

# Development of a genomic evaluation for milk production for a local bovine breed

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The dual purpose Belgian Blue breed (DP-BB) is a vulnerable breed rooted in the tradition of the Walloon Region of Belgium. Those animals have interesting feature (e.g., robustness, good longevity, and ease of calving) and the average milk yield is 4,000 kg/lactation (it can reach up to 7,000 kg/lactation). Due to its dual purpose type, income generated by both milk and meat is more stable and more flexible in responding to market fluctuations.

## Aims

- ❖ To develop a single step genomic evaluation (ssGBLUP) for milk production
  - Use of a Bayesian procedure to integrate the Walloon estimated breeding values (EBV) and associated reliability (REL) as *a priori* known external information
- ❖ To choose the best combination of genomic ( $\alpha$ ) and additive ( $1 - \alpha$ ) relationships into a merged (co)variance structure

## Methodology

- ❖ Model : Single-Step Bayesian genomic evaluation
 
$$(H^{-1} + \Lambda) \hat{a} = D^{-1} \hat{u}$$
  - H : Combined genomic-pedigree based (co)variances matrix (using  $\alpha$ )
  - $\Lambda = RE \sigma_e^2$  : Matrix mining least square part of hypothetical BLUP
  - RE : Diagonal matrix with number of records equivalents (RE) free of relationships contributions for each animals
  - $\hat{a}$  : Walloon GEBV
  - $D^{-1} = G^{-1} + \Lambda$  : Inverse of prediction error (co)variances matrix of  $\hat{u}$
  - G : Pedigree based (co)variances matrix
  - $\hat{u}$  : Available and predicted EBV
- ❖ REL for GEBV (GREL) obtained through inversion of left-hand side

## Data

- ❖ 3,799 DP-BB animals
- ❖ Milk yield EBVs and associated REL from evaluation
  - Based on data recorded until 31/01/2013 → EBV and REL
  - Based on data recorded until 31/01/2009 → EBV<sub>4</sub> and REL<sub>4</sub>
- ❖ 363 genotyped animals
  - 209 bulls and 154 cows
  - 39,157 SNP after editing

## Parametrization

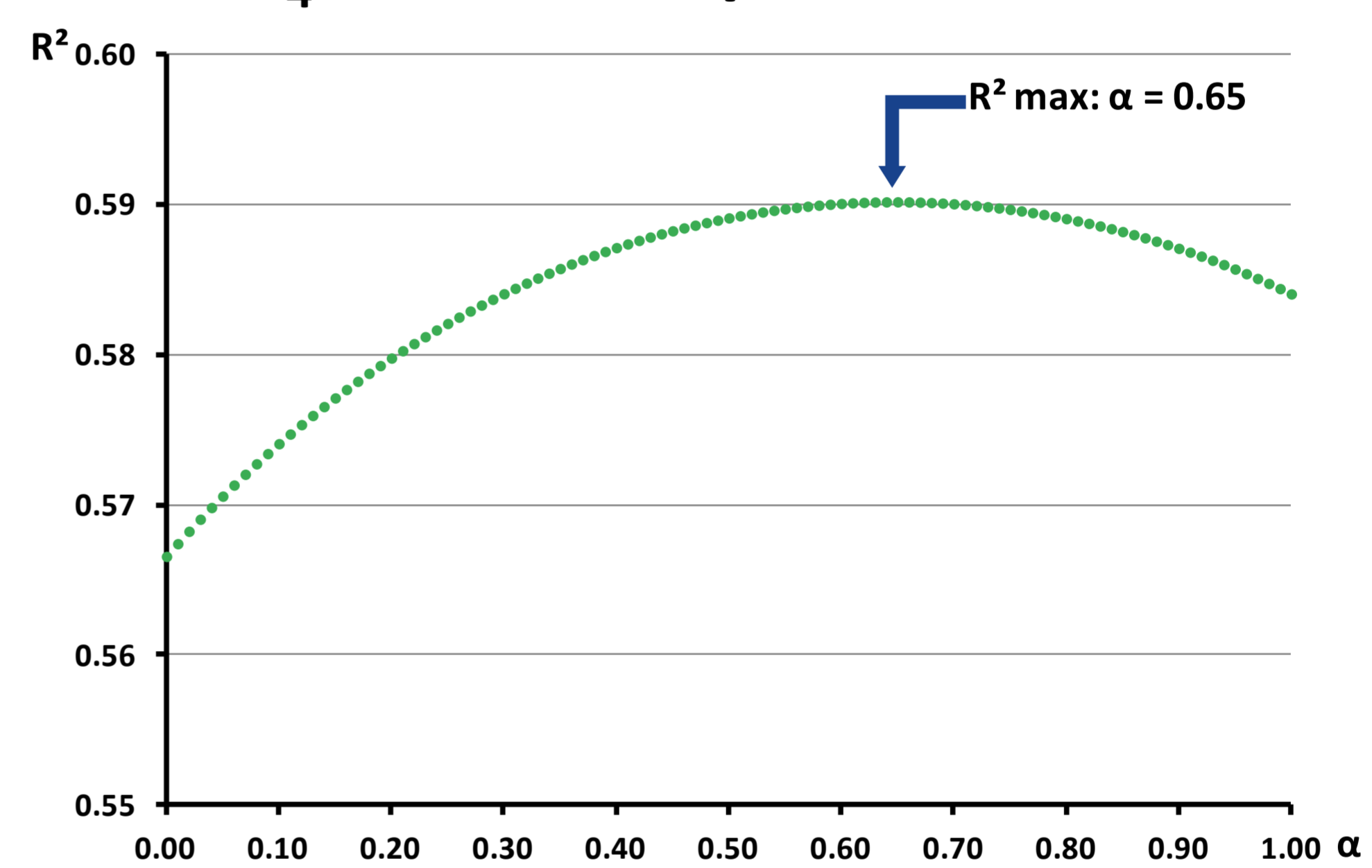
- ❖ 200 computations :  $\alpha$  from 0.01 to 1.00 by 0.01
  - GEBV and GREL from evaluation using EBV and REL
  - GEBV<sub>4</sub> and GREL<sub>4</sub> from evaluation using EBV<sub>4</sub> and REL<sub>4</sub>
- ❖ Deregressed proof (DRP) computed from EBV and REL
- ❖ For each of 100 possible  $\alpha$ , regression of DRP on GEBV<sub>4</sub> with REL as a weight

## Conclusions

- ❖ Best combination genomic-pedigree with  $\alpha = 0.65$
- ❖ Feasibility of modified ssGBLUP for a small breed
  - Reliability increases for genotyped animals with small REL in polygenic evaluation when using modified ssGBLUP

## Results

- ❖ Determination coefficients ( $R^2$ ) of the regression of DRP on GEBV<sub>4</sub> for the 100 possible  $\alpha$



- ❖ Average reliability (SD) associated to EBV and GEBV REL and GREL, respectively) for genotyped bulls by class of REL

| Class of REL | N  | REL         | GREL ( $\alpha = 0.65$ ) |
|--------------|----|-------------|--------------------------|
| < 0.25       | 17 | 0.14 (0.09) | 0.24 (0.12)              |
| 0.25 – 0.49  | 69 | 0.38 (0.06) | 0.40 (0.06)              |
| 0.50 – 0.74  | 53 | 0.60 (0.07) | 0.61 (0.07)              |
| ≥ 0.75       | 70 | 0.87 (0.06) | 0.87 (0.06)              |

- ❖ Increase of REL for genotyped animals ( $\blacktriangle$  = cows,  $\blacksquare$  = bulls,  $\blacksquare$  = bulls not yet included in polygenic evaluation) sired by genotyped bulls when  $\alpha = 0.65$

