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HIGH-THROUGHPUT PHENOTYPING TO ENHANCE WHEAT YIELD POTENTIAL

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The potential to add significant value to the revolution in plant breeding associated with genomic technologies is a new frontier for crop physiology and modelling. Yield advance by genetic improvement continues to require prediction of phenotype based on genotype. Recently, molecular breeding strategies using genome wide prediction and genomic selection approaches have developed rapidly. However, their applicability to complex traits, such as crop yield, remains constrained by gene-gene and gene-environment interactions, which restrict the predictive power of associations of genomic regions with phenotypic responses. Together with increased scientific understanding of plant growth, improvements in instrument technology and survey platforms are now enabling the application of spectral techniques at higher resolutions (down to sub-cm) than have been previously possible in field-scale research. In field trials, we are interested in being able to measure the 'phenotypes' of plants, which are any of the observable traits or derived calculations of traits that may vary across genotypes of the same species. In measuring more complex traits like water use, we create indices to combine thermal and visible channel data, and also feed these types of traits into crop models.Crop physiology and modelling provide opportunities to improve breeding efficiency by either dissecting complex traits to more amenable targets for genetic prediction, or by trait evaluation via phenotypic prediction in target production regions to help prioritise effort and influence selection strategies. But this requires a transdisciplinary approach that integrates physiology and modelling into quantitative genetic improvement systems, rather than a model-based focus on 'genotypic coefficients' and 'ideotypes'.