International issues in dairy cattle genetics

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Outline

- New context: genomic era
- Principles of international genetic evaluations / Interbull
- How do farmers get access to the best bulls with genetic or genomic evaluations
  - from countries which are Interbull members
  - from the others (with/without genetic or genomic evaluations)
- Key messages
Genomic selection: very fast adoption

- Started between 2008 and 2010
- **Reference population** = genotyped progeny-tested bulls from which estimates of the effect of tiny chromosome segments are computed
- Reference population size = key parameter of accuracy of genomic selection
Importance of reference population size

Goddard M.E, Hayes J.E. Genetics, 2009
Genomic selection: very fast adoption

- Tens of thousands of young calves genotyped each year
- Organized progeny testing: decreased or abandoned
- Market share of semen from young bulls: 40 to 75%
International Genetic Evaluations

- National evaluations are not directly comparable (different traits, different production system and environments, different recording systems, different models of analysis)

- For the past 30 years, Interbull has made such comparisons possible (+ has contributed to the international recognition of national evaluations (harmonization, validation))
Interbull

- 32 member countries
- 6 (groups of) breeds: Holstein, Simmental (including Montbéliarde), Brown Swiss, “Red” Dairy cattle, Jersey, Guernsey.
- Traits: Production, Type, Udder Health, Fertility, Longevity, Workability, Calving traits
International genetic evaluations

- Meta-analyses of national results of bulls

MACE = Multiple Across Country Evaluation

EBV bull A
EBV bull B
EBV bull C
EBV bull D
EBV bull E
EBV bull F
EBV bull G
EBV bull H
EBV bull I
EBV bull J

MACE = Multiple Across Country Evaluation

+ pedigree

INTERBULL

EBV bull B
EBV bull D
EBV bull E
EBV bull F

EBV bull A
EBV bull D
EBV bull E
EBV bull F
EBV bull H

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EBV bull A
EBV bull B
EBV bull D
How much reranking?

Depends on **genetic correlation between countries**

(= a measure of Genotype x Environment interaction)

Within Europe or North America

(for production traits)
How much reranking?

Corr = 0.90  Corr = 0.75  Corr = 0.50  Corr = 0

Country A

Country B
How much reranking?

Between New Zealand or Ireland and continental Europe (or some fertility traits)

Between Kenya and UK (Ojango et al, 2003)
Farmers /breeding organisations: Consequences

- Strongly depends on the country situation
  - Is it an Interbull member? (access to international ranking on own national scale)

- Even more complex with genomic evaluations
  - Access to a (inter)national reference population?
Interbull members
Non members

✔ Europe? too many scales !!!
which one to choose?
# US scale

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<th>Net merit (NM$) (2010)</th>
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<td>(Milk)+Fat+Protein</td>
<td>35</td>
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<tr>
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<td>Udder composite</td>
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<td>Feet/legs composite</td>
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<td>Body size</td>
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Source 1: Net merit as a measure of lifetime profit: 2010 revision J. B. Cole et al., AIPL, ARS-USDA
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Source 1: Net merit as a measure of lifetime profit: 2010 revision J. B. Cole et al., AIPL, ARS-USDA
Source 2: http://www.holsteinusa.com/genetic_evaluations/ss_tpi_formula.html
TPI: the worst possible choice for many countries

- Very strong emphasis on type: the big “show” cow
- Not adapted to suboptimal environments!
- Most American farmers don’t use it!
Alternatives do exist!

- Use Net Merit $!
- Use Interbull results on a more adequate Interbull scale (New-Zealand, Ireland, South Africa, Argentina ...)
- For low input environments: choose a more sustainable Total Merit Index combining Interbull information
  
  30% Fertility, 30% Health, 20% Longevity, 10% Production, 10% Feet and legs?

  ➠ A much larger choice of (cheaper) bulls
  ➠ genetic level may still be (too) high for production
  ➠ for exporting countries: larger range of bulls
Genomic era: Interbull members
Interbull members: the ideal situation
Interbull members: the ideal situation
Reference populations
The Holstein situation

- favors the largest (groups of) countries able to jointly assemble large reference populations ➞ 2 large consortia
Issues for countries with genomic evaluations

- Each country has its own genomic evaluation with its own particularities and its own scale

- Interbull *does not* have access to (Holstein) genotypes

- How to insure fair across country GEBV comparison?

- Interbull is developing a GMACE (extension of MACE) but faces technical + political problems
Issues for countries with genomic evaluations

- Interbull *genetic* evaluations are extremely important

  - **Only way** to combine reference populations from different countries!
  - **BUT** resulting *genomic* evaluations are **better** (G x E free)!
... for countries without genomic evaluations

- How to benefit from genomic information?
  - How to create a national reference population large enough?
  - How to join a consortium (and which one?)
  - How to compare foreign GEBV from different countries?
    - Rely on GMACE? Just starting (trust?)
    - Not comparable scales ➔ Currently the most popular is GTPI!

E.g., on tweeter:

Official Top 5 GTPI Young Bulls 5: #1
NUMERO UNO(+2604); #2 SUPERSIRE(+2581); #3 MCCUTCHEON(+2547); #4 HEADLINER(+2496); #5 MOGUL(+2493)
A longer term, more **sustainable** alternative

- Help (sufficiently large) countries with performance recordings
  - to join Interbull
  - and **to benefit from existing reference populations**
  - ... in order to develop genomic evaluations adapted to the local conditions and to import the best young bulls worldwide for the local needs

- e.g., INRA program GENOSOUTH with South Africa, Brazil and India
Key messages

- Genomic selection is characterized both by intense international **collaboration** and strong economic **competition**, in particular in Holstein

- Even for large exporting countries, collaborations are still needed
  - use of sequence data: 1000 genome projects
  - phenotyping of new traits (feed efficiency, methane emission)

- The gap between leading countries and the others is widening fast, to such an extent that « **collaborative spirit** » is declining
Key messages

- Fair across-country comparisons are (and will remain) a necessity
- Interbull plays (and will play) a central role
- For importing countries without own genetic/genomic evaluation: a proper choice of scale is essential and the (G)TPI is certainly NOT the most sustainable one
- For (large) importing countries, becoming an Interbull member and developing an own genomic evaluation is strategic
- A unique (€) scale for genetic evaluations would make Europe stronger on the international market
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LABOGENA

Thank you
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