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Genomic Inference and Prediction of Perennial Ryegrass Yield and Quality Traits Under Spatio-Temporal Genotype By Environment Interaction

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Abstract Text:

The selection of superior breeding materials of perennial pastures involves recording phenotypes over time-points in multiple locations. This condition yields a spatio-temporal genetic correlation structure, which is rarely accounted for in inferential studies and prediction settings. Therefore, the main objective of this study was to model the longitudinal dimension of perennial ryegrass breeding data while accounting for multiple sites and within-trial random spatial variability by leveraging genomic random regression mixed models (gRRMs). The plant material consisted of 381 bi-parental F_2 family pools from two unconnected sparse diallel crosses and four check varieties of diploid perennial ryegrass evaluated in eight environments for biomass yield and nutritive quality traits. A bias-corrected allele frequency-based genomic relationship matrix was calculated using 56,645 single nucleotide polymorphisms from DNA nanoball-based sequencing technology. Non-linear additive and residual genetic trends over the temporal dimension were modeled by a second-order Legendre polynomial function while a linear fit was assumed over the environments, yielding estimates of biologically meaningful coefficients. A simpler reaction norm model was fitted to the data of single cuts to contrast with the full model. Cross-validations ran over two prediction schemes with either high or low relatedness between training and testing sets. Low values of additive genetic correlations across space and time points indicated complex genotype by environment (GxE) interaction in early harvest measurements. The temporal dimension was the main driver of genomic estimated breeding value re-ranking whereas slope-intercept correlation revealed moderate spatial GxE. Modeling the temporal dimension substantially increases the predictive ability when train-test relatedness is low.

Session Selection:
Other Plant Species

Final Number:

Title:
Genomic Inference and Prediction of Perennial Ryegrass Yield and Quality Traits Under Spatio-Temporal Genotype By Environment Interaction

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