LeasyScan: 3D scanning of crop canopy plus seamless monitoring of water use to harness the genetics of key traits for drought adaptation

Vadez V[1], Kholova J[1], Srikanth M[1], Rekha B[1], Tharanya M[1], Sivasakthi K[1], Alimagham M[1], Karthika G[1], Keerthi C[1]

ICRISAT – Crop Physiology Laboratory, Greater Hyderabad, Patancheru 502324, Telangana, India
*E-mail: v.vadez@cgiar.org

With the genomics revolution in full swing, relevant phenotyping is now a main bottleneck. New imaging technologies provide opportunities for easier, faster and more informative phenotyping of many plant parameters. However, it is critical that the development of automated phenotyping be driven by a clear framing of target phenotypes rather than by a technological push, especially for complex constraints. Previous studies on drought adaptation shows the importance of water availability during the grain filling period, which depends on traits controlling the plant water budget at earlier stages. We will then discuss "cause" and "consequence" in phenotypes. Drawing on this, a phenotyping platform (LeasyScan) was developed to target canopy development and conductance traits. Based on a novel 3D scanning technique to capture leaf area development continuously and a scanner-to-plant concept to increase imaging throughput, LeasyScan is also equipped with 1488 analytical scales to measure transpiration seamlessly. Examples of the first applications are presented: (i) to compare the leaf area development pattern of pearl millet breeding material targeted to different agro-ecological zones, (ii) for the mapping of QTLs for vigour traits in chickpea, shown to co-map with an earlier reported "drought tolerance" QTL; (iii) for the mapping of leaf area development in pearl millet; (iv) for assessing the transpiration response to high vapour pressure deficit in different crops. This new platform has the potential to phenotype traits controlling plant water use at a high rate and precision, opening the opportunity to harness their genetics towards breeding improved varieties.

Drought acclimation during multiple vegetative growth stages in wheat improves drought tolerance during generative growth: insights from proteomics and physiology

Wang X[1], Jiang D[1]*

[1]Key Laboratory of Crop Physiology and Ecology in Southern China, Ministry of Agriculture/Hi-Tech Key Laboratory of Information Agriculture of Jiangsu Province, Nanjing Agricultural University, P. R. China
*E-mail: xiaowang@njau.edu.cn, jiangd@njau.edu.cn

Wheat is one of the major crops grown throughout the world, with primary use in human nutrition. Anticipated changes in global climatic variability leading to more frequent extreme conditions will require adaptation of crop species on an unprecedented magnitude in order to sustain agricultural production. Drought stress is one of the most severe abiotic stress forms, constraining both plant growth and productivity. The response of plants to stress involves both short-term molecular and physiological responses as well as long-term structural and morphological modifications. Little is known on the impact of the increased frequency of extreme climate events and the implications of environmental variability on quality parameters in wheat. We tested the hypothesis that acclimation to drought-stress during vegetative growth could be "memorized" by the plants and could lead to tolerance against a stress event during reproductive growth. In order to investigate the effect and mechanisms of drought acclimation, the responses of the physiological (photosynthesis rate and activities of antioxidant enzymes) and proteomic parameters (protein expression in leaves) were analyzed and identified. The results indicate changes to both enzyme synthesis and enzyme activity which may contribute to drought tolerance mechanisms in wheat.