Bicountry Evaluation for Conformation Using MACE and Animal Model

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Introduction

Currently breeding values for bulls on milk production traits, conformation traits and somatic cell counts are converted by Interbull from one country's base and scale to another country's base and scale. For this conversion Interbull applies the MACE method (Schaeffer, 1994). Breeding values of bulls are used as observations in this system. Pedigree of the bull is taken into account by adding his sire, maternal grandsire and a genetic group for maternal granddam. Breeding values of different countries are considered to be different traits by using genetic correlations among the countries lower than one.

Compared to the national genetic evaluation systems (GES), MACE has made some simplifications of the reality. In GES full pedigrees are used, as far as they can be traced back and as far as they are informative to the GES. MACE uses only sire, maternal grandsire and a maternal granddam genetic group. Further GES take data into account with most of the times from a larger time frame than MACE. MACE currently is using data of bulls born since 1986.

Goal of this research is to compare results on bulls from a MACE system with results using an animal model in a bi-country setting. For demonstration conformation data has been used from the Netherlands and USA.

Material and Methods

Data

Conformation scores of 15 linear traits, overall feet and overall final from USA and the Netherlands were made available by Holstein Association USA and NRS. The scores used in the analysis are the same scores are used in the national GES. The only edit for USA case is that only scores of first calvers are used instead of all scores for all parities in the USA GES. As time frame of data collection varies for the traits, the number of observations per trait vary (Table 1).

In total 11,134,261 animals were analyzed in the evaluation.

Table 1. Number of conformation scores from the Netherlands and USA.

	NLD	USA
Stature	3 511 146	4 310 694
Chest width	1 120 719	4 310 693
Body depth	1 120 661	4 310 694
Angularity	1 120 661	4 310 694
Rump angle	3 511 146	4 310 694
Rump width	1 904 477	4 310 694
Rear leg set side	3 511 146	4 310 694
Rear leg set rear	676 276	3 049 474
Foot angle	959 341	4 310 694
Fore udder attachm.	1 120 661	4 310 694
Udder height	3 511 146	4 310 694
Udder ligament	3 511 146	4 310 694
Udder depth	3 511 146	4 310 694
Teat placement	3 511 146	4 310 694
Teat length	3 511 146	3 152 800
Overall final	3 511 146	5 217 247
Overall feet	3 511 146	2 014 453

Method

First two single trait animal model evaluations were carried out, one using NLD data, the other the USA data. The model used was the same as currently used in the Netherlands, with in the model the effect of herd* visit* classifier* classification standard, age at classification, stage of lactation at classification and cow. Further pedigrees were traced back as far as possible, and unknown parents were replaced by phantom groups. For

each evaluation the domestic heritability was used. The estimated breeding values (EBV) from both single country evaluations were then used as input for MACE, using the genetic correlations of the May 2003 Interbull evaluation, further referred to as MACE.

Second, a bi-country evaluation was carried out using the same data and model as in the two single country evaluations. Correlations used between countries were from the May 2003 Interbull evaluation, further referred to as AM.

Breeding values of bulls from MACE and AM are compared. In this report only results on bulls tested in one country having at least 10 daughters being scored for a trait are shown. USA bulls are bulls tested (or having at least 10 daughters) only in USA, NLD bulls are bulls only tested in the Netherlands.

Results

The average differences between EBVs of bulls from the MACE and AM evaluation are shown in table 2. The analysis is carried out for the Dutch traits (on Dutch base) and for the USA traits (on the USA base).

For chest width, rear leg set rear view and foot angle the average level of the USA bulls on the Dutch base is estimated at least 0.20 genetic standard deviation higher in AM than in MACE. For three traits, stature, angularity and rear leg set side view, the level of USA bulls is estimated at least 0.20 genetic standard deviation lower in AM than in MACE.

For NLD bulls converted to the USA base, the average level of three traits, chest width, rear leg set rear view and foot angle, are estimated higher in AM than in MACE.

When looking at correlations between EBVS from AM and MACE for one part of the traits (Table 3), the correlations are high. As expected the correlations between EBVs from AM and MACE for NLD bulls on Dutch base are for all traits 1.0. The same can be seen for the USA bulls on USA base. The lowest correlation between AM and MACE for USA bulls on NLD base is found for stature, overall feet and overall final, with 0.97. For NLD bulls on USA base the lowest correlation is 0.97 for the traits overall feet and overall final.

Table 2. Difference between EBVs of bulls for NLD and USA traits from MACE and AM (difference = MACE – AM, in genetic standard deviation).

	Dutch traits		USA traits	
	NLD bulls	USA bulls	NLD bulls	USA bulls
Stature	0.03	0.23	-0.06	-0.01
Chest width	0.03	-0.22	0.21	0.01
Body depth	0.04	-0.02	0.06	0.01
Angularity	0.00	0.24	0.00	0.00
Rump angle	0.00	-0.04	0.05	-0.01
Rump width	0.04	-0.04	0.12	0.01
Rear leg set side	0.03	0.20	-0.17	-0.02
Rear leg set rear	-0.09	-0.35	0.20	0.02
Foot angle	-0.08	-0.39	0.35	0.02
Fore udder att.	0.01	-0.03	0.12	0.01
Udder height	0.00	0.08	0.04	0.00
Udder ligament	0.00	0.14	-0.11	-0.01
Udder depth	-0.01	-0.02	-0.05	0.00
Teat placement	0.01	-0.18	-0.16	-0.01
Teat length	0.00	0.01	0.02	0.00
Overall final	0.01	0.12	-0.01	0.00
Overall feet	0.01	0.11	-0.08	-0.02

Table 3. Correlation between EBVs from AM and MACE for bulls tested in NLD and USA on NLD and USA base.

	Dutch base		USA base	
	NLD bulls	USA bulls	NLD bulls	USA bulls
Stature	1.00	0.97	0.99	1.00
Rump angle	1.00	1.00	1.00	1.00
Rear leg set side	1.00	0.98	0.98	1.00
Rear leg set rear	1.00	0.98	0.98	1.00
Udder ligament	1.00	0.99	0.99	1.00
Udder depth	1.00	0.99	0.99	1.00
Teat placement	1.00	0.99	0.99	1.00
Teat length	1.00	0.99	0.99	1.00
Overall final	1.00	0.97	0.97	1.00
Overall feet	1.00	0.97	0.97	1.00

So the correlations between AM and MACE EBVs indicate there are in general no large differences, the average level is still estimated different for some traits in AM compared to MACE. Further still considerable individual differences can be found when

comparing EBVs from MACE with EBVs from AM (see Table 4).

On Dutch base, so for Dutch traits, the standard deviation of the difference between EBVs for in USA tested bull from AM and MACE are larger than 0.25 genetic standard deviation for udder depth and overall final. Some individual bulls even change more than one genetic standard deviation for traits like rear leg set rear view, udder depth and overall final. The same picture is seen for NLD bulls converted to USA base by MACE or AM (Table 4), where stature, rear leg set rear view, udder depth, overall feet and overall final show the largest differences between individual bull EBVs.

Table 4. Standard deviation, minimum and maximum of difference between EBVs from AM and MACE for NLD and USA bulls. All figures are expressed in units of genetic standard deviation).

Trait	USA bulls on Dutch base			NLD bulls on USA base		
	std. dev	min	max	Std. Dev	min	max
Stature	0.23	-0.74	1.48	0.20	-0.77	0.70
Rump angle	0.14	-0.54	0.47	0.13	-0.43	0.52
Rear leg side	0.16	-0.42	0.99	0.16	-0.85	0.42
Rear leg rear	0.22	-1.21	0.40	0.25	-0.70	1.00
Udder ligament	0.12	-0.34	0.66	0.11	-0.55	0.46
Udder depth	0.28	-1.12	1.17	0.24	-0.88	0.77
Teat placement	0.13	-0.50	0.77	0.15	-0.64	0.53
Teat length	0.09	-0.50	0.41	0.10	-0.33	0.38
Overall final	0.30	-1.00	1.52	0.22	-0.74	0.97
Overall feet	0.19	-0.72	0.89	0.22	-1.08	0.68

The effect on ranking of bulls in top 100 for each country is shown for USA bulls for five traits as an example in table 5. The results for Dutch bulls on NLD base are shown in table 6. When using AM for the bicountry evaluation, a reduction of USA bulls in top 100 is seen from 85 with MACE to 58 for stature. Also a reduction is found for overall feet. For Overall final there was no effect. For rump angle and udder depth an increase of number of USA bulls was found. In case of NLD bulls in NLD top 100 a large increase was for stature, 19 in MACE versus 58 in AM, and overall feet, 62 in MACE and 80 in AM. For rump angle, udder depth and overall a decrease of number of bulls in top 100 was found.

Table 5. Number of USA bulls in top 100 for the USA traits, based on EBVs from MACE and AM evaluation.

	MACE	AM
Stature	85	58
rump angle	55	76
udder depth	83	99
overall final	90	91
overall feet	74	50

Table 6. Number of NLD bulls in top 100 for the NLD traits, based on EBVs from MACE and AM evaluation.

	MACE	AM
Stature	19	58
rump angle	49	28
udder depth	15	3
overall final	26	8
overall feet	62	80

Discussion

With comparing the results from the MACE evaluation with the AM evaluation the assumption is that AM is the superior evaluation due to the fact:

- AM uses directly the observations, which avoids extra steps and simplifications as in used in MACE, with for example using EBV's of bulls as information source and apply deregression of EBV's as "data treatment".
- AM makes use of all pedigree information, which creates more links between countries and which takes across boarder selection effects into account. For example: bull dams have been selected in one country while the bull had been tested in another country.

For these reasons it is expected that AM is better able to estimate the difference of genetic levels of two countries and could AM be used to benchmark MACE.

Results shown with this study indicate that both evaluations, MACE and AM, give for several traits different results. Although it is hard to indicate which difference should be considered considerable and which not. Still one should strive for an evaluation, which can do the best job.

Conclusions

The method of evaluation, MACE or animal model (AM) has an effect for several traits on

- the estimated difference in genetic level of NLD and USA population;
- the ranking of bulls;

Further for several bulls considerable differences are found between MACE and AM in the conversion of their proof from the country they were tested to the country they are converted to.

When assuming that AM is the preferred model it could be stated that for international evaluation of bulls it is important to improve the current system. Options for improving the international evaluations are the improvement of current MACE or replacing current MACE with a system using pre-corrected observations from countries and analyse these in an international evaluation using an animal model. The last option has been described in the Proteje project (Canavesi, 2001).

Further an option is to validate MACE in future always with an animal model analysis. This beside the current procedure to test changes in MACE method always with a simulation study.

References

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