Use of foreign proofs in the early years of importation.

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Australian Dairy Herd Improvement Scheme

A comparison of all sires with semen available is essential in a national dairy breeding program. Sires with local daughters can be compared in a national genetic evaluation but alternative methods are required to provide a fair comparison of these sires with foreign sires that have semen available but which are yet to have local daughters.

Where a foreign sire has a proof in his country of origin, INTERBULL has provided guidelines on methods of conversion of proofs from exporting country to importing country (Goddard, 1985; Wilmink et al, 1986; INTERBULL 1990). Plans for the INTERBULL Centre to conduct international evaluations using aggregated data from several countries are advanced and it is proposed that if the international evaluations are successful then they may replace current conversion methods.

This paper will discuss the use of conversion equations in Australia and examine international evaluation proposals. The experience with U.S. importations will serve as a guide to future importations of European sires.

Use of conversion equations in Australia

Foreign semen has been imported into Australia since artificial insemination was used on a wide scale in the 1960’s. Initial imports were from New Zealand, with imports of Canadian semen commencing in the 1970’s via the U.K. Rudimentary conversion equations were developed in the late 1970’s and INTERBULL approved methods used, where possible, once they became available.

There was importation of live animals from the U.S. before semen was imported in the late 1980’s. In 1990, Bit-O-Wind Starwar was the only U.S. bull which had a reliable proof in both the U.S. and Australia. Prior to 1992 we used indirect conversion equations for the U.S. through Canada. The U.S. to Canada conversion was the mean of the official U.S. → Canada and an unofficial Canada → U.S., both calculated at USDA (this reciprocal equation was used to ensure that the U.S. proofs were not regressed twice), and the Canada to Australia conversion was the official one.

In 1992 and 1993 direct conversions were calculated using U.S. and Canadian bulls with proofs in the U.S. and Australia. The equations were similar to the indirect conversions and it was felt that using the direct approach, albeit with non-country-of-origin bulls included, was the preferred method. In 1992 there were 7 U.S. bulls and 47 Canadian bulls that met the INTERBULL criteria, with 25 and 74 respectively in 1993.

In 1994 there are 59 U.S. bulls with reliable proofs in both countries. The ABVs and the official conversion line for protein yield are given in Figure 1. The equation for the line is 14.0 + 0.313 PTA and the correlation between ABV and PTA is 0.63. INTERBULL recommends using data with a correlation above 0.75, however with 59 U.S. bulls it does not appear productive to add a further 85 Canadian bulls. The effect on the line of adding the 85 Canadian bulls is minimal.
The slope of the conversion line is flatter than expected with many bulls away from the regression. This indicates the genetic correlation between true breeding value in the two countries is likely to be less than one - possibly due to a GxE for performance under the different production systems in the two countries, differences in the model or genetic evaluation in the two countries, and of course to favoured treatment of daughters of some bulls.

Limitations of conversion equations

Calculation of conversion equations relies on bulls having daughters in both the exporting and importing country. Preferential treatment of daughters in the importing country is well documented (for example, INTERBULL, 1993) and leads to upwards bias of converted proofs. The bias is likely to be a particular problem where semen is either in short supply or is sold at a high price. Canadian importations give an example of the change in conversion equations that arises when imported semen becomes available in commercial quantities after a period of limited supply at high prices (Figure 2). The official Canada to Australia conversion lines for protein in Figure 2 have been adjusted for the rolling base used in Canada. The Goddard (1985) method was used in each case. It can be seen that the regression coefficient has decreased with time, which corresponds with the uptake of Canadian semen by commercial farmers.

International Evaluations

INTERBULL proposes to use a multi-trait model of the type introduced by Schaeffer and Zhang (1993) for international genetic evaluations within the Holstein breed.

It is planned that foreign daughters will be omitted from the analysis if they have not been part of a recognised progeny test in order to reduce the bias due to preferential treatment. This effectively means that daughters will be used in the country of origin, and sons and grand-daughters will be used in the importing country. This reduces the amount of data
available, particularly where a bull doesn't have foreign sons - some families may be omitted from the analysis altogether.

Figure 2 Conversion of Canadian BCA to Australian ABV for protein yield from 1992 to 1994.

There are several implications of this. Firstly, for a country in the early years of importation, omitting local daughters is like omitting most of the data. It may lead to less bias but it will certainly lead to less precision. An example is given in Table 1 which shows there are only three U.S. bulls that have achieved 75% reliability in their Australian proof if their Australian daughters are omitted from the evaluation.

Table 1 Number of bulls with >75% reliability based on performance of Australian progeny

<table>
<thead>
<tr>
<th>Country of first Proof</th>
<th>Bulls with Australian daughters included</th>
<th>Bulls with Australian daughters omitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>203</td>
<td>22</td>
</tr>
<tr>
<td>U.S.</td>
<td>59</td>
<td>3</td>
</tr>
</tbody>
</table>

Secondly, the estimate of genetic trend has to be good in both countries. Rather than comparing recent information in the two countries we are comparing information a generation apart. Errors in the estimation of genetic trend in either country will cause biases that will affect bull rankings and conversions. INTERBULL is taking great steps to validate genetic trend in countries involved in the international evaluation, and this should reduce the potential errors from this source.

Thirdly, it is important that the merit of mates is accounted for adequately. If there are gaps in the pedigree, and missing parents are underestimated, then parents tend to be
overestimated. This may occur particularly where embryos or animals are imported and the dam information is not available, or not used in the importing country.

The INTERBULL proposal is a multi-trait model and so allows for \( r_g < 1.0 \) for performance in different countries. If the model uses \( r_g < 1.0 \) between Australia and the U.S., then local information becomes more important. It will not be swamped by the other country’s data where the bull may have been used more widely. Also, there will be some protection from local errors flowing across national boundaries. However, the small amount of Australian data for U.S. bulls as shown in Table 1 (if their Australian daughters are omitted), will mean the proof for performance in Australia of U.S. bulls will not be very precise.

If true \( r_g < 1.0 \) between performance in Australia and the U.S., but the model uses \( r_g = 1.0 \), then the Australian information would be swamped by the U.S. information, and this would be inappropriate. Published reliabilities for performance in Australia would also be higher than one might believe. The international proof for performance in Australia could still be used as the starting point for a bull’s ABV, and reliability calculated assuming the appropriate \( r_g \).

**Future alternatives**

Determination of the merit of foreign bulls holds particular problems for countries in the early years of importation. If \( r_g < 1.0 \) between an exporting country and a newly-importing country then omitting foreign daughters of bulls from the international evaluation will markedly reduce precision of proofs for performance of these bulls in the importing country.

A more pragmatic approach to omitting daughters holds some attraction in this case. An alternative proposal would be to include daughters in both countries if the semen is available in commercial quantities at commercial prices after the initial progeny test. This proposal requires judgement as to what constitutes commercial quantities and commercial prices, however it does not lead to the rejection of substantial amounts of data that may not in fact be subject to bias.

The estimation of \( r_g \) becomes difficult if there are a limited number of families available. There will be large standard errors, particularly where foreign daughters are omitted. It may be appropriate to include these daughters when estimating the parameters even if they are omitted from the international evaluation.

The multi-trait model being proposed holds many attractions and should become the model of choice for international comparison of bulls and as the starting point for foreign bulls in national evaluations. Further consideration of alternative ways of handling daughters of foreign bulls may prove fruitful.

**References**

Schaeffer and Zhang (1993) Paper presented at the INTERBULL meeting, Århus, Denmark August 19-20, 1993