

# Can We Make a Dent in Genotype and Environmental Interaction in this High Throughput Era?

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Genotype by Environment interaction is a long-standing issue in biology and agriculture. It hampers our ability to predict plant traits from plant genomes in diverse environments. Three major areas of research can be identified as the key elements to establish an Integrated Modeling Approach for Performance Prediction (IMAPP): quantitative and population genetics framework and associated developments, crop physiological modeling and agriculture production system, and systems biology. All three areas have their advantages and disadvantages in modeling and prediction performance at different levels (*e.g.*, number of genotypes, context of performance, and input and output). Recent advances in genomic technologies have greatly empowered research to conduct genome-wide prediction within the quantitative and population genetics framework. Genome-wide prediction has been shown as a practical tool that outperforms the traditional quantitative trait locus (QTL) identification and marker assisted prediction of performance. Systems biology and comparative genomics allow the construction of gene regulatory networks (GRN) that facilitate both pathway- and network-based mapping and prediction. However, targeted research is urgently needed to incorporate these new advances into a broader crop modeling framework that deals directly with environmental and production conditions. Ongoing research in flowering time of a sorghum population with a well-defined genetic context will be used to illustrate the plan to implement IMAPP.