Alternative Weighing Factors for Daughter Information in International Genetic Evaluations: Progress Report

Freddy Fikse and Georgios Banos
INTERBULL Centre, SLU, Box 7023, 750 07 Uppsala, Sweden

Introduction

International genetic evaluations of dairy sires can be performed by combining national evaluation results from various countries. Schaeffer (1994) proposed a multiple trait model (MACE) for this purpose, and this model is currently applied for routine international genetic evaluations of dairy sires (Banos and Sigurdsson, 1996). For practical reasons, the actual number of daughters (TOTDAU) of each bull is used to weight national proof information. However, this figure ignores factors like number of lactations, records in progress, contemporary group structure and other aspects determining the accuracy of daughter information, and it has been suggested to use an alternative weighing factor instead.

Weigel (personal communication), using a subset of the national proof file from USA, looked at differences between (single country) MACE results based on actual number of daughters and effective number of daughters approximated from national reliability (RELDAU). Although no significant effect on MACE proofs was found, reliabilities of MACE proofs were significantly influenced by the distribution of daughters across herds, and lactation length.

The objective of this study was to examine the difference in MACE proofs and their reliabilities when using RELDAU instead of TOTDAU for a case with two countries.

Data

February 1997 national evaluation results for milk yield from Canada and United States were used. Data editing and preparation was according to the routine international genetic evaluations conducted at INTERBULL Centre. Milk yield proofs from 18,146 bulls born after 1980 were used. Of these proofs, 4,182 and 14,367 were realized in CAN and USA respectively; 403 bulls had proofs in both countries. Heritabilities assumed for both CAN and USA were 0.33 and 0.25 respectively. Table 1 shows some characteristics of the data.

Table 1. Summary of data.

	CAN	USA
Reliability of proof	88. (7) *)	82. (8)
Nr. of daughters in proof	223. (1106)	277. (1488)
Nr. of herds	125. (374) 1)	120. (448) 2)
Nr. of daughters/nr. of herds	1.3 (0.5)	1.5 (1.0)

*) SD in brackets
1) Counted over all lactations
2) Counted over first lactation

Methods

Two alternative weighing factors in the international genetic evaluation were considered: TOTDAU and RELDAU. RELDAU was derived from national reliability (REL_{anim}) (VanRaden and Wiggans, 1991):

$$RELDAU = k_d \times REL_{anim}/(1 - REL_{anim})$$

where:

$k_d = (4 - h^2)/h^2$, for CAN (Koots et al., 1997), and

$k_d = (4 - 2h^2)/h^2$, for USA (VanRaden and Wiggans, 1991)

National proofs were de-regressed within country following Sigurdsson and Banos (1995), modified by Rozzi and Schaeffer (1996). (Co)Variance components were estimated according to Sigurdsson *et al.* (1996). De-regressed proofs were then analyzed jointly in MACE. Two sets of MACE proofs were obtained, one were de-regression, parameter estimation and breeding value estimation were based on TOTDAU, and one were RELDAU was used throughout the whole procedure of international genetic evaluation. Accuracy of international proofs was based on block-diagonal submatrices from the MACE mixed model equations specific to each bull.

Results

Genetic parameters

Table 2 shows the estimated sire standard deviations and genetic correlation for both alternatives. Sire standard deviations are slightly lower using RELDAU compared to TOTDAU. The ratio of sire standard deviation changed in favor of Canadian bulls. The genetic correlation was somewhat lower for the RELDAU alternative as well.

Table 2. Estimated genetic parameters using either total number of daughters (TOTDAU) or effective number of daughters, approximated from national reliability (RELDAU).

	TOTDAU	RELDAU	Difference
$\sigma_{s,CAN}$	422. kgs	414. kgs	-1.96%
$\sigma_{s,USA}$	752. lbs	741. lbs	-1.46%
r_g	.96	.95	

Conversion equations

For both sets of MACE proofs conversions, based on bulls born since 1985 with at least 40 daughters and minimum reliability of 75% in the country of origin, were estimated:

TOTDAU
USA/LBS/TA = -227.27 + .896 * CAN/KGS/BV
CAN/KGS/BV = 234.25 + 1.037 * USA/LBS/TA
RELDAU
USA/LBS/TA = -231.32 + .894 * CAN/KGS/BV
CAN/KGS/BV = 239.32 + 1.018 * USA/LBS/TA

Table 3 shows the converted proofs when these conversion equations were applied to elite as well as average young bulls in the two countries. For both countries the b-factor is lower in the RELDAU case, as was expected from the changes in sire standard deviations and the lower genetic correlation. For bulls with an above average national proofs this results in lower converted proofs using the RELDAU conversion equations.

Table 3. Converted proofs for elite bulls and average young bulls from CAN (kgs/BV) and USA (lbs/TA) using conversion equations based on either TOTDAU or RELDAU.

Country of original proof		Original proof	Conversion equations based on: TOTDAU	RELDAU
CAN	Elite bull	2577. kgs	2082. lbs	2071. lbs
	Average young bull	789. kgs	480. lbs	474. lbs
USA	Elite bull	2860. lbs	3201. kgs	3152. kgs
	Average young bull	1031. lbs	1303. kgs	1289. kgs

Ranking of bulls

Origin of bulls ranked in the top 50 based on the international proofs are shown in Table 4. Choice of weighing factor had very small effect on these ranking, which was confirmed by the high rank correlation (>.99) between international proofs based on RELDAU versus TOTDAU, on both scales.

Table 4. Origin of top 50 bulls, using TOTDAU or RELDAU.

Ranking country		Origin of bulls: CAN	USA
CAN	TOTDAU	3	47
	RELDAU	4	46
USA	TOTDAU	2	48
	RELDAU	2	48

Changes in international proofs

The average change in international proofs on local scale for bulls with proof in CAN was -1 kgs EBV, ranging from -159 - 119. For bulls with proof in USA the average, minimum and maximum were -1., -73 and 41 lbs TA, respectively. Mean, minimum and maximum difference between international proofs on the foreign scale were 5. -73 and 41 lbs ETA for bulls with CAN proof, and 2, -150 and 119 kgs EBV. Bulls with proofs in both countries were most affected by choice of weighing factor.

Table 5 shows the difference between international proofs computed using TOTDAU and RELDAU, for the 10% bulls with lowest or highest ratio nr. of daughter/nr. of proofs. Distinction has been made between bulls having daughters in 10-15 herds and 90-110 herds. For bulls with daughters in many herds changes in international proofs were negligible. Bulls with daughters in few herds are more affected by choice of weighing factor.

Table 5. Difference between international proofs (in % genetic sd) based on actual and approximated effective number of daughters, for the 10% bulls with highest ratio nr. of daughters/nr. of herds.

	Country of evaluation					
	CAN			USA		
	Average ratio	Local scale	Foreign scale	Average ratio	Local scale	Foreign scale
10 # nr. of herds # 15						
Lowest ratio	.9	-1.3	-.1	1.1	-.7	1.1
Highest ratio	5.1	-.1	1.6	7.5	.2	-.2
90 # nr. of herds # 110						
Lowest ratio	1.0	-.2	.8	1.9	-.0	-.1
Highest ratio	1.7	-.2	.6	3.4	-.1	-.0

Average change of international proof on CAN scale for bulls tested in both countries and with low number of daughters in CAN (<20) was about -1.6% sire standard deviations (RELDAU proof being higher), ranging from -18.8 to +12.0. Bulls tested in both country having low number of daughters in USA showed an increase in international proof in the local scale for the RELDAU alternative (.7% σ_s), ranging from -2.6 to +4.2. Highly reliable proven bulls showed almost no change.

Changes in reliability of international proofs

Reliability of international proofs on local scale for bulls with CAN proof changed on average -1.%, ranging from -14% to 4%. On the foreign scale the mean, minimum and maximum were -2%, -15% and 3%, respectively. Bulls with USA proof had an average change of reliability of international proof of -0%, ranging from -11% to 21%. The reliability of international proof on the foreign scale changed -1% (-13% - 25%). From Table 6 it can be seen that changes in reliability were most important when national proofs were based on a low number of daughters.

Table 6. Difference between reliability of international proofs based on TOTDAU and RELDAU, for bulls with proofs in one or both countries.

Total number of daughters	Country of evaluation			
	CAN		USA	
	Local scale	Foreign scale	Local scale	Foreign scale
Bulls with only one proof				
< 20	-8.	-6.	-5.	-4.
> 200	-0.	1.	1.	2.
Bulls with proof in both countries				
< 20	-0.	-1.	-1.	-2.
> 200	0.	0.	0.	0.

Discussion

In this study we compared the use of TOTDAU versus RELDAU as weighing factor of daughter information in international genetic evaluation. As shown, individual changes in both international proofs and their reliabilities are in some cases quite substantial. Actual number of daughters and the ratio nr. of daughters/nr. of herds explain some of the variation, but still a large part of the variation is unexplained.

Approximating effective number of daughters using national reliabilities seems intuitively appealing, however, there are some disadvantages associated with it. First, national reliabilities are approximated figures themselves, and a small survey showed that considerable differences exists between approximation methods as applied in the various countries. Second, reliability has maximum value of .99, implying a maximum on RELDAU. By using this figure, weight on information from proven bulls with large number of progeny is underestimated. Third, computation of an animal's reliabilities usually includes the reliability of its pedigree index, and therefore overestimates the weight put on *daughter* information.

In the next phase a simulation study will be carried out. Different approximated figures will be evaluated for their suitability as weighing factor for daughter information in MACE.

References

Banos, G. and Sigurdsson, A. 1996. Application of contemporary methods for the use of international data in national genetic evaluations. *J. Dairy Sci. 79*, 1117-1125.

Koots, K., Schaeffer, L.R. and Jansen, G.B. 1997. Approximate accuracy of genetic evaluation under an animal model. *J. Dairy Sci. 80* (suppl 1), 226.

Rozzi, P. and Schaeffer, L.R. 1996. New deregression procedure used on type traits. *Paper presented at INTERBULL workshop* Nov. 25-26, Verden, Germany.

Schaeffer, L.R. 1994. Multiple-country comparison of dairy sires. *J. Dairy Sci. 77*, 2671-2678.

Sigurdsson, A. and Banos, G. 1995. Dependent variables in international sire evaluations. *Acta Agric. Scand., Sect. A, Anim. Sci. 45,* 209-217.

Sigurdsson, A., Banos, G. and Philipsson, J. 1996. Estimation of genetic (co)variance components for international evaluation of dairy bulls. *Acta Agric. Scand., Sect. A, Animal Sci. 46,* 129-136.

VanRaden, P.M. and Wiggans, G.R. 1991. Derivation, calculation, and use of national animal model information. *J. Dairy Sci. 74,* 2737-2746.