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Statistical Analysis of Data from the Field Phenotyping Platform "breedvision"

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Abstract

The inclusion of secondary traits and environmental covariates in the prediction model became an important consideration in recent years. Our study was aimed at quantifying the impact of adding secondary traits and covariates in the improvement of the target trait. An experiment was conducted in 2018–19 at Hohenheim for sensor-based non-invasive prediction of yield (biomass and grain) in triticale (× *Triticosecale Wittmack*) field trials with four trial areas t_1, t_2, t_3 and t_4 and four nitrogen levels N_1= 40 %, N_2= 70 %, N_3= 100 %, and N_4= 130 % in each trial area. A trial area contains 25 triticale genotypes in an -lattice design with ten incomplete blocks within two replicates and the data were recorded for dry matter yield (DMY) and a secondary trait canopy temperature (CT). CT was measured with a sensor machine using the field phenotyping platform "BreedVision" from the Senselgo project during the vegetation period by using hyperspectral cameras and the sensor machine ran twice in each plot for the data recording. Mixed models are effective in handling repeated measures on the same statistical units and are widely used in biological sciences. Therefore, considering repeated measure issues and measurement of two traits in parallel, a mixed linear bivariate model was developed to predict the target trait 'DMY' without measuring it in the field. Radiation intensity and ambient temperature are two covariates also considered in the model. The model with covariates showed reasonable improvement in prediction performance. There was no gain from the model with secondary trait CT (bivariate model), however, we recommend using this model where it is difficult to measure the target trait DMY due to extreme weather conditions and limited seed supply. Thus, our model allows early selections to be made and saving considerable resources in breeding experiments.

Keywords: Mixed modelling, phenotyping, prediction performance, repeated measures

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