International Genetic Evaluation of Calving Traits in Beef Cattle

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Abstract

For some time now, international genetic evaluation has been available for dairy cattle in Interbull. It was also found that beef cattle breeders want to have tools for the decision making on how to find the best animals from all available countries. Interbeef actually works with adjusted weaning weights and there are several research teams for other traits. A research team from the Czech Republic will be responsible for the research of calving traits. Research of calving traits in the Czech Republic is focused on two pure breeds – Charolaise and Limousine and three traits – birth weights (BWT), calving ease (CAE) and stillbirth (STB). Research of calving traits started in August 2013 and it is planned to finish in August 2014. The highest share of animals with performance is from France - 96.43% of animals for birth weights and 92.27% for calving ease. Other countries have a smaller share of animals with the performance. There are a different number of traits. Some of the countries record only selective traits or none at all. A similar situation was found for Limousine in the case of the number of animals with performance. In this situation, France will also play a very important role. In comparison, there were available fewer animals than the Charolaise. On the basis of the previous information, it is possible to conclude that animals are mostly from France. There is unbalance among the number of animals and it will be necessary to take this into account during the estimation of genetic parameters. It is expected that connectedness will be mostly through the French bulls. The best approach for the estimation of genetic correlation will be to include three countries and of which one will be France which will maintain connectedness.

Key words: Interbeef, calving traits, International genetic evaluation, birth weights, calving ease, stillbirth, Charolaise, Limousine

Introduction

For some time now, international genetic evaluation has been available for dairy cattle in Interbull. It was also found that beef cattle breeders want to have tools for the decision making on how to find the best animals from all available countries. There are several systems of international beef genetic evaluation, but most countries have only national (local) evaluation. ICAR was involved in the past in beef performance recording, but during recent years potential and analysed possibilities for International genetic evaluation in beef cattle have been created. In 2011, countries interested to joining Interbeef signed the Interbeef Working Group Agreement. Interbeef is the working group in ICAR and is focused on international genetic evaluation for beef cattle, in particular for purebred Charolaise (CHA) and Limousine (LIM), discussion forums, prepared international standards and guidelines for beef cattle survey. In the future, genomic selection for beef cattle are planned to be provided and it will extend to other breeds and crossbreeds. It is a paid service and some of the countries maintain scientific research which is primarily oriented to the development of a method for international genetic evaluation of different traits. 2013 is the high phase international genetic evaluation of adjusted weaning weights. There are the following research collaborators: France - INRA & FGE, Ireland - ICBF & Teagasc, Czech - Institute of Animal Science, Czech Moravian Breeders Corporation, Inc. Czech Beef Breeders Assn., United Kingdom – SRUC, Spain – INIA and Sweden – Interbull Centre, SLU. The Czech Republic is responsible for the research of international genetic evaluation of calving traits, which follow an approved research plan and approval of Interbeef technical committee and Interbeef working group. This paper

introduces the project, scope of the project and the basic statistical indicators and shows the methodological approach on how to approach this evaluation. The main goal is to provide a feasible solution for international genetic evaluation of calving traits in beef cattle. The project was started in August 2013 and it is planned to finish it in August 2014 or in autumn 2014.

Scope of the project

Countries and organisations involved in the project which provided data are listed in Table 1 and research team would like to address its acknowledgement to these countries and organisations which provided data. The Interbeef project is managed in the Czech Republic by the Czech Moravian Breeders´ Corporation. The Institute of Animal Science is responsible for the research. It is very important that raw data was used in Interbeef and not breeding value as in case of dairy cattle in Interbull as the research concept of our research is different.

Research of calving traits in the Czech Republic is focused on two pure breeds – Charolaise and Limousine and three traits – birth weights (BWT), calving ease (CAE) and stillbirth (STB). Table 2 shows a basic statistical overview with the number of animals with performance of Charolaise. The highest share of animals with performance is from France - 96.43% of animals for birth weights and 92.27% for calving ease. Other countries have a smaller share of animals with the performance. There are a different number of traits. Some of the countries record only selective traits or none at all.

A similar situation was found for Limousine in the case of the number of animals with performance. Also, in this case, France plays a very important role, but the share from France is lower. One can find a higher share in animals with performance in Great Britain, Denmark and Ireland (table 3). In comparison, fewer animals were available than the Charolaise. As in the previous case, there are different traits for calving traits recorded. On the basis of the previous information, it is possible to conclude that the animals are mostly from France. There is an unbalance among the number of animals and it will be necessary to take this into account during the estimation of genetic parameters. It is expected that connectedness will be mostly through the French bulls. The best approach for the estimation of genetic correlation will be to include three countries and of which one will be France which will maintain connectedness.

Table 1. Countries involved in the project International genetic evaluation of calving traits in beef cattle.

Country	Organisation(s)
Czech Republic	Czech Moravian Breeders´ Corporation, Inc. Czech Beef Breeders Association Institute of Animal Science
France	France Génétique Elevage
Denmark	Knowledge Centre for Agriculture
Ireland	Irish Cattle Breeding Federation Society Limited
Sweden	Swedish Dairy Association
Spain	INIA, FECL
Great Britain	Edinburgh Genetic Evaluation Service, a unit of Scottish Agricultural College

Table 2. Charolaise - number of animals with performance.

	CZE	DNK	FRA	IRL	SWE
BWT	40,113 *0.62%*	63,470 *0.98%*	6,256,877 *96.43%*		128,158 *1.98%*
CAE	40,113 *0.59%*	114,093 *1.68%*	6,251,815 *92.27%*	231,866 *3.42%*	137,431 *2.03%*
STB		132,769 *36.41%*		231,866 *63.59%*	

Table 3. Limousine - number of animals with performance.

	CZE	DNK	ESP	FRA	GBR	IRL	SWE
BWT	9,554 *0.24%*	139,180 *3.56%*	56,814 *1.45%*	3,493,022 *89.33%*	186,814 *4.78%*		25,010 *0.64%*
CAE	9,554 *0.24%*	258,448 *6.37%*		3,468,851 *85.53%*	121,406 *2.99%*	170,856 *4.21%*	26,369 *0.65%*
STB		310,706 *64.52%*				170,856 *35.48%*	

There are data available for stillbirth from only two countries – Denmark and Ireland. This may be a potential problem with the connectedness between these two countries. One of the solutions could be an estimation of genetic parameters together with other correlated traits (for example CAE).

Phase of research and methodological approach

There are four phases of the research:
- 1st phase – research commences after receiving data files from ITBC (resp. the participating countries), statistical analysis and preparation of input data files for genetic parameters estimation
- 2nd phase – genetic parameters estimation, breeding values prediction (including reliabilities) – direct & maternal
- 3rd phase - after the successful completion of the test and the calculation of EBV's & Rel's, the software will be transferred to ITBC for routine running
- 4th phase (and further) – (and further) continued international evaluation research (new parameters, evaluation model & reliability) for new countries and breeds for calving traits

The approach on how to calculate BVE is assumed as follows:
- An animal model on raw performance, accounting for heterogeneous variance and different genetic correlations between countries, will be used. The aim will be to estimate direct and maternal genetic breeding values and permanent maternal environmental effects for calving ease
- Furthermore, we suggest joint evaluation of breeding values for calving ease and breeding values for birth weight due to the genetic correlation between calving ease and birth weight
- Bi- or multivariate analyses
- Sire model
- Method proposed by Venot *et al.* 2009 for international genetic evaluations of calving traits in beef cattle data

Heritability

Heritability for a direct genetic effect in the countries which provide data for the research on calving traits in the national genetic evaluation is shown in Table 4. For calving ease, heritability is around 10%. The highest was reached in Sweden at 16%. It was from 5% to 16%. There are actually only two countries in the case of stillbirths and in both cases it is below 10%. There is higher variability in the case of birth weight, which is influenced by environmental effects, quality of recorded data, different models, different scale, herd size, creation of contemporary group and interaction genotype – environment. For example, in France it is higher than 40%, in some countries less than 10%. This is of course

influenced by the model used, effects, data quality, and different scales in the countries, contemporaries group and the interaction genotype environment.

Table 4. Heritability for a direct genetic effect.

Country	BWT		CAE		STB	
	CHA	LIM	CHA	LIM	CHA	LIM
CZE	7	7	9	9	.	.
DNK	7	7	10	10	4	4
ESP	.	21	.	.	.	.
FRA	41	48	10	5	.	.
GBR	.	25	.	12	.	.
IRL	.	.	9	9	4	4
SWE	38	38	16	16	.	.

Basic statistical description and overview

Basic statistical indicators deal with birth weights are in Table 5 and include the number of animals, extreme values, means and standard deviation. It is evident that it will be necessary to focus on data editing and exclusion of extreme or incorrect values during the research in the case of birth weights.

Table 5. Basic statistical description of birth weights.

Breed	Country	N	MIN	MAX	MEAN	STD
CHA	CZE	40,113	1	99	40.8	6.2
	DNK	63,470	20	80	46.6	7.1
	FRA	6,256,877	26	80	46.6	6.0
	SWE	128,158	15	79	46.7	5.7
LIM	CZE	9,554	10	70	38.7	5.4
	DNK	139,180	20	60	40.3	4.3
	ESP	56,814	25	55	40.3	4.4
	FRA	3,493,022	23	70	40.1	4.6
	GBR	186,814	10	80	37.4	4.8
	SWE	25,010	15	66	41.2	4.4

Table 6. Relative distribution (%) of calving ease in different countries and beef breeds.

Breed	Y	CZE	DNK	FRA	GBR	IRL	SWE
CHA	1	82.95	80.73	60.35		85.85	87.33
	2	13.17	11.28	30.95		10.59	12.02
	3	3.11	2.94	4.64		2.02	0.65
	4	0.77	3.03	4.01		1.53	
	5		2.03	0.04			
LIM	1	92.23	90.21	92.19	83.32	90.46	90.49
	2	5.53	5.79	5.96	14.29	7.56	9.05
	3	1.67	1.91	1.51	1.06	1.32	0.46
	4	0.57	1.78	0.31	0.66	0.66	
	5		0.31	0.03	0.68		

The basic descriptive statistics for calving ease for the Charolaise show better results on the same scale in the case of the Limousine (Table 6). This means greater problems with calving ease in Charolaise. There is a different approach on how to measure calving ease and different scale in participants' countries used in beef cattle. Some countries use a four level scale, some five levels. Also, the definitions are less or more different (Table 7).

Table 7. Definition of calving ease.

Country	1	2	3	4	5
CZE	Spontaneous calving without any help from a breeder	Calving with help from one or two breeders	Calving requiring help from three or more people or help from a vet	Caesarean section or dystocia requiring postpartum treatment from a vet	
DNK	Easy	Easy with help	Difficult without vet	Difficult with vet	Caesarean
FRA	Spontaneous calving without any help from a breeder	Easy calving with the assistance of one person maximum	Hard calving with the assistance of many people or with a vet or with mechanical assistance	Caesarean	Embryotomy
GRB	Easy unassisted calving	Easy pull	Hard pull	Vet assistance	Caesarean section
IRL	Easy unassisted calving	Easy pull	Hard pull	Vet assistance	Caesarean section
SWE	Easy			Difficult	

Table 8. Relative distribution (%) of stillbirth in Denmark and Ireland.

Breed	Trait	DNK	IRL
CHA	1	94.3	97.9
	2	5.7	2.2
LIM	1	96.2	98.2
	2	3.8	1.8

Table 8 shows the relative distribution of still birth. There are only two countries - Denmark and Ireland. There is a better situation with the Limousine breed.

Connectedness

What is very important for international genetic evaluation is the number of common bulls. The number of bulls in particular country and common bulls was analysed which connected a different population in the case of birth weights. It is evident that bulls and common bulls available in the project are mostly from France. France will be a key country for connectedness. There are less connected bulls and common bulls in Sweden. There are 62 common bulls for stillbirth between Denmark and Ireland.

A similar situation was found for the Limousine in the case of birth weights. A high number of common bulls were found between

France and Spain and France and Great Britain. It was more than 370. In the case of calving ease, the highest number of common bulls is between France and Great Britain. There are only two countries for still birth and 63common bulls.

A useful source of information is also maternal grandsire common bulls available for different traits. There are more than 100 connected maternal grandsire bulls and common bulls available between France and Denmark and 170 connected maternal grandsire bulls and common bulls available between the Czech Republic and France for birth weights. The number of bulls available between France and Sweden is lower than in other countries. France plays a key role concerning the maternal grandsire common bulls available for calving ease as in the previous case. One can find a higher number of the maternal grandsire bulls and common bulls available between France and Ireland. A similar situation occurs as in previous case for the Czech Republic. There are only two countries for still birth as can be seen below the Table with calving ease.

Number of sires and progenies with the records of these sires

Number of sires and progenies with the records of these sires influences the reliability of BVE. For the breeding value estimation, a sufficient amount of progenies per one sire is requested. In the case of Charolaise birth weights, France has the sire higher average at almost 42. All countries have more than 20 progenies (records) per one sire in the case of birth weights. In Ireland, there is a lower number for calving ease and still birth. There are only two countries in the case of still birth. Denmark has a higher mean of records per one sire than Ireland.

From the analysis of sire birth rates, it is evident that the highest mean of progeny with records is France for the Limousine breed. It is more than 50. The average is mostly around twenty and more. There is one exception-Spain with 36 progenies. In the case of calving ease,

the situation is similar as in previous traits. There is only one exception - Ireland with 10 progenies for calving ease and birth weights.

Conclusion – how to continue with the research?
- Define connectedness between countries with sire and maternal grand sire
- Clean data of extreme and error values. This is particularly important in birth weights in some countries which sent unedited data
- Create files for estimation of genetic parameters in such a way as to create appropriate connectedness through sire and maternal grand sire among countries in the research (focus on data from France, which will ensure the connectedness of files)
- Create files for estimation of genetic parameters with a focus on ideal structure (contemporary, number of offspring of sire, number of offspring of dam, maternal grand sire and number of animals with effects)
- Single trait for the estimation of genetic parameters birth weight and calving ease 3 x 3 country with connectedness through France
- Test the possibilities of including the effect of the permanent environment on dam and maternal genetic effect
- Matrix of genetic correlation among all countries on the basis of 3 x 3 countries bending of data with the goal to receive positive definite matrix
- Test the possibilities of using multi-trait for more traits (calving traits) together

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