Trends in Sire Variance Estimates by Birth Year

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Introduction

Previous research results in Canada (4) and Italy (1) have shown that various countries have differing trends in sire variance estimates over time. In addition, the impact of each country's sire variance estimate, relative to estimates for other countries, is known to have an important impact on international sire rankings computed by Interbull using the Multi-trait Across Country Evaluation procedure (MACE).

One approach used to valid the accuracy of national evaluations, as suggested by Van Doormaal et al. (4), is to examine trends in the average and variance of Mendelian Sampling (MS) terms where MS is the difference of Parent Average (PA) less Estimated Breeding Value (EBV) for each animal. The expectation is that a trend in the average or variance of MS terms indicates a bias in the genetic evaluation system. Van Doormaal et al. showed that standardizing the variance of bull EBVs across birth years within the Canadian Test Day Model resulted in a positive time trend in the standard deviation (SD) of MS, indicating the introduction of bias within the national genetic evaluation system. It was therefore recommended that the MACE procedure used by Interbull be modified to standardize the heterogeneous sire variance estimates over time.

Miglior and Van Doormaal (2) showed that the variance of daughter MS for bulls with second country proofs in Canada is higher compared to bulls first proven in Canada. In conjunction with previous research in Italy, this result led to the following objectives for this current study:

(1) To examine the impact of excluding Canadian second country proofs from the MACE evaluations as computed by Interbull and,

(2) To examine the impact of standardizing the variance of de-regressed proofs for Canadian EBVs rather than standardizing the variance of the EBVs themselves.

Data and Analysis

Since this study was a continued effort of the initial research by Van Doormaal et al. (4), the same May 1999 national evaluations and pedigree files from Canada (CAN), Germany (DEU), Italy (ITA), Netherlands (NLD) and United States (USA) were used, but only protein yield was considered.

Sire standard deviations within each birth year and country were estimated using the REML procedure described by Sullivan (3). MACE evaluation programs used by Interbull, modified only to use the Sullivan sire variance estimation methodology, were run for three analyses; (1) using the actual files provided by the respective countries for the May 1999 official Interbull run (ie: ORIG), (2) changing the bull proof file for Canada to exclude bulls which had a second country proof in Canada (ie: W/O 21), and (3) using the bull proofs from Canada after implementing a procedure for standardizing the variance of the de-regressed proofs across birth years (ie: STD).

Analysis of the results included correlations for bulls with official domestic evaluations in Canada and rankings within the top 100 for protein yield EBV on each country scale, as estimated by each of the three MACE runs. Changes in time trends of the estimated sire variance for protein yield in Canada were also examined.

Results and Discussion

Figure 1 shows the trend in the standard deviation (SD) of the bull proofs (ETA) within each year of birth since 1983, from each of the three analyses with the Canadian genetic evaluations. The decreasing trend in the variance of ORIG bull proofs, as documented by Van Doormaal et al. (4), is significantly flatten for bulls born prior to 1990 when second country proofs were excluded (W/O 21), but an increase for bulls born since 1991 was only visible when the variance of the de-regressed proofs was standardized over time (STD).

As input to the MACE procedure, the trend in SD of the re-regressed proofs, is presented in Figure 2. The same effect of the W/O 21 and STD analyses was observed as in Figure 1. Excluding second country proofs reduced the variance of the actual proofs and the de-regressed proofs for bulls born before 1990, whereas the approach of standardizing the variance of the de-regressed proofs within the national system, essentially removed all heterogeneity of variance over time.

A critical component of the MACE procedure is the ratio of the estimates of sire variance from country to country. Figure 3 shows that the Interbull estimate of the sire SD for protein yield in Canada, as determined across all birth years, would not be significantly affected by the W/O 21 or STD analyses. On the other hand, the estimates of sire SD within birth year show that the STD analysis results in the most complete removal of time trends.

In addition to studying the impact of the W/O 21 and STD analyses on various parameter estimates, the resulting affect on MACE evaluations and international ranking is also of interest. Table 1 provides the Spearman rank correlations of EBVs for protein as estimated by each of the three MACE runs within each country, for all the 4,430 bulls which had an official domestic proof in Canada in May 1999 while Table 2 shows the analogous correlations based on only the 301 bulls which had a second country proof in Canada at that time. In general, the rank correlations based on all bulls with a domestic evaluation in Canada are very high (above .997) with the only impact for EBV protein resulting after the national genetic evaluation system standardized the de-regressed bull proofs across birth years. From Table 2, it is clear that the exclusion of Canadian second country proofs from the MACE procedure only affected the bull rankings on the Canadian scale, although the procedure of standardizing the variance of de-regressed proofs over time also resulted in the lowest rank correlation for these bulls on the Canadian scale.

From the perspective of global rankings, it is mainly those bulls among the top 100 in each country which have significant marketing opportunities. The impact of excluding the Canadian second country proofs (W/O 21) and the standardization of the variance of de-regressed proofs across birth years (STD) on the number of bulls within the top 100 for protein EBV on each country's scale is presented in Table 3. An expected trend which is very clear is that the number of high ranking bulls from a given country of first proof is maximized when expressed on that country's own scale. For example, the maximum number of NLD bulls which rank among the top 100 for protein in the ORIG data of this study was 35 on the NLD scale, followed by 28, 23, 21 and 19 on the CAN, USA, DEU and ITA scales, respectively. It is , however quite surprising and concerning that this is not true for bulls from CAN when there are more bulls which rank high on the DEU scale in each analysis compared to the home scale in CAN.

Conclusions

Exclusion of second country proofs from MACE evaluations which are biased at the national level, can impact the estimates of sire variance used by Interbull, although in this study based on Canadian proofs, little impact results on international rankings. Future research is required to ensure that second country proofs are accurately estimated nationally. In addition, trends in MS terms for cows and bulls within each national system should be introduced as an Interbull data validation requirement for inclusion in official international evaluations.

References

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2 Miglior, F. & Van Doormaal, B.J. 2000. Impact of second country proofs on genetic evaluations. *Presented at the Interbull Open Meeting in Bled, Slovenia* on May 14-15, 2000.

3 Sullivan, P.G. 1999. REML estimation of heterogeneous sire (co)variances for MACE. *Interbull Bulletin No. 22*, 146.

4 Van Doormaal, B. J., Kistemaker, G.J. & Sullivan, P. G. 1999. Heterogeneous variances of Canadian bull EBVs over time. *Interbull Bulletin No. 22*, 141.

Table 1. Within country rank correlations for EBV protein from the ORIG, W/O 21 and STD runs for all bulls with a Canadian domestic proof in May 1999 (N = 4,430)

	Protein EBV Rank Correlations		
CountryScale	ORIG and W/O 21	ORIG and STD	W/O 21 and STD
CAN	.9990	.9979	.9974
DEU	.9991	.9974	.9977
ITA	.9993	.9977	.9981
NLD	.9991	.9972	.9977
USA	.9993	.9977	.9981

Table 2. Within country rank correlations for EBV protein from the ORIG, W/O 21 and STD runs for bulls with a second country Canadian proof in May 1999 (N = 301)

	Protein EBV Rank Correlations		
CountryScale	ORIG and W/O 21	ORIG and STD	W/O 21 and STD
CAN	.9782	.9903	.9766
DEU	.9924	.9979	.9933
ITA	.9994	.9997	.9995
NLD	.9977	.9992	.9983
USA	.9995	.9998	.9997

Table 3. Number of bulls by country of first proof which rank among the top 100 for protein EBV, expressed on each country's scale, based on the ORIG, W/O 21 and STD runs

Country of 1st Proof	ORIG	W/O 21	STD
No. in Top 100 Protein EBV on CAN Scale			
CAN	**3**	**3**	**4**
DEU	7	10	5
FRA	2	3	2
ITA	2	4	4
NLD	28	17	22
USA	58	63	63
No. in Top 100 Protein EBV on DEU Scale			
CAN	5	5	7
DEU	**16**	**16**	**15**
FRA	3	3	3
ITA	6	7	6
NLD	21	20	20
USA	48	48	48
No. in Top 100 Protein EBV on ITA Scale			
CAN	2	3	4
DEU	5	5	3
FRA	2	2	2
ITA	**8**	**8**	**8**
NLD	19	19	18
USA	64	63	65
No. in Top 100 Protein EBV on NLD Scale			
CAN	3	3	4
DEU	4	4	4
FRA	2	2	2
ITA	6	6	5
NLD	**35**	**35**	**35**
USA	50	50	50
No. in Top 100 Protein EBV on USA Scale			
CAN	2	2	2
DEU	0	0	0
FRA	2	2	2
ITA	5	5	5
NLD	23	22	22
USA	**68**	**69**	**69**

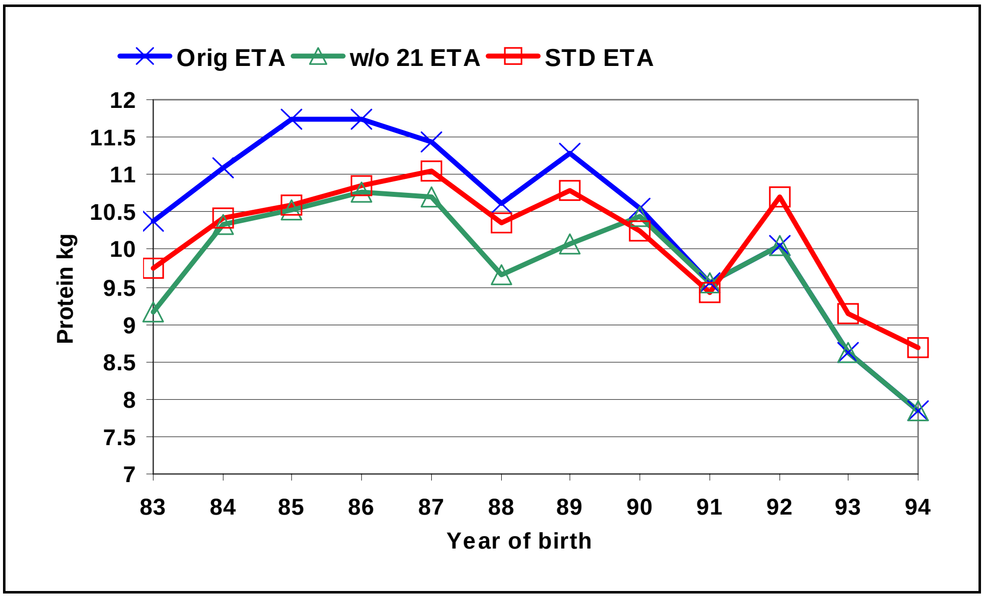

Figure 1:

Trend in standard deviation (SD) of bull ETA for protein yield from the ORIG, W/O 21 and STD runs.

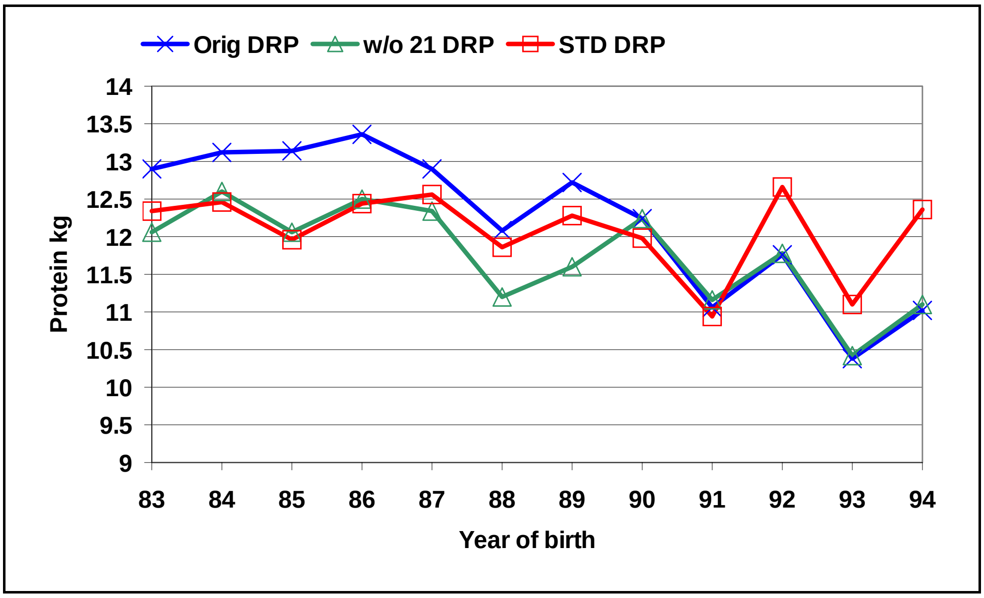

Figure 2:

Trend in standard deviation (SD) of de-regressed proofs for protein yield from the ORIG, W/O 21 and STD runs.

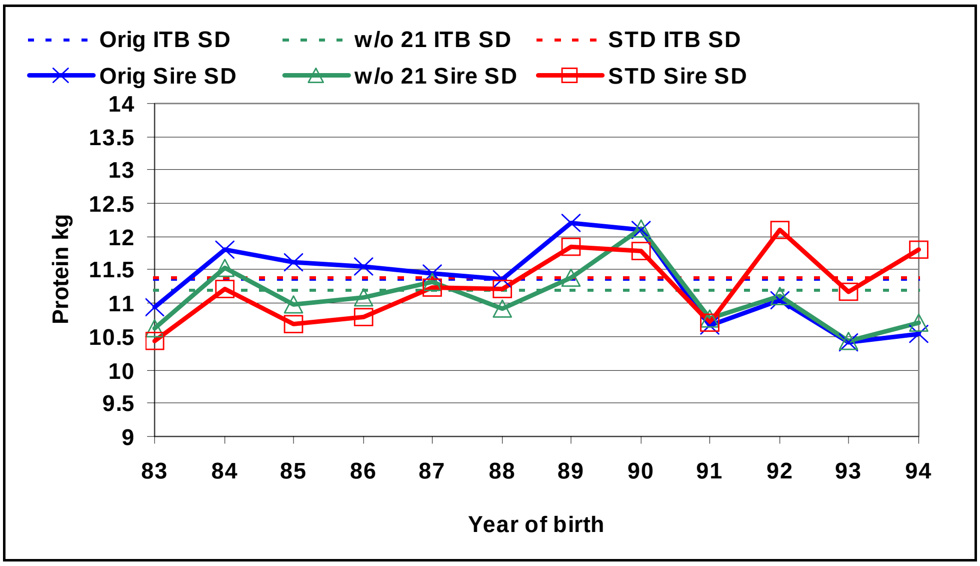

Figure 3:

Trend in estimates of sire standard deviation (SD) for protein yield from the ORIG, W/O 21 and STD runs.