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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 20 countries were
included in this evaluation.

International genetic evaluations for female fertility traits of bulls from
Australia, Belgium, Canada, Czech Republic, Denmark-Finland-Sweden, France, Germany,
Ireland, Israel, Italy, Netherlands, New Zealand, Poland, Spain,
Switzerland, South Africa, the United Kingdom, Uruguay, Japan 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.

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Country  Traits  Submitted traits and their definitions
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AUS      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), %
         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
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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   FL=Interval from first to last insemination cows

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   CR=Heifers' Conception rate for maiden heifers
          T2=CY   CF=Interval from calving to first insemination cows (days)
          T3=C1   CR=Cows' conception rate for cows
          T4=C2   FL=Interval from first to last insemination cows (days)
          T5=IT   DO=Days open (days)

ESP       T2=CY   Interval from Calving to First Service (ICF)
          T3=C1   Conception rate
          T4=C2   Interval from first to last insemination (IFL)
          T5=IT   Sum of Interval to first to last insemination and interval from calving to first service (IFL+ICF)

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)
          T4=C2   FL=Interval from first to last insemination cows (days)
          T5=IT   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   DO=Days Open

NOR       T1=HC   NI=Number of inseminations (heifers)
          T2=CY   CF=Days from calving to first insemination (days)
          T3=C1   NI=Number of inseminations (cows)
          T4=C2   NI=Number of inseminations (cows)
          T5=IT   CF=Days from calving to first insemination (days)

NZL       T2=CY   PM=Lactating cow's ability to start cycling
          T4=C2   CSD= Calving Season Day (CDS123) number of days from the planned start of calving date to calving for a
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                    given herd-year expressed in days from -50 to 150 (CI)
        T5=IT   CSD= Calving Season Day (CDS123) number of days from the planned start of calving date to calving for a
                    given herd-year expressed in days from -50 to 150 (CI)

POL     T1=HC   CR=Conception Rate (heifer)
        T2=CR   CF=Interval from calving to first insemination
        T3=C1   CR=Conception Rate (cow)
        T4=IT   DO=Days open
        T5=IT   DO=Days open


URY     T4=C2   Days open expressed as Daughter Pregnancy Rate
        T5=IT   Days open expressed as Daughter Pregnancy Rate


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
        T3=C1   CR=Cows'Conception rate
        T4=C2   DO=Days open
        T5=IT   DO=Days open
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CHANGES IN NATIONAL PROCEDURES
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Changes in the national genetic evaluation of fertility traits are as follows:

NLD int re-included (blocked in 2009t)
NZL changes from 2009t not introducedINTERBULL CHANGES COMPARED TO THE DECEMBER ROUTINE RUN
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No changes in Interbull procedures

DATA AND METHOD OF ANALYSIS
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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
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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 2020

Country Date

BEL   20190901
CAN   20201201
DEU   20201201
DFS   20201103
ESP   20201110
GBR   20201020
ITA   20201104
NLD   20201201
POL   20201031
FRA   20201202
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Table 2.

Number of bulls in reference population for   hco

CAN 34540.0
DEU 6852.0 38851.0
DFS 4247.0 34218.0 35149.0
FRA 3778.0 32182.0 31680.0 33810.0
POL 4174.0 29509.0 29328.0 27768.0 31361.0
NLD 3836.0 33555.0 33049.0 31725.0 28847.0 34694.0
ITA 28882.0 6113.0 3467.0 3003.0 3318.0 3072.0 29801.0

Number of bulls in reference population for   crc

BEL 2694.0
CAN 1655.0 34418.0
DEU 1331.0 7125.0 41322.0
DFS 1126.0 4391.0 36505.0 37497.0
ESP 1275.0 4922.0 37323.0 36713.0 38327.0
GBR 1294.0 31017.0 7271.0 4521.0 5087.0 33138.0
ITA 1590.0 31381.0 6371.0 3598.0 4075.0 30268.0 32326.0

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NLD  1208.0   3990.0 35863.0 35386.0 35951.0  4182.0   3229.0 37658.0
POL  1370.0   4165.0 31871.0 31735.0 32184.0  4022.0   3380.0 31249.0 33137.0
FRA  1245.0   3976.0 34282.0 33785.0 34381.0  3997.0   3189.0 33840.0 29914.0 36013.0


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Number of bulls in reference population for       cc1
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CAN 37471.0
DEU  7036.0 39230.0
DFS  4289.0 34407.0 35316.0
FRA  3883.0 32407.0 31852.0 34086.0
GBR 31029.0  7179.0   4418.0   3906.0 32363.0
ITA 31384.0   6287.0   3508.0   3105.0 30214.0 32300.0
NLD  3908.0 33752.0 33207.0 31892.0  4015.0   3142.0 34975.0
POL  4209.0 29752.0 29555.0 27997.0  4004.0   3354.0 29073.0 31551.0


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Number of bulls in reference population for       cc2
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BEL  3152.0
CAN  1805.0 39968.0
DEU  1355.0   7199.0 41498.0
DFS  1138.0   4446.0 36613.0 37615.0
ESP  1292.0   4981.0 37436.0 36830.0 38451.0
GBR  1389.0 33450.0   7329.0   4550.0   5120.0 35608.0
ITA  1678.0 33093.0   6391.0   3608.0   4086.0 31946.0 34017.0
NLD  1237.0   4068.0 35966.0 35482.0 36049.0  4215.0   3256.0 37964.0
POL  1739.0   4358.0 31975.0 31842.0 32289.0  4128.0   3460.0 31365.0 33856.0


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Number of bulls in reference population for       int
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BEL  2284.0
CAN  1235.0 38082.0
DEU  1316.0   7115.0 41357.0
DFS  1126.0   4403.0 36537.0 37527.0
ESP  1271.0   4929.0 37353.0 36746.0 38353.0
GBR  1293.0 33280.0   7294.0   4528.0   5092.0 35435.0
ITA  1175.0 31671.0   6345.0   3598.0   4069.0 31856.0 32582.0
NLD  1204.0   4002.0 35890.0 35409.0 35967.0  4193.0   3242.0 37821.0
POL  1286.0   3885.0 31897.0 31764.0 32205.0  4024.0   3117.0 31272.0 32873.0
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