International Wheat Yield Partnership

Research to Deliver Wheat for the Future

Transforming Yield through Source-Sink Synchronization

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Abstract

The greatest improvements in crop yields are likely to come from optimising and coordinating the whole plant source-sink system to fully realise photosynthetic potential as grain yield. Emerging research on trehalose 6-phosphate (T6P) has shown that T6P plays a key role in coordinating source and sink activities in crops. Recent novel chemical biology has been used to modify T6P in such a way that it can be used to screen for yield traits. Using T6P precursors as a chemical spray to wheat during early grain filling stimulates starch synthesis in grain increasing starch content, grain size and overall yield by up to 20%. Significantly, this is accompanied by increased photosynthesis in flag leaves due to the enhanced demand created by the sink. This shows that photosynthetic potential may be masked by sink limitations. In addition to its effect on grain size T6P influences initiation and setting of grain number. Through analysis of the response of genetically diverse high-yielding germplasm, T6P precursor will be used as a smart screen for true photosynthetic potential, grain number and size potential as well

as biomass and harvest index affected by the harmonisation of source and sink activity. T6P precursors can significantly push physiological boundaries to identify genes for high yield not feasible with current genetic and physiological methods. Germplasm for screening will consist of the genotyped panels, High Biomass Association Panel and doubled-haploid lines (Bacanora/ Weebil). Genome wide association mapping will be performed to discover genomic regions associated with high source and sink and quantitative trait loci will be identified. Given recent examples of association of trehalose phosphate phosphatase genes with crop yield attention will also be given to finding SNPs in trehalose pathway genes as likely genetic variants underlying traits. Further screening will be conducted on new and highly diverse genetic resources unrepresented in global wheat gene pools based on primary synthetic hexaploid lines (tetraploid durum wheat x diploid Triticum tauschii). Outputs will be used at the IWYP Hub to design strategic crosses that maximise genetic complementarity of both source and sink for high yield using where possible at least one elite parent and the best progeny delivered to breeders in developed and developing countries via the International Wheat Improvement Network.