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Climate change will induce harsher environments for European cattle production. One likely consequence is a growing antagonism between production and functional traits. To address this question, we investigated the evolution of trade-offs between fertility and production in French dairy cattle across a range from 15 to 75 of the temperature-humidity index (THI). Conception rate (CR) at first insemination (AI) and test-day protein yield (PY) from Holstein (HOL) and Montbeliarde (MON) cows were analysed. Only first lactation performances, recorded between 2010 and 2020, were considered. CR and PY were modelled according to the average THI of the 8 days after the AI and of the 3 days before the test-day, respectively. In total, we analysed 3,351,068 and 649,814 CR and 10,245,692 and 1,966,985 PY records from 3,368,605 and 656,164 HOL and MON cows, respectively. The evolution of trade-offs between CR and PY according to THI values was estimated with bivariate random regression models which included the fixed effects of herd × year, conventional vs sexed semen, weekday, age at AI, days in milk at AI for CR, and herd-test-day, age at calving, and days in milk for PY, and two random effects, the additive genetic effects of the sire for both traits and the permanent environment effect of the cow for PY. A sire model was chosen to allow very large analyses and thus ensure accurate estimates. The random effects were modelled with THI-dependent third-order Legendre polynomials. These models estimate genetic variances all along the THI trajectory as well as genetic correlations between traits across increasing THI conditions. The genetic correlations between PY and CR were moderately negative and evolved only slightly in the range of the observed THI. They increased with THI in HOL (around -0.1 for high THI), whereas they decreased in MON (around -0.15 for high THI). This study received funding from the European Union's Horizon 2020 research and innovation program under grant number 101000226 (Rumigen) and from APIS-GENE (CAICalor). The authors thank Meteo-France for the Safran database.

Genetic analyses of resilience indicator traits in German Holstein, Fleckvieh and Brown Swiss

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Modern livestock farming faces various challenges such as climate change and new evolving pathogens, associated with new animal stressors. To meet these challenges, high performance and resilient animals are needed that are able to cope with disturbances. Animal breeding has been dealing with the possibilities of breeding for resilience since several years. In this context, the indicator traits variance of performance (Var) and variance (LnVar), autocorrelation (r_{Auto}) and skewness (Skew) of deviation of the observed from the expected performance were introduced in different animal species. With the long-term objective of establishing resilience as a breeding goal, we used in our study daily milk yields to apply these resilience indicators to 9,373 lactations from 4,426 dairy cows of German Holstein, Fleckvieh, and Brown Swiss breeds. A breed comparison and the effect of different degrees of smoothing of the expected lactation curves were investigated. We estimated heritabilities, phenotypic- and genetic correlations between resilience indicators and resilience indicators of different smoothing degrees. We also examined the correlations between resilience indicators and performance traits as well as functional traits. Resilience indicators showed low to moderate heritabilities in all breeds e.g. approximately 0.09 in Var, 0.14 in LnVar, 0.06 in r_{Auto} and 0.02 in Skew. Significant phenotypic and genetic correlations between resilience indicators were found e.g. approximately 0.43 Var/LnVar, -0.21 LnVar/r_{Auto} and 0.63 LnVar/Skew. The highest correlations between smoothing levels were found for LnVar and the lowest correlations were identified for Skew. The strongest correlations between performance traits and resilience indicators were found for LnVar e.g. 0.23 with milk yield. Estimation of genetic correlations with further functional and health traits are in progress, as well as a detailed investigation of external triggers (e.g. heat waves) that causes the resilience traits to be relevant.