Transgenerational heat stress effect on genetic parameters for weight traits in dual-purpose cattle

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The aim of the study was to analyse the transgenerational and direct impact of mean daily temperature-humidity index (mTHI) and number of heat stress days (nHS) at different recording periods (7 d and 56 d) during late pregnancy (a.p.) and postpartum (p.p.) on genetic parameter estimates for birth weight (BW) and weight gain traits (200 day- and 365 day-weight gain (200dg, 365dg)) in the offspring generation of the local dual-purpose cattle breed 'Rotes Hoehenvieh' (RHV). The dataset included 5,434 observations for BW, 3,679 observations for 200dg and 2,998 observations for 365dg. To calculate the mTHI, climate data from public weather stations with minimal distance to the farms was used. Within the two recording periods, the number of HS days (mTHI≥60) was counted. Both heat stress (HS) indicators mTHI and nHS were classified. Bivariate animal models were applied, considering same traits from the mTHI- and nHS-classes as different traits. The AI-REML algorithm was used to estimate (co)variance components, genetic correlations and estimated breeding values (EBV). Genetic correlations <0.80 between same traits from different mTHI- or nHS-classes as well as substantial alterations of EBV in different climatic conditions were taken as indicators for possible GxE. Additive genetic variances and heritabilities increased for all traits when calves and dams were kept under HS conditions, which was observed for all climate recording periods. A very low mTHI (indicating cold stress) during the 56 d p.p. period caused similar results for 365dg. Results indicate a pronounced genetic differentiation due to climatic stress with possible positive effect on selection response, also from a transgenerational aspect. Considering same traits from mTHI- and nHS-classes in greater distance, genetic correlations were <0.80, indicating GxE. Fluctuations of sire EBV across the mTHI- or nHS-classes support the impact of time-lagged THI impact on genetic (co)variance components. Some sires displayed stable EBV across the climatic range, indicating the possibility to improve robustness in the RHV outdoor population genetically.

Physiological determinants underlying differences in feed efficiency between crossbreed beef cattle

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The part of meat offer from crossbreed growing cattle originating from a dairy breed mother and a beef breed father increase steadily. Aim of the present study was to compare feed efficiency and prioritize its physiological and behavioural determinants among the most widespread crossbreeds used in Switzerland. 88 fattening bulls (169±13 kg BW) from Brown Swiss mothers and sires of Angus (AN), Limousin (LI) or Simmental (SI) breeds received one of two corn silage based TMR (A with alfalfa, B with beet pulp and grass silage), until slaughter either at 477 or 530 kg BW. Individual feed efficiency was computed over 85 days initiating at 230±18 kg BW as either residual feed intake (crossbreed not included in RFI model) or feed conversion ratio (FCR). Concomitantly, digestibility, feeding behaviour, physical activity, gaseous production and consumption, the isotopic N discrimination of plasma proteins ($\Delta^{15}N$) as a proxy of N use efficiency, and carcass composition were measured. All data were analysed by ANOVA with diet, breed type and their interaction as fixed effects. The relationships between RFI or FCR and the measured determinants were explored by regressions using GLM procedures. AN differed from LI and SI by higher DMI, RFI, FCR, frequency of ruminating chews, daily CH_4 production, $\Delta^{15}N$ and carcass fatness ($P<0.05$). LI differed from AN and SI by higher ingestion time (%) and carcass muscle percentage, and from SI by lower DMI and higher CH_4 yield ($P<0.05$). The best single variables explaining most of the variation were carcass fatness for RFI ($R^2=0.29$) and $\Delta^{15}N$ for FCR ($R^2=0.34$). Relationships were improved when CO_2 yield for RFI or daily O_2 consumption for FCR were combined with physical activity (%), carcass fatness and $\Delta^{15}N$ in multiple regressions ($R^2=0.41$ and 0.42 for RFI and FCR, respectively; every slopes >0, $P\leq0.05$). The inclusion of the crossbreed effect did not improved such relationships ($P>0.20$). In conclusion, when receiving high-energy diets, LI and SI crossbreed bulls showed higher feed efficiency than AN ones, which is at least partly linked to their higher lean mass and a more efficient use dietary N.