INTRODUCTION

The latest genomic routine international evaluation for females fertility traits took place as scheduled at the Interbull Centre. Data from 18 countries were included in this evaluation.

International genetic evaluations for female fertility traits of bulls from Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Netherlands, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, South Africa, Japan, the United Kingdom and the United States of America were computed. Holstein data were included in this evaluation.

BEL, CAN, DEU, ESP, FRA, DFS, GBR, ITA, NLD, POL submitted GEBVs.

cc1: CAN, DEU, , FRA, DFS, GBR, ITA, NLD, POL
cc2: BEL, CAN, DEU, ESP, , DFS, GBR, ITA, NLD, POL
crc: BEL, CAN, DEU, ESP, FRA, DFS, GBR, ITA, NLD, POL
hco: CAN, DEU, , FRA, DFS, , ITA, NLD, POL
int: BEL, CAN, DEU, ESP, , DFS, GBR, ITA, NLD, POL

Based on a decision made by Interbull Steering committee in August 2007, female fertility traits are classified as follows:

T1 (HC): Maiden (H)eifer's ability to (C)onceive. A measure of confirmed conception, such as conception rate (CR), will be considered for this trait group. In the absence of confirmed conception an alternative measure, such as interval first-last insemination (FL), interval first insemination-conception (FC), number of inseminations (NI), or non-return rate (NR,preferably NR56) can be submitted;
T2 (CR): Lactating (C)ow's ability to (R)ecycle after calving. The interval calving-first insemination (CF) is an example for this ability. In the abscence of such a trait, a measure of the interval calving-conception, such as says oprn (DO) or calving interval (CI) can be submitted;
T3 (C1): Lactating (C)ow's ability to conceive (1), expressed as a rate trait. Traits like conception rate (CR) and non-return rate (NR, preferably NR56) will be considered for this trait group;
T4 (C2): Lactating (C)ow's ability to conceive (2), expressed as an interval trait. The interval first insemination-conception (FC) or interval first-last insemination (FL) will be considered for this trait group. As an alternative, number of inseminations (NI) can be submitted. In the abscence of any of these traits, a measure of interval calving-conception such as days open (DO), or calving interval (CI) can be submitted. All countries are expected to submit data for this trait group, and as a last resort the trait submitted under T3 can be submitted for T4 as well.
T5 (IT): Lactating cow's measurements of (I)nterval (T)raits calving-conception, such as days open (DO) and calving interval (CI).

Based on the above trait definitions the following traits have been submitted for international genetic evaluation of female fertility traits.

Country	Traits	Submitted traits and their definitions
AUS	T2=CY	Calving interval converted to 42 days pregnancy rate
	T4=C2	Calving interval converted to 42 days pregnancy rate
	T5=IT	Calving interval converted to 42 days pregnancy rate
BEL	T2=CY	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T4=C2	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
	T5=IT	PR=Pregnancy Rate (=[21/(DO-45+11)]*100, with DO=days open)
CAN	T1=HC	NR=Non Return Rate after 56 Days in heifers (NRR), %

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         T2=CY   CF=Interval from Calving to First Service in cows(CF)
         T3=C1   NR=Non Return Rate after 56 Days in cows(NRR), %
         T4=C2   FC=Interval first insemination-conception in cows
         T5=IT   DO=Days open

CHE      T1=HC   CR=Heifers' Conception rate
         T2=CR   CF=Interval from Calving to First Service (ICF), days
         T3=C1   NR=Non Return Rate after 56 Days (NRR), %
         T4=C2   NR=Non Return Rate after 56 Days (NRR), %

CZE      T1=HC   CR=Heifers' Conception rate (pregnant or not after 3 months)
         T3=C1   CR=Cows' Conception rate (pregnant or not after 3 months)
         T4=C2   CR=Cows' Conception rate (pregnant or not after 3 months)

AUT/DEU  T1=HC   NR=Heifers' Non Return Rate after 56 days
         T2=CY   CF=Interval from calving to first insemination cows (days)
         T3=C1   NR=Cows' Non Return Rate after 56 days
         T4=C2   FL=Interval from first to last insemination cows (days)
         T5=IT   DO=Days open (days)

DFS      T1=HC   NR=Heifers' Non Return Rate after 56 days
         T2=CY   CF=Interval from calving to first insemination cows (days)
         T3=C1   NR=Cows' Non Return Rate after 56 days
         T4=C2   FL=Interval from first to last insemination cows (days)
         T5=IT   DO=Days open (days)

ESP      T2=CY   DO=Days open
         T4=C2   DO=Days open
         T5=IT   DO=Days open

FRA      T1=HC   CR=Heifers' Conception rate (binary trait) for maiden heifers
  T2=CY  Interval between calving and first AI
         T3=C1   CR=Cows' Conception rate (binary trait) for cows
  T4=C2   FL=Interval from first to last insemination cows (days)

GBR      T2=CY   CI=days between 1st and 2nd calvings
         T3=C1   NR=1st lactation non return at 56 days
         T4=C2   CI=days between 1st and 2nd calvings
         T5=IT   CI=days between 1st and 2nd calvings

IRL      T2=CY   CI=Calving interval
         T4=C2   CI=Calving interval
         T5=IT   CI=Calving interval

ISR      T3=C1   CR=Inverse of the number of insemination to conception (%)
         T4=C2   CR=Inverse of the number of insemination to conception (%)

ITA      T1=HC   NR= non-return rate 56 days (heifers)
         T2=CY   CF=Days to first service
         T3=C1   NR=Non-return rate at 56 days (%)
         T4=C2   FL=Interval from first to last insemination cows (days)
         T5=IT   DO=days open (days)

ITA(BSW) T2=CY   CF=Interval calving to first insemination
         T4=C2   Days Open
         T5=IT   CI=Calving interval

NLD      T1=HC   CR=Heifers' Conception rate
         T2=CY   CF=Interval calving to first insemination (days)
         T3=C1   CR=Cows' Conception rate (binary trait) for cows
         T4=C2   FL=Interval from first to last insemination cows (days)
         T5=IT   CI=Calving Interval (days)

NOR      T1=HC   NR=NR=Non-return rate 56 days (heifers)
         T2=CY   CF=Interval calving to first insemination (days)
         T3=C1   NR=NR=Non-return rate 56 days (cows)
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         T4=C2   CI=Calving Interval (days)
         T5=IT   CI=Calving Interval (days)

NZL      T2=CY   PM=Lactating cow's ability to start cycling
         T4=C2   PC=Lactating cow's ability to conceive (CR42)
         T5=IT   PC=Lactating cow's ability to conceive (CR42)

POL      T1=HC  CR=Conception rate for heifers
  T2=CR  Interval from calving to first insemination
         T3=C1  CR=Conception rate for cows
         T4=IT  Days open
         T5=IT  Days open

USA      T1=HC   CR=Conception rate (heifer)
         T2=CY   CF=Interval from calving to first insemination
         T3=C1   CR=Conception rate (cow)
         T4=C2   DP=Daughter Pregnancy Rate
         T5=IT   DP=Daughter Pregnancy Rate

ZAF  T4=IT   CI=Calving Interval
      T5=IT   CI=Calving Interval

JPN      T1=HC   CR=Heifers'Conception rate
         T2=CY   DO=Days open
         T3=C1   CR=Cows'Conception rate
         T4=C2   DO=Days open
         T5=IT   DO=Days open
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CHANGES IN NATIONAL PROCEDURES

Changes in the national genetic evaluation of fertility traits are as follows:

NLD (HOL) New added edc from a new validation affecting GREL and SD

BEL (HOL) Same data as August but after correcting some run bugs and removing some previous adjustments

HUN (HOL) Changes affecting genomic EDC

ESP (HOL) Stopped incorporating candidates and culled bulls older than 2 years old in the genomic evaluation

INTERBULL CHANGES COMPARED TO THE AUGUST ROUTINE RUN

Starting with the December 2019 evaluation, the GMACE software was updated to ensure GMACE reliabilities
are always at least 1 point higher than the corresponding reliabilities of MACE parent averages.
This update affects bulls from countries with extremely low national genomic reliabilities for a given trait.
The vast majority of GMACE results were unaffected by the update.

DATA AND METHOD OF ANALYSIS

Eleven Holstein populations sent GEBV data for up to 38 traits, while
classical EBVs for the same traits were used in the analyses. Young bull
GEBVs from the GEBV providers have been converted to the scales of all
countries participating in classical MACE. A bull will get a MACE EBV or
a GMACE EBV but not both.
From those eleven countries, National GEBVs of bulls less than seven years of age and with no
classical MACE proofs were included for the breeding value prediction
with a further requirement of either a MACE-PA or a GMACE-PA (for young
genomic bulls with young genomic sires) being available.

The parameter-space approach is used for the GMACE genetic evaluations (Sullivan, 2016)

SCIENTIFIC LITERATURE

The international genetic evaluation procedure is based on international work described in the following scientific publications:

Sullivan, P.G. 2016. Defining a Parameter Space for GMACE. Interbull Bulletin 50, p 85-93.

VanRaden, P.M. and Sullivan, P.G. 2010. International genomic evaluation methods for dairy cattle. Gen. Sel. Evol. 42:7

Sullivan, P.G. and Jakobsen, J.H. 2012. Robust GMACE for young bulls methodology. Interbull Bulletin 45, Article 1.

Sullivan, P.G. 2012a. GMACE reliability approximation. Report to the GMACE working group of Interbull. GMACE_rels 2013

Sullivan, P.G. 2012b. GMACE variance estimation. Report to the GMACE working group of Interbull. GMACE_vce 2013

Sullivan, P.G. 2012c. GMACE Weighting Factors. Report to the GMACE working group of Interbull. GMACE_gedcs 2013

Jakobsen, J.H. and Sullivan, P.G. 2013. Trait specific computation of shared reference population. Reference sharing Nov 2013

NEXT ROUTINE INTERNATIONAL EVALUATION

Dates for next routine run can be found on http://www.interbull.org/ib/servicecalendar

NEXT TEST INTERNATIONAL EVALUATION

Dates for next routine run can be found on http://www.interbull.org/ib/servicecalendar

PUBLICATION OF INTERBULL ROUTINE RUN

Results were distributed by the Interbull Centre to designated representatives in each country. The international evaluation file comprised international proofs expressed on the base and unit of each country included in the analysis. Such records readily provide more information on bull performance in various countries, thereby minimising the need to resort to conversions.

At the same time, all recipients of Interbull results are expected to honour the agreed code of practice, decided by the Interbull Steering Committee, and only publish international evaluations on their own country scale. Evaluations expressed on another country scale are confidential and may only be used internally for research and review purposes.

Table 1. National evaluation dates in GMACE run December 2019

Country	Date
BEL	20190901
CAN	20191201
DEU	20191203
DFS	20191105
ESP	20191111
GBR	20191009
ITA	20191112
NLD	20191201
POL	20190630
FRA	20191204

Table 2.

Number of bulls in reference population for hco

CAN	33109.0						
DEU	5487.0	37141.0					
DFS	3687.0	33439.0	34366.0				
FRA	3604.0	31829.0	31452.0	33633.0			
POL	3858.0	28960.0	28869.0	27583.0	30819.0		
NLD	3590.0	32977.0	32624.0	31474.0	28467.0	34183.0	
ITA	27215.0	4516.0	2855.0	2801.0	2996.0	2752.0	27817.0

Number of bulls in reference population for crc

BEL	2665.0									
CAN	1628.0	32896.0								
DEU	1281.0	5661.0	39360.0							
DFS	1088.0	3787.0	35567.0	36552.0						
ESP	1234.0	4143.0	36135.0	35803.0	37115.0					
GBR	1255.0	29584.0	5713.0	3838.0	4202.0	31297.0				
ITA	1547.0	29637.0	4666.0	2947.0	3225.0	28373.0	30264.0			
NLD	1195.0	3705.0	35123.0	34817.0	35314.0	3812.0	2872.0	36984.0		
POL	1356.0	3819.0	31166.0	31132.0	31504.0	3588.0	3024.0	30728.0	32467.0	
FRA	1234.0	3763.0	33759.0	33421.0	33957.0	3783.0	2946.0	33461.0	29603.0	35666.0

Number of bulls in reference population for cc1

CAN	35978.0									
DEU	5605.0	37367.0								
DFS	3713.0	33565.0	34460.0							
FRA	3699.0	31969.0	31565.0	33805.0						
GBR	29632.0	5662.0	3769.0	3727.0	30687.0					
ITA	29656.0	4606.0	2884.0	2893.0	28343.0	30263.0				
NLD	3651.0	33111.0	32725.0	31589.0	3681.0	2807.0	34400.0			
POL	3888.0	29148.0	29041.0	27768.0	3603.0	3027.0	28647.0	30994.0		

Number of bulls in reference population for cc2

BEL	3111.0									
CAN	1775.0	38370.0								
DEU	1299.0	5683.0	39457.0							
DFS	1097.0	3831.0	35671.0	36654.0						
ESP	1248.0	4188.0	36237.0	35904.0	37217.0					
GBR	1348.0	31959.0	5710.0	3861.0	4220.0	33706.0				
ITA	1634.0	31420.0	4682.0	2959.0	3239.0	30122.0	32046.0			
NLD	1223.0	3769.0	35220.0	34895.0	35391.0	3830.0	2898.0	37266.0		
POL	1720.0	4007.0	31269.0	31231.0	31605.0	3689.0	3103.0	30837.0	33197.0	

Number of bulls in reference population for int

BEL	2254.0									
CAN	1206.0	36545.0								
DEU	1263.0	5618.0	39345.0							
DFS	1086.0	3791.0	35597.0	36574.0						
ESP	1227.0	4140.0	36160.0	35827.0	37128.0					
GBR	1252.0	31802.0	5687.0	3843.0	4198.0	33548.0				
ITA	1134.0	30100.0	4654.0	2954.0	3229.0	30047.0	30722.0			
NLD	1190.0	3707.0	35150.0	34826.0	35313.0	3812.0	2888.0	37128.0		
POL	1271.0	3538.0	31194.0	31161.0	31528.0	3590.0	2762.0	30749.0	32208.0	