QUALITAS

Do dual-purpose cattle react differently than dairy cattle along a continuous environment scale (temperature & humidity)?

B. Bapst[1], M. Bohlouli[2], S. König[2] and K. Brügemann[2]

[1]Qualitas AG, Switzerland
[2]University of Gießen, Germany

31 August 2018, EAAP 2018, Dubrovnik

beat.bapst@qualitasag.ch

Overview

QUALITAS

Background/Motivation I

- Dual-purpose cattle is "trendy" (at least in Switzerland)
  - General opinion: more robust than dairy cattle
    - only a few scientific publications available regarding direct comparisons (e.g. Bieber et al. 2018, ...)
    - Swiss genetic evaluation shows clear differences on the genetic levels
  - Cost efficient
  - Milk and meat ⇒ several sources of income
  - Often local/indigenous breeds ⇒ consumer expectations
  - ...
- Heat stress
  - Climate change
  - Genetic evaluations for heat tolerance has been launched (e.g. Australia(Nguyen et al., 2018)

QUALITAS

Background/Motivation II

- Analysis of genotype by environments (GxE) interactions are increasing (revival)
  - more information/data available for environment descriptors
  - Resilience
- Switzerland: Dual-purpose cattle populations (especially Original Braunvieh) are increasing
- Brown Swiss(BS) and Original Braunvieh(OB) originate from the same breed
  - ~150 years ago: first exports to USA ⇒ dairy
    ~50 years ago: return to Europe BS x OB ⇒ BS
  - OB breeding scheme was without contributions from BS in Europe (especially in Switzerland) ⇒ dual-purpose

Background/Motivation III

⇒ Do dual-purpose cattle react differently than dairy cattle along a continuous environment scale (temperature & humidity)?

Original Braunvieh (OB)
No. of herdbook cows: 9,032 (2017/2018)

Brown Swiss (BS)
No. of herdbook cows: 137,512 (2017/2018)

QUALITAS

Material/Data I

Available test-day(TD) records from 2007 - 2016

Breed	n TD records	n Cows	n Herds
BS	11,580,434	530,966	13,458
OB	618,332	28,944	3,564

data editing

$\Downarrow$

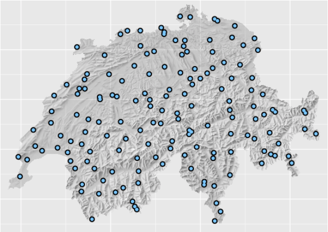
Breed	n TD records	n Cows	n Herds
BS	5,384,987	272,649	5,173
OB	150,545	8,062	627

QUALITAS

Material/Data II

- 60 official federal weather stations
- Weather data were assigend to each BS and OB herd in Switzerland
- Average of temperature (T) and relative humidity (RH) of 3 days before TD ⇒ TD
- Temperature humidity index (THI) was built (NRC, 1971)

$$THI = (1.8 * T^{\circ}C + 32) - (0.55 - 0.0055 * RH\%) * (1.8 * T^{\circ}C - 26) \quad (1)$$



QUALITAS

Methods I: Random regression test-day model

$$y_{ijkl} = HTD_i + \sum_{n=1}^{q} \alpha_{kn} z_n(s) + \sum_{n=1}^{q} \beta_{jn} z_n(s) + \sum_{n=1}^{q} \gamma_{jn} z_n(s) + \sum_{n=1}^{q} \delta_{jn} z_n(t) + \sum_{n=1}^{q} \varepsilon_{jn} z_n(t) + e_{ijkl} \quad (2)$$

where:

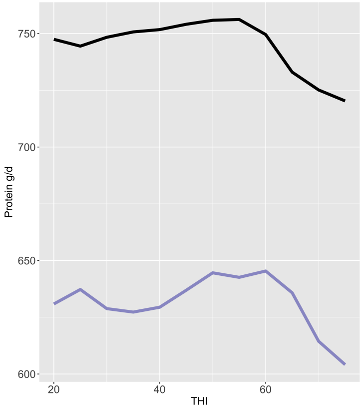
HTD_i	fixed effect of the ith herd-test-day
α_{kn}	the nth fixed regr. coeff. on DIM for the kth age of calving - region - time period - season class
β_{jn}	nth rand. regr. coeff. on DIM for add. gen. effect for cow j
γ_{jn}	nth rand. regr. coeff. on DIM for perm. env. effect for cow j
δ_{jn}	nth rand. regr. coeff. on THI for add. gen. effect for cow j
ε_{jn}	nth rand. regr. coeff. on THI for perm. env. effect for cow j
e_{ijkl}	random residual effect
q	number of covariates

QUALITAS

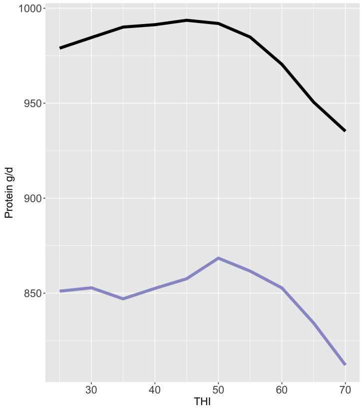
Methods II: Random regression test-day model

- Model (2) derived from Bohmanova et al. (2008)
- and from the Swiss model for genetic evaluation for yield traits and somatic cell score
- Legendre polynomials of order 3
- Variance/Covariance estimation: REMLF90 (Misztal et al., 2002)
- Trait of interest: Daily protein yield in g

Results I: Phenotypic daily protein yield along THI



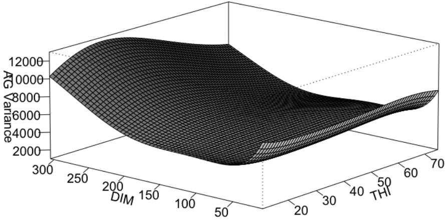
Lactation 1, 1-100 DIM



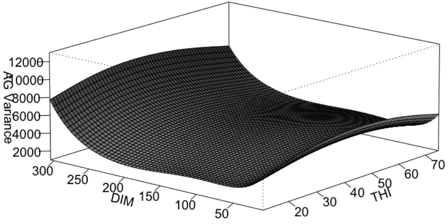
Lactation 3ff, 1-100 DIM

Breeds: BS — OB —

Results II: Add. gen. Variance along DIM and THI



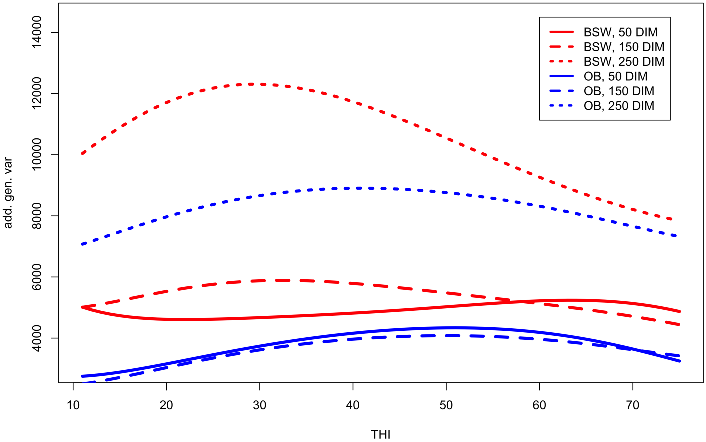
BS



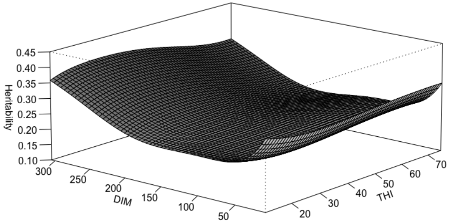
OB

QUALITAS

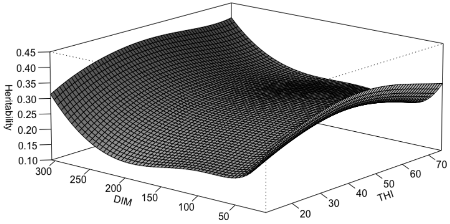
Results III: Add. gen. Variance along THI for diff. DIM



Results IV: Heritabilities along DIM and THI

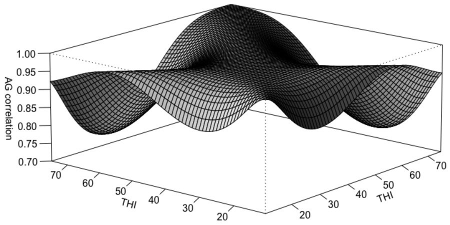


BS

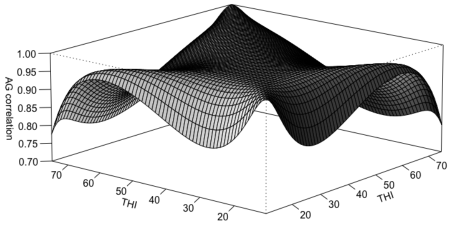


OB

Results V: Add. gen. Correlations along THI



BS



OB

QUALITAS

Conclusion/Discussion

- No clear differences in the reaction norms on THI between OB and BS
- OB cattle react differently to THI, but not a lot:
  - In late lactation stages: OB is a little bit more stable than BS
  - BS(min. r_a: 0.73) has lower genetic correlation along THI than OB (min. r_a: 0.78)
- Applied THI formula: right indicator for heat stress? (Hammami et al., 2013)
- Probably both breeds are resilent . . . ?
- Basics are developped for breeding value estimation for the slope $\Rightarrow$ resilience indicator
- Analysis with other traits and other breeds are running

Thanks

- For your attention

- The authors acknowledge the financial support for this project(2-Org-Cows) provided by transnational funding bodies, being partners of the FP7 ERA-net project, CORE Organic Plus, and the cofund from the European Commission
- We would like to acknowledge Association of Swiss Cattle Breeders (ASR) for the permission to use their data for this study

Appendix I: THI distribution for BS and OB