Development of Routine International Genetic Evaluation Services for Beef Cattle as an Extension of Interbull's Services

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Summary

We can discribe 3 principal steps in the recent development of international genetic evaluation in beef cattle. At the beginnings of the 90's the first attempts were multi-countries genetic evaluation of close countries using a single model without country effect. In 1999 the Irish initiative named EUBEEVAL provided a Frame to study the best statistical model to compare breeding values of animals reared in different countries and to test the feasibility of this type of genetic evaluation. This initiative was integrate in the ICAR and Interbull development in 2004 (ICAR general assembly in Sousse Tunisia). The last two years was used to put the basement of a new Interbull service and to improve the quality of the data exchanges (specially the International identification of exchanged animals) and the genetic evaluation methodology.

Introduction

In beef cattle, the international exchange of genetic material is increasing and so is the need to compare breeding values. The best way to provide useful information to the breeders in their choice of foreign genetic material is through a scientifically sound international genetic evaluation service. However, the situation regarding beef cattle is more complex than the one in dairy production: the use of artificial insemination is not as spread as it is in the dairy population with a consequent reduction in the quality of the genetic links between populations. Furthermore, the farming conditions and farming systems are far more heterogeneous.

From 2001 to 2004, Irish Cattle Breeding Federation (ICBF) coordinated a research project to develop the first European international BEef EVALuation (EUBEEVAL) in close collaboration with ICAR and INTERBULL. The conclusions of this project convinced ICAR to study the possibility for INTERBULL to introduce an international beef genetic evaluation service.

This paper summarises the historical developments prior to 2001, describes the main results of the EUBEEVAL project and relates the collaboration with INTERBULL over the last two years.

The historical background

Since the beginning of the 90's, several groups of countries have developed a common genetic evaluation in beef cattle. This generally comprised of a leader country with a large population and associated countries with smaller populations. These countries use the same rules for performance recording and have similar environment conditions and farming systems. Examples can be found in Oceania (Autralia and New Zeland) with Breedplan (Reverter *et al*., 2002), North America (United States and Canada) (Benysheck, 1998; Bullock *et al.,* 2003), and Europe (France, Italy and Luxembourg) with the IBOVAL system (Laloë and Menissier, 1990 ; Menissier *et al.,* 1996).

Breeders continued to seek more facilities for comparing breeding values obtained in different countries. Between 1994 and 1996, the French and British Limousine breeders associations started a close collaboration involving exchanges of semen to improve the genetic link between these two countries and compare the breeding values obtained in both countries (Journaux *et al.*, 1996). We obtained a sound genetic evaluation for 2 UK Limousine sires in France. In UK the US of the French AI bulls planned to develop genetic links was lower essentially because this planned AI represented a too high percentage of pure breed AI activity in UK (between 15 to

20 %). So after 2 years the collaboration was stopped.

The EUBEEVAL project

A collaborative project

In 1999, ICBF in association with the Meat Livestock Commission (MLC) from the United Kingdom and the Institut de l'Elevage from France took the initiative in establishing a research project with a double objective : (i) develop prototype software to compute breeding values with data from different European countries taking into account the heterogeneity of production systems ; and (ii) study the best way for comparing breeding values obtained in different systems. The first item was developed by the Institut National de la Recherche Agronomique team (INRA) from France on the Charolais breed and the second by the Animal Genetics and Breeding Unit (AGBU) based at the University of New England in Armidale (Australia) on the Limousine breed. These were funded by the Irish, French and UK participants in the collaboration.

Scientific results

At the term of the project in 2004, INRA showed the heterogeneity of the environment effects on performances, the feasibility of a joint genetic evaluation for beef cattle taking into account this heterogeneity and the potential benefit for the selection intensity: this study provided indeed a specific ranking of the French, UK and Irish bulls in each country. However, it also pointed out quality problems in the Irish data and the need of a new set of Irish data to compute more reliable genetic parameters

The AGBU team, with the support of Florence Phocas from INRA, determined that the best model to apply on beef cattle data for international comparisons is an animal model using raw data and accounting for across country interactions (Phocas and Donoghue, 2004, Phocas *et al*., 2004).

Practical results

Associated with these scientific results, this study underlined the necessity of a clean and complete cross-reference table which establish the correspondence between a unique international identification number, a national number (both at the INTERBULL format) and a national number (at the national format) for every exchanged animals (Quintanilla *et al.*, 2002 ; Renand 2004): this file is the key point of the joint genetic evaluation and allows the organism responsible for the international genetic evaluation to trace back all the genetic links between the countries.

Consequently, this file structure has been taken up to build all other exchanged files (performances, pedigree or fixed effects files). These files were tested and further improved during the following studies in collaboration between ICBF, Institut de l'Elevage and INRA, leading to a general guideline presenting precisely all these files (Journaux and Pabiou, 2006).

The current developments

Before any new joint genetic evaluation can take place, across-country genetic parameters have to be reestimated based on a new set of data. Following the INRA study, the quality of the cross reference table between Ireland and France have been dramatically improved (worked out by Anthunes (2004a, 2004b) and Pabiou thereafter) (tables 1 and 2): international identifications of many Charolais and Limousine animals that had not been previously identified as coming from a foreign country were corrected in the Irish database. As a result, a better connectedness has been established between the populations of Charolais and Limousine cattle between France and Ireland, France and the UK and France and Italy. Based on these new links, the INRA team computed a new set of genetic parameters between France and Ireland (Venot, 2005a 2005b).

The development of a new INTERBULL service

These results were presented at the ICAR general assembly in 2004. After discussions in the ICAR board and INTERBULL Steering committee, a task force was created with the responsibility for determining the potential market for an international beef genetic evaluation service to be offered by INTERBULL. Hans Jurgen Schild, former secretary of the ICAR beef Group, was in charge of this market analysis (Schild *et al.,* 2005).

The task force concluded that there is a potential market for an INTERBULL service of international genetic evaluation in beef cattle. For each major international breed (Angus, Charolais and Limousin), Schild *et al.* (2005) identified about 20 countries with beef performance recording. For each breed, 65 to 75% of the countries expressed an interest in getting a service from INTERBULL and about half of them, including countries with the biggest recorded populations, agreed to a financial contribution to the cost of such a service. This new service would consist in managing the cross-reference file (through a possible interactive internet interface) and computing an international joint genetic evaluation.

In November 2005, ICAR decided to proceed with the next step in establishing this new service. INTERBULL estimated that the investment required is one man-year of work for the Uppsala center spread on 3 years. The next step would therefore consist in funding the development of this INTERBULL service. Ireland, France, Denmark, Norway, Sweden, Finland, ICAR and INTERBULL have agreed to contribute much of the initial investment required to establish the service at the INTERBULL Centre.

Conclusion

These preliminary steps in developing an international genetic evaluation of beef cattle have showed the feasibility of such an evaluation in practice but have also revealed the key position of data quality and more especially of the cross reference file to identify the genetic links between the involved countries. The management of this cross reference file by a new INTERBULL service for the beef cattle will insure the quality of future genetic evaluation.

Table 1. Number of animals in the cross-reference table for Charolais breed.

			Country of birth													
Country of use	CHED	SEX	AUT	BEL	CAN	CUB	CZE	DEU	DNK	ESP	**FRA**	GBR	IRL	LUX	NLD	POL
FRA		F	1	64	6		7	29	2	9		18	5	4116	24	
FRA		M	2	47	12	3	178	97	3	6	1	27	44	3582	17	25
FRA	D	M			3	9			1			3	2			
FRA	V	M											9			
GBR	D	M									13		1			
GBR	**V**	**F**									**2385**					
GBR	**V**	**M**									**722**					
IRL	D										560					
IRL	D	F									1					
IRL	D	M									60	4				
IRL	**V**	**F**									**7640**					
IRL	**V**	**M**									**3649**					
ITA	**V**	**F**									**1825**					
ITA	**V**	**M**									**1409**					
NLD		F										10		1		
NLD		M										7		8		
NLD	D	F									27					
NLD	D	M									14					
NLD	V	F									67					
NLD	V	M									124					

CHED (chek digit) : blank : not yet validated ; “V” validated ; “D” Discarded
SEX (sex of the animal) M : Male ; F : Female

Table 2. Number of animals in the cross-reference table for Limousine breed.

			Country of birth															
Country of use	CHED	SEX	AUT	BEL	CAN	CZE	DEU	DNK	ESP	**FRA**	GBR	IRL	ITA	LUX	NLD	NOR	POL	SWE	USA
AUS	D	?								23	39								
AUS	D	M									1								
AUS	V	F								3									
AUS	V	M								58									
FRA		F	2	32	7	16	57	1	1		5		2	10161	12	1			3
FRA		M	2	96	9	184	200	4	20		9	53	6	9424	5	2	36		9
FRA	D	?			4			1			3				14				6
FRA	D	F		7							1		1						
FRA	D	M		2	3						5								3
FRA	V	M										18							
GBR	D	F								4									
GBR	D	M								2									
GBR	**V**	**F**								**2278**									
GBR	**V**	**M**								**5340**		13							
IRL	D	?								175									
IRL	D	F								56									
IRL	D	M								45									
IRL	**V**	**F**								**5269**									
IRL	**V**	**M**								**2551**									
ITA		F	18		1		3	188			2			3	10			1	
ITA		M	10		2			129			2			6	5			2	
ITA	**V**	**F**								**3853**									
ITA	**V**	**M**								**1970**									

CHED (chek digit) : blank : not yet validated ; “V” validated ; “D” Discarded
SEX (sex of the animal) M : Male ; F : Female ; ? unknown

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