ABSTRACT

"Tackling leaf growth and its response to water stress: high-throughput phenotyping to the rescue"

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Understanding the physiological and genetic bases of plant performance under drought is an important challenge in the context of global climate change. Genotypes with unaffected or increased whole plant leaf area could have an advantage in terms of plant performance under drought, at least in moderate or transitory water deficits scenarios. In order to perform a genetic engineering approach for breeding plants with maintained or increased leaf area under drought treatments, it is important to identify underlying processes that control leaf growth in response to drought and to classify them.

Development of an automated phenotyping platforms and imaging techniques has provided new insights into the temporal and spatial patterns of leaf growth as affected by drought stresses in *Arabidopsis thaliana*. We have now access to a range of phenotypic traits that are measured at cellular, biophysical, physiological, and whole plant levels. Increasing the throughput of leaf growth analyses, i.e. increasing both the number of genotypes and the variety of traits, have contributed to a better understanding of how processes at different scales are coordinated to control leaf growth and its response to drought. Emerging properties at whole plant or whole leaf scales have been highlighted with evidence that the control of individual leaf expansion is more complex than merely the sum of cellular processes, and the control at the whole plant level is more complex than the sum of individual leaf expansions. When leaf expansion is maintained, this is due to a combination of responses involving traits at different scales.