

Increasing Wheat Drought Tolerance and Recovery throughout the Life Cycle through Regulation of Plant Growth Mechanisms

Drought is the factor worldwide that most limits food production. New ideas and approaches are necessary to increase crop resilience to drought in a way that does not reduce maximum yield potential. In this proposal, we consider this in the context of growth mechanisms and management of carbon budgets that regulate resilience, recovery and productivity under drought. In previous BBSRC-funded work in Arabidopsis we have discovered that trehalose 6-phosphate (T6P) can regulate both sucrose allocation and use of sucrose once allocated. In relation to this we have shown that T6P can prime gene expression for recovery from stress. Our related research in maize shows substantial improvements in the field under drought through GM of one trehalose pathway gene (Nuccio et al. 2015). Our strategy combines GM with natural variation in the trehalose pathway and the novel resurrection gene SDG8i involved in strigolactone glycosylation to improve drought tolerance during vegetative and reproductive growth in wheat applicable to UK and to global regions where drought is prevalent.

1) Characterize novel wheat transgenics in trehalose pathway and SDG8i resurrection genes and controls under drought and drought recovery for impact on gene networks by RNA seq. Determine interaction between trehalose pathway and SDG8i-mediated regulation of growth and sucrose allocation mechanisms and impact on trehalose pathway gene expression. Measure growth, yield, carbon status and T6P.

2) Sample mapped CIMMYT wheat germplasm in field plots in Mexico and determine gene expression by Q-RT-PCR of trehalose pathway genes identified from RNA seq analysis in 1). Grow a subset in controlled environment at Rothamsted for further trehalose pathway gene expression analysis during drought and drought recovery.

3) Construct mechanistic model from gene expression analysis and RNA seq for a long-term strategy for productivity of wheat under drought.

4) Deliver new technology to wheat varieties for enhanced productivity under drought involving knowledge exchange with CIMMYT and industry.