INCORPORATING FOREIGN ESTIMATED BREEDING VALUES INTO BREEDPLAN

B. Tier[1], D. J. Johnston[1], H.-U. Graser[1] and M. E. Goddard[2]

[1]Animal Genetics and Breeding Unit*, University of New England, Armidale NSW 2351
[2]Institute of Food and Land Resources, University of Melbourne, Parkville VIC 3052

SUMMARY

Although the performance of immigrant animals in their country of origin may be well known it has not been reflected in the EBVs produced by early versions of BREEDPLAN. Foreign information is used in the new version of BREEDPLAN. Data generated from immigrants' EBVs and accuracies are included in the analysis as a proxy for the immigrants' local performance. As a result the EBVs of immigrants with high accuracy overseas but low accuracy locally reflect performance overseas. EBVs of immigrants with high local accuracy are unaffected.

Keywords: EBVs

INTRODUCTION

New genetic material - semen, embryos or live animals - is frequently imported from overseas countries to Australia. Often it has been evaluated and published in overseas sire summaries and this information has been used in the original selection decision. The foreign evaluations of some widely used animals are highly accurate whereas accumulation of data in Australia, required for these animals to be thoroughly evaluated locally, can take a long time. In particular, this is a problem for traits either recorded later in life (eg. mature cow weight) or requiring grand-progeny (eg. 200-day milk performance). With inadequate data the EBVs produced by early versions of BREEDPLAN have had low accuracy and did not reflect the breeders' state of knowledge. Estimates of 200-day milk breeding values for some imported sires has been a source of concern.

With the exception of calving ease all traits in BREEDPLAN are analysed in the one multiple trait analysis (see Johnston *et al.* 1999). The use of such a large multiple trait model allows all observations to contribute to the evaluation of all traits and allows for the unbiased analysis of observations which result from non random mating and culling of animals during the recording process. This is unlike the situation in the USA where it is common practice for a series of analyses to be performed to produce EBVs. For example, evaluations of the Angus breed in the USA are done in five separate analyses: birth weight, weaning weight and post weaning gain (published as yearling weight), scrotal size, mature cow weight (analysed with hip height), and carcase traits (fat depth, eye muscle area, marble score and carcase weight).

The use of five separate analyses implicitly assumes genetic correlations of zero between the groups of traits in the different analyses, and cannot accommodate the effect that culling animals has on the evaluations. As a result one cannot expect the evaluations of performance of the same animals in the USA and Australia to be the same, even if performance in both countries was the same. Another

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* AGBU is a joint institute of NSW Agriculture and the University of New England

source of differences in evaluations arises from differences in the production environments in North America and Australia. Finally, different models and genetic parameters used by BREEDPLAN and the overseas analyses will also induce differences in evaluations.

A variety of methods have been suggested for using information from one analysis in another. These range from using simple conversion equations to directly incorporating the information into the model (Van Vleck 1982). Conversion equations can be used to express foreign EBVs on the local scale and are developed from accurate evaluations of the same individuals in two countries. It is uncommon for many beef sires of one breed to be widely used both locally and overseas and consequently there are insufficient data for reliable conversion equations to be developed even for the traits recorded in both Australia and North America. Van Vleck (1982) developed a method for incorporating sire evaluations into within herd analyses. It assumes a common genetic background for the both evaluations. Goddard and Smith (unpublished) describe a Bayesian approach whereby the foreign EBVs are used as prior information in the local analysis. Multiple across country evaluation (MACE), whereby information from a number of analyses is combined into another, is now commonplace for traits recorded in many countries in the dairy industry (eg. Weigel and Banos 1997). These methods use the genetic correlation to describe the relative performance of animals in two different countries. The use of a high genetic correlation implies that for bulls with high accuracy in the foreign analysis almost no amount of local data will affect the local EBV. The use of a lower correlation will allow local data to dominate in time, but reduce the spread of the foreign EBVs initially.

It is common overseas for different groups of traits to be analysed indpendently. This implies genetic correlations of zero between the groups of traits. As a consequence it is not possible to use the information without assuming some unusual correlations among the foreign traits and between the foreign and local traits for the genetic covariance matrix to be positive-definite. This paper describes the method used by BREEDPLAN version 4.1 to include information from foreign analyses. It is similar to those of Van Vleck (1982) and Goddard and Smith (unpublished). The method is illustrated with some sample analyses made with and without incorporating the foreign information.

METHOD

The method uses the foreign genetic parameters, EBVs and their accuracies to generate approximations to the data (adjusted for all other effects) that were used in the foreign analyses. This is done separately for each immigrant with progeny recorded locally or without descendants. The latter are assumed to be newly imported animals without the opportunity to have had any progeny recorded yet. However, they are of significant interest to breeders. Records of ancestors of these immigrants without local data are not generated.

Using the minimum possible number of offspring and observations, a coefficient matrix is constructed using the foreign genetic and residual covariance matrices. Zero covariances are assumed between traits analysed separately. This coefficient matrix is multiplied by the foreign evaluations to provide a right hand side, which is used to generate an approximation of the numbers of animals contributing to the data (N_f) and the mean of their observations. The mean of these observations is converted into local units (eg. lb to kg) and these are treated as observations from a number of equivalent local progeny. The numbers of these equivalent progeny for each immigrant are artificially limited to a maximum of 0.5λ (where $\lambda=(4-h^2)/h^2$, and h^2 is the heritability). This is done so that, as local data become available, the EBVs will reflect the local performance. The numbers of (N_b) progeny for immigrants with fewer than the maximum are reduced using the formula

$$N_b=0.5\lambda\ (\log (1+ N_f^*)/ \log (1+M)),$$

where N_f^* is the minimum of M and N_f, and M=10λ. This has the effect of limiting the use of foreign information to a maximum for highly accurate sires but allowing the evaluations of foreign sires with low accuracies to have some influence on the local evaluations.

In the BREEDPLAN analysis these progeny and their observations are assigned to each immigrant and are accommodated in a similar way to real observations. A series of contemporary groups – one for each trait – is assigned for each source of foreign information. The solutions to these groups accommodate differences in the genetic bases between the two analyses. When there is more than one source of foreign information then the N_f^* are weighted accordingly. This method corresponds to a genetic correlation between each pair of foreign and local traits of approximately 70 % for animals with high accuracies in the foreign analyses.

The method was evaluated by analysing a breed with and without the inclusion of foreign information. Changes and correlations between EBVs resulting from pairs of analyses were examined.

Table 1. Foreign and local EBVs and accuracies for sample bulls analysed without (EBV^-) and with (EBV^+) foreign information

Bull	Local accuracy.	Foreign accuracy.	EBV^-	EBV^+	Foreign EBV
		400-day Weight (kg)			
A	High	High	+17	+17	+56
B	High	High	+23	+24	+34
C	High	n.a.	+14	+15	n.a.
		200-day Milk (kg)			
A	Low	High	+7	+23	+31
B	High	High	+4	+4	-9
C	High	n.a.	+4	+4	n.a.
		Intra-muscular Fat (%)			
A	Low	High	-0.9	-0.1	+0.6
B	Low	n.a.	-0.9	-0.6	n.a.
C	Low	n.a.	-0.5	-0.5	n.a.

n.a. = not available

RESULTS AND DISCUSSION

Table 1 presents the local and foreign accuracies, the foreign EBVs and the local EBVs calculated with and without the foreign information for three traits on three example bulls. All bulls had high accuracies locally for 400-day weight and as a consequence the foreign information had almost no effect on the local evaluations. The EBV for 200-day milk of Bull A, a bull with no daughters locally but a proven performer in the USA, changed considerably with the inclusion of the foreign data whereas that of Bull B, with plenty of daughters with calves, did not change. The EBV from the analysis which includes foreign information for Bull A better reflects the current state of knowledge than does the evaluation without foreign information. The EBVs of both Bulls A and B for percent intra-muscular fat change with the inclusion of foreign information. The change in Bull B results from correlated information on other traits. The EBVs for Bull C, with no foreign information, are unaffected by its inclusion.

Table 2 describes the mean change in EBVs and the correlations between them for sires, resulting from analyses made without or with including the foreign information. It shows that when the local EBVs are of high accuracy then the foreign information has little or no effect, but when the local accuracies are low then the foreign information alters the EBVs. The method achieves the desired goals of EBVs better reflecting the current state of knowledge of the immigrant animals initially and also allowing them to describe local performance as records becomes available.

Table 2. Changes in and correlations between EBVs for sires at different levels of local and foreign accuracies

N	Foreign accuracy	Local accuracy	Mean change in EBV ($EBV^{+} - EBV^{-}$)	Correlation
		Birth Weight		
89	>80%	>80%	+0.0	0.99
24	>80%	<80%	+1.0	0.84
24	<80%	>80%	+0.1	0.98
		400-day Weight		
70	>80%	>80%	+1.0	0.98
36	>80%	<80%	+8.2	0.72
23	<80%	>80%	-1.5	0.99
		200-day Milk		
37	>80%	>80%	+1.0	0.89
48	>80%	<80%	+2.8	0.58
20	<80%	>80%	-0.4	0.98

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