
**Summary.** Under globalization, breeding organizations are selecting animals and exchanging germplasm across various environments. Ignoring genotype by environment interaction (G x E) may affect the efficiency of breeding strategies and limit outcomes from cooperation between breeding programs. Quantifying the effectiveness of indirect selection and effects of G x E for different breeds is therefore necessary. The objective of this thesis was to evaluate the magnitude of G x E for milk yield using Luxembourg and Tunisian Holstein populations. In fact, these two countries rely considerably on importation of superior genes from diverse origins for their breeding programs. This study needed records on both the genotype and the environment. In the first part of this thesis, genetic ties between the two populations were studied. Additive relationships and genetic similarity were important and genetic links have been strengthened with time which allowed the analysis of the phenotypic expression of daughters of common sires under each of these low production environments. In the second part, genetic parameters for production traits of Tunisian Holsteins were estimated by a test-day random regression model (RRTD). Heritability estimates for 305-d milk, fat and protein yields were low to moderate (0.12 to 0.18) suspecting difficulties of high-producing cows to express their potential under limiting production conditions. In the third part, G x E for milk yield and persistency were investigated using character state models, where milk yield in each country was considered as a separate trait, and where the country border delimitation was designed as an environmental character state. A RRTD sire model was applied and was extended to a RRTD animal model. Significant G x E was detected for milk yield and persistency by both models. Large differences in genetic and permanent environmental variances between the two countries were observed. Genetic correlations for 305-d milk yield and persistency between Luxembourg and Tunisian Holsteins were 0.50 and 0.43 (sire model) and 0.60 and 0.36 (animal model). Moreover, low rank correlations obtained between estimated breeding values of common sires translate a significant re-ranking between the two environments. At the end of this thesis, a herd management (HM) parameter reflecting feeding and management intensity was defined. Three HM levels were identified in each country and G x E was investigated within- and across-environments. Significant G x E was detected between the Tunisian HM levels, whereas, only heterogeneous genetic variance for milk yield with limited re-ranking of sires across the three Luxembourg environments was observed. Overall, this thesis shows that under constraining environmental effects, selection for adaptive traits among economically valuable traits under their specific conditions is needed for low-input systems. When satisfactory feeding resources, management and husbandry practices are available, high degree environmental sensitivity is desired and the use of a high yielding breed may be encouraged.