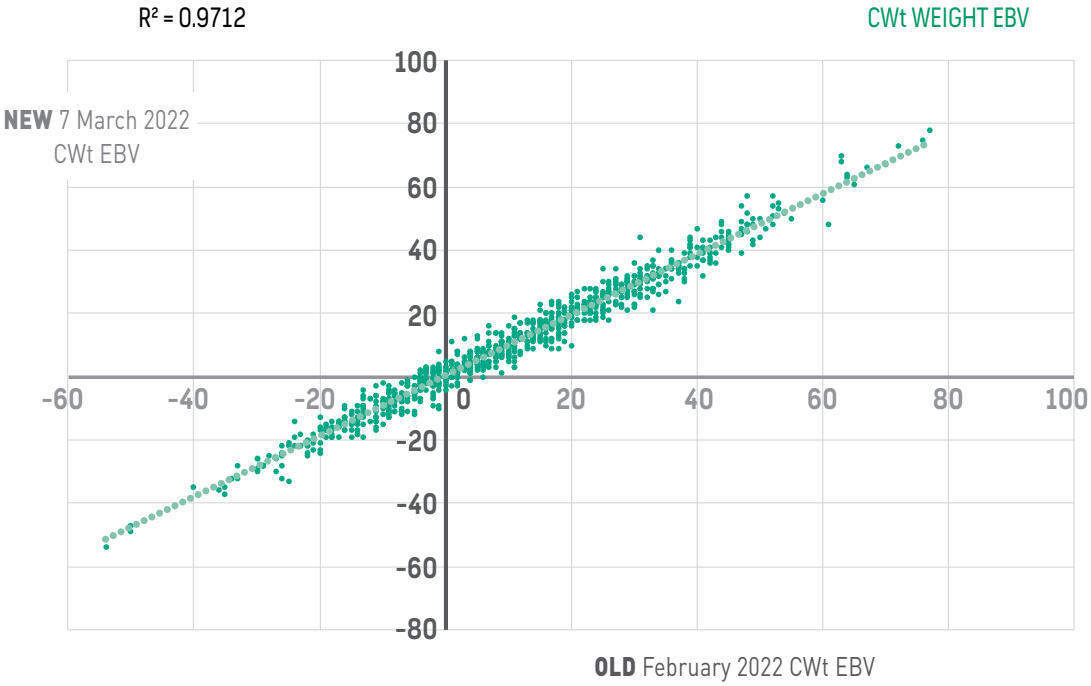


FIGURE 3
Old vs New CWt EBV - 900 Sires with 0 new progeny

Figure 4 shows that the relationship between the Old EBV and the New EBV for the Marble Score (MS) trait is 93%. The slightly greater change in MS EBVs is largely due to the significant increase in heritability for this trait with the change in new Genetic Parameters (almost doubled from 0.32 to 0.59). This change in heritability results in more of the phenotypic differences between animals attributed to genetics in the New BREEDPLAN analysis compared to the Old BREEDPLAN analysis. The average MS EBV for these sires increased slightly from 0.67 to 0.74 MS units in the New analysis. The range in EBVs from minimum to maximum increased slightly. The average EBV accuracy for the MS EBV for these sires also increased slightly from 73% to 75% in the New analysis.

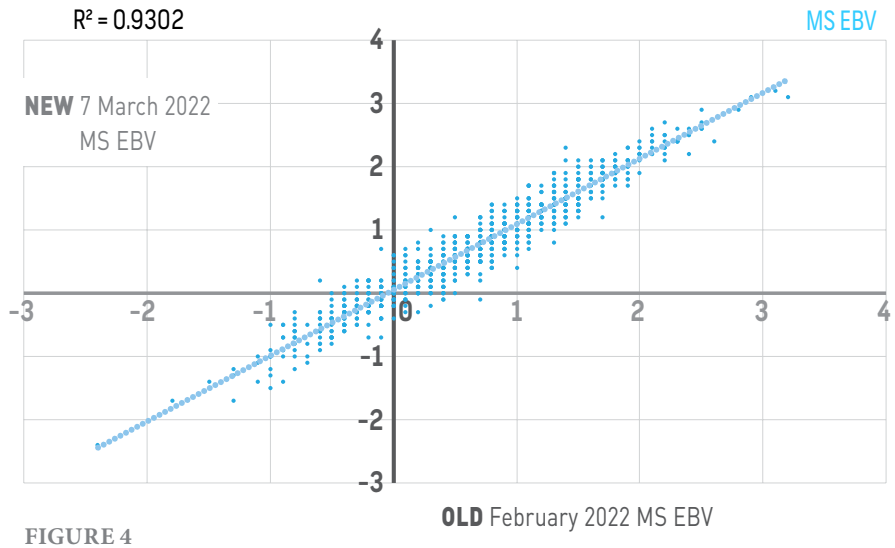


FIGURE 4
Old vs New MS EBV - 900 Sires with 0 new progeny

Figure 5 shows that the relationship between the Old EBV and the New EBV for the Eye Muscle Area (EMA) trait is 83%. The slightly greater change in EMA EBVs is due to the large change in heritability for this trait (0.34 to 0.46), along with changes in the heritability of ultrasound scanned Eye Muscle Area traits (0.35 to 0.47 and 0.41 to 0.42 for heifer and bull scanned EMA respectively).

The range in EBVs from minimum to maximum has slightly increased. The average EBV accuracy for the EMA EBV increased slightly from 69% to 72% for these sires. The average EMA EBV for these sires also increased slightly from 1.20 to 1.46 CM2 in the New analysis.

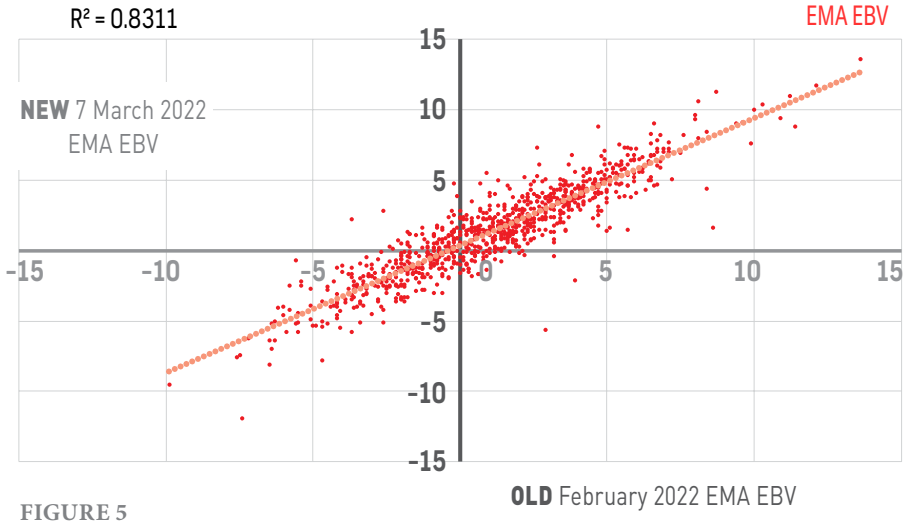


FIGURE 5
Old vs New EMA EBV - 900 Sires with 0 new progeny

SUMMARY AND FINDINGS

The Wagyu BREEDPLAN Genetic Parameters were last updated in 2018 by the independent research group – the Animal Genetics and Breeding Unit (AGBU) based at the University of New England. The AGBU undertake all research and development for BREEDPLAN.

The AGBU have now completed a 2022 recalculation of the Wagyu Genetic Parameters which has included many thousands of new animal and carcase records across a significantly larger Wagyu database.

The impacts of changes to the genetic parameters within AWA Wagyu BREEDPLAN are consistent with those expected – a slightly larger range in genetic variance in those traits where higher heritability estimates are now calculated. These changes are advantageous for Wagyu breeders to make genetic progress when using EBVs in their herds.

Within the March 2022 Wagyu BREEDPLAN analyses, the revised Wagyu Genetic Parameters as calculated by AGBU were applied. The new Genetic Parameters will continue to be applied to all future standard monthly Wagyu BREEDPLAN evaluations provided by the AWA to its members.

MORE INFORMATION

Contact the Australian Wagyu Association for further information or if you wish to republish any part of this article

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