IWYP International Wheat Yield Partnership
Research to Deliver Wheat for the Future

IWYP SCIENCE BRIEF

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LIGHT, CO_2, ACTION!

The improvement of photosynthetic efficiency is a largely untapped major target for achieving the types of "breakthrough" sustainable crop yield increases needed to meet future food demands. Efforts to date have focused on increasing efficiencies/rates under steady-state (constant) conditions. However, in field conditions the light environment of every leaf is constantly changing due to shading and clouds. A major increase in productivity could be achieved by accelerating the speed at which rates of photosynthesis react to these rapidly changing light environments. Over the course of a day, a slow return to maximum photosynthetic rate after shading could result in a loss of 20% of the potential carbon assimilation that could be used to produce grains. A project "**Speeding the Adjustment of Photosynthesis to Shade-Sun Transitions to Increase Yield Potential in the Field**", led by Elizabete Carmo-Silva at Lancaster University, UK, and in partnership with colleagues in Mexico aims to accelerate the induction of photosynthesis during sun-shade transitions. The main outcome will be the inclusion of photosynthetic induction-related traits in a wheat breeding pipeline with lines having faster photosynthetic induction rates backcrossed into elite parents in parallel with the development of a HTP screening method to facilitate early generation selection.

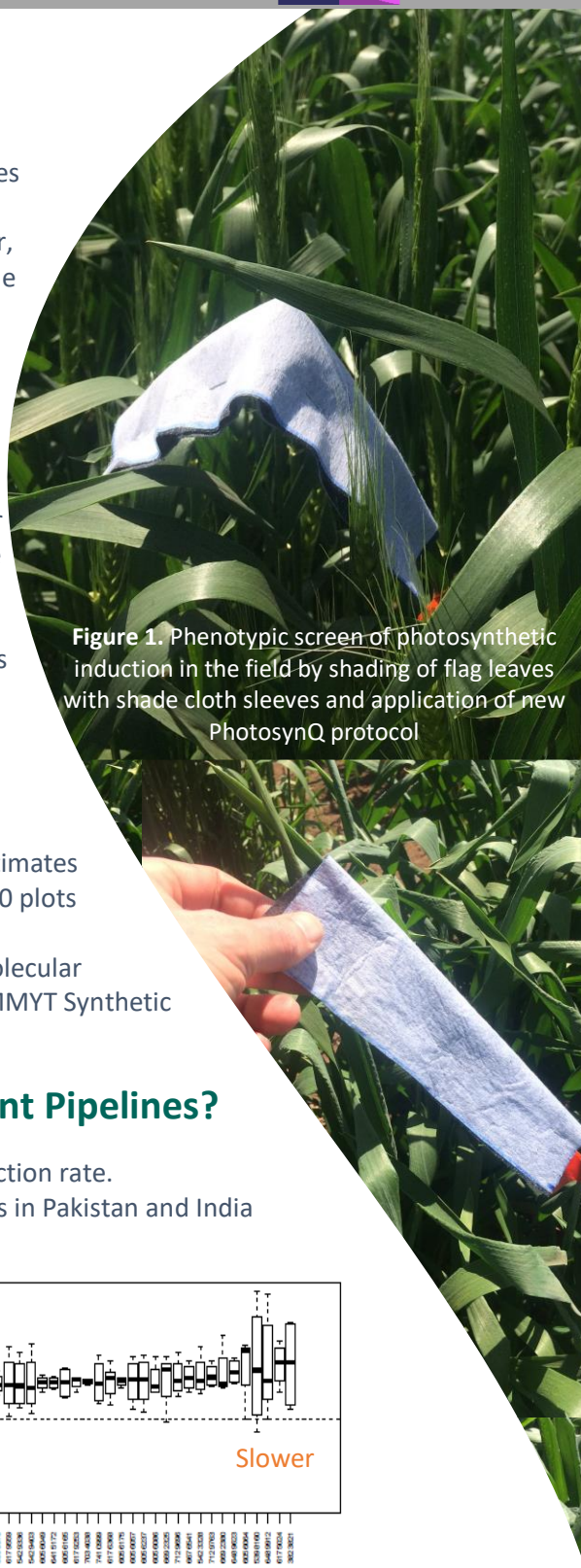

Figure 1. Phenotypic screen of photosynthetic induction in the field by shading of flag leaves with shade cloth sleeves and application of new PhotosynQ protocol

What Solutions have been Identified?

- A new, cost effective HTP screening protocol with improved heritability estimates for higher photosynthetic induction rate phenotypes by screening up to 400 plots in two days (**Figure 1**).
- Higher photosynthetic induction rate phenotypes were used to identify molecular genetic markers for faster induction in a mixed population drawn from CIMMYT Synthetic (SynPAN) and High Biomass (HIBAP I) wheat germplasm sets.

What has been transferred to the Wheat Improvement Pipelines?

- Trait-associated molecular genetic markers for higher photosynthetic induction rate.
- Lines with fast-induction-linked markers shared with CIMMYT collaborators in Pakistan and India for multi-environment evaluation.

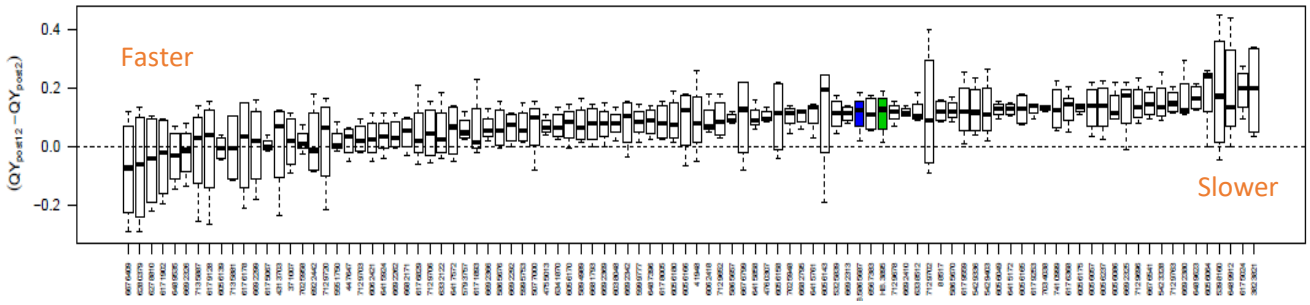

Figure 2. Genetic variation in the speed of photosynthetic induction (quantum yield (Φ_{PSII}) following shade) observed in the CIMMYT High Biomass Panel (HiBAP I) in the field, CIMMYT 2018.

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https://iwyp.org/funded-projects/. *Supported by BBSRC Grant Number: BB/S005072/1*