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INTRODUCTION
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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
         absence 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 absence 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.

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Country  Traits  Submitted traits and their definitions
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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:

FRA (HOL)   Evaluation now performed by a new genetic centre, GENEVAL

POL (HOL)   Change in trait definition for hco and cc1: conception rates instead of non-return rates

ITA (HOL)   First participation with HCO
            Change in the definition of T4 from calving interval to interval first to last insemination
            Change in the definition of T5 from calving interval to days open, calculated as the sum of
            raw solutions for T2 and T4
            Updated genetic parameters

BEL (HOL)   Changed the pedigree rules for the genomic evaluation, the pedigree is now reduced
            and limited to birth year of YYYY-15

INTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN

No changes in Interbull procedures

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 2018

Country Date

BEL   20181201
CAN   20181201
DEU   20181204
DFS   20181106
ESP   20181113
GBR   20181105
ITA   20181116
NLD   20181201
POL   20181031
FRA   20181205
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Table 2.
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Number of bulls in reference population for         hco
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CAN 31260.0
DEU  3831.0 35039.2
DFS  3031.0 32397.2 33394.2
FRA  3137.0 30956.2 30753.2 32913.2
POL  3379.0 28027.0 28130.0 26875.0 30041.0
NLD  3085.0 32146.0 31906.0 30784.0 27732.0 33349.0
ITA 26119.0  3376.0  2511.0  2606.0  2812.0  2551.0 26743.0


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Number of bulls in reference population for         crc
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BEL  2454.0
CAN  1445.0 34033.0
DEU  1138.0  3951.0 37089.2
DFS   973.0  3103.0 34385.2 35396.2
ESP  1079.0  3107.0 34560.2 34362.2 35333.2
GBR  1067.0 28003.0  3969.0  3166.0  3124.0 29203.0
ITA  1390.0 28513.0  3477.0  2570.0  2642.0 27255.0 29130.0
NLD  1099.0  3180.0 34164.0 33960.0 34087.0  3275.0  2642.0 36019.0
POL  1246.0  3310.0 30094.0 30204.0 30153.0  3088.0  2785.0 29853.0 31488.0
FRA  1125.0  3270.0 32749.2 32556.2 32686.2  3301.0  2725.0 32624.0 28716.0 34745.2
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Number of bulls in reference population for         cc1
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CAN 34005.0
DEU  3903.0 35209.2
DFS  3045.0 32504.2 33437.2
FRA  3226.0 31086.2 30829.2 32998.2
GBR 27857.0  3933.0  3119.0  3268.0 28587.0
ITA 28552.0  3445.0  2531.0  2696.0 27241.0 29162.0
NLD  3137.0 32267.0 31995.0 30883.0  3164.0  2602.0 33549.0
POL  3405.0 28201.0 28247.0 27019.0  3128.0  2837.0 27899.0 30158.0

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Number of bulls in reference population for         cc2
-------------------------------------------------------
BEL  2902.0
CAN  1594.0 36387.0
DEU  1158.0  3994.0 37201.2
DFS   983.0  3157.0 34481.2 35493.2
ESP  1094.0  3165.0 34658.2 34467.2 35449.2
GBR  1160.0 30208.0  3993.0  3196.0  3164.0 31434.0
ITA  1503.0 30298.0  3483.0  2579.0  2654.0 28995.0 30881.0
NLD  1125.0  3250.0 34254.0 34040.0 34184.0  3302.0  2666.0 36294.0
POL  1612.0  3501.0 30189.0 30285.0 30244.0  3188.0  2886.0 29952.0 32206.0

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Number of bulls in reference population for         int
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BEL  2048.0
CAN  1029.0 34650.0
DEU  1123.0  3941.0 37104.2
DFS   973.0  3127.0 34422.2 35426.2
ESP  1075.0  3130.0 34594.2 34406.2 35376.2
GBR  1065.0 30061.0  3974.0  3182.0  3148.0 31287.0
ITA   984.0 28984.0  3456.0  2575.0  2645.0 28903.0 29559.0
NLD  1094.0  3194.0 34193.0 33978.0 34117.0  3286.0  2655.0 36166.0
POL  1163.0  3034.0 30123.0 30221.0 30176.0  3090.0  2522.0 29869.0 31219.0
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