International Wheat Yield Partnership
Research to Deliver Wheat for the Future

IWYP SCIENCE BRIEF

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Harnessing Blue Light to Gain Yield

Manipulating the stomatal influence on photosynthesis, water use efficiency and leaf temperature is an important target for improving crop productivity. Increasing light, temperature and water availability cause stomata to open. With light, two responses have been described. The first, called "red light" or mesophyll response, occurs at high light levels and is linked directly to higher rates of photosynthesis. The second, called "specific blue light" response, saturates at light levels too low to drive photosynthesis and causes stomata to open more than needed to achieve maximum CO_2 uptake. Therefore, water use efficiency (WUE), which is the ratio of carbon gain to water loss from transpiration, is reduced. Reducing stomatal sensitivity to blue light has the potential to enhance photosynthetic rates and yield by maintaining a maximal uptake of CO_2 while concomitantly reducing water loss. Decreasing water use during the early stages crop growth can enable sustained higher photosynthetic rates through the grain filling period when water often becomes limiting. A project, "**Manipulating Stomatal Blue Light Response in Wheat to Improve Productivity**", led by Tracy Lawson at The University of Essex, UK, with other colleagues in the UK and at CIMMYT is identifying single mutations in a gene known to be essential in stomatal responses to blue light (*BLUS1*) and present in each of the wheat homoeologous A, B and D genomes. Single, double and triple mutants have been made in different genetic backgrounds and will be evaluated for gas-exchange and their effect on grain yield.

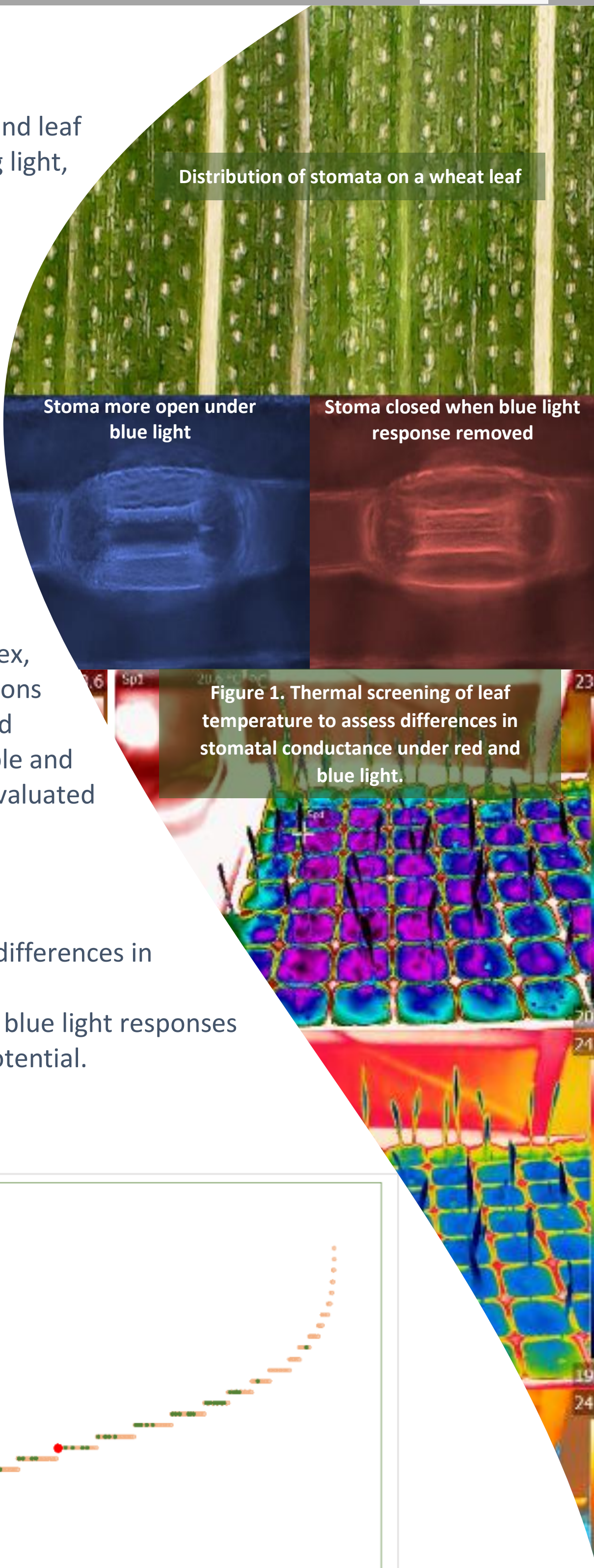

Figure 1. Thermal screening of leaf temperature to assess differences in stomatal conductance under red and blue light.

What Solutions have been Identified?

- A high throughput screening protocol based on thermography to identify differences in stomatal density in wheat cultivars under red and blue light (**Figure 1**).
- Single, double and triple *BLUS1* mutants in elite lines which have different blue light responses (**Figure 2**) that may lead to selection of wheat lines with increased yield potential.

Anticipated Impact of this Research?

- Clearer understanding of the impact blue light has on stomatal responses and the signaling pathway involved to know how to produce wheat lines differing in photosynthetic efficiency and yield potential.
- Wheat lines with greater WUE and thus potentially improved lifetime photosynthetic rates and grain yield.

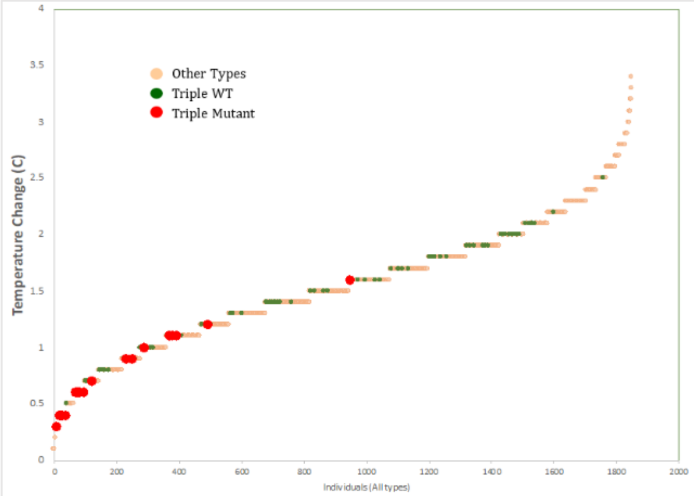

Figure 2. Variation in the change (decrease) in leaf temperature (a proxy for stomatal conductance) or WUE between leaves subjected to red and blue light. A large decrease in leaf temperature (a cooler leaf) indicates a greater magnitude of change in stomatal conductance or degree of stomatal opening that aids evaporative cooling with blue light. Included are all single, double, triple mutant and wild-type lines. Highlighted are the triple mutants showing that the stomatal response to blue light is diminished.

IWYP123: T. Lawson, University of Essex (lead); C. Uauy, John Innes Centre; E. Carmo-Silva, Lancaster University; M. Reynolds, CIMMYT. https://iwyp.org/funded-projects/. Supported by BBSRC Grant Number: BB/S005080/1