Studentship Project: Annual Progress Report 11/2021 to 10/2025

Student Name:	**Mengjie Fan**	**AHDB Project Number:**	**SF/TF 170a**
Project Title:	**Optimising photosynthesis performance and efficiency using blue light**		
Lead Partner:	NIAB, University of Essex		
Supervisor:	Prof. Tracy Lawson, Dr. Andrew Simkin, Dr. Mark Else		
Start Date:	15/11/2021	**End Date:**	1/10/2025

1. Project aims and objectives

This project aims to enhance strawberry photosynthetic performance and resource use efficiency while overcoming yield limitations through understanding plant photo-physiology, with a specific focus on blue light responses and using genetic manipulation.

2. Key messages emerging from the project

This project has successfully demonstrated the benefits of blue light applications as a stress priming method for enhancing strawberry photosynthetic performance during early growth stages. Our research has revealed the dynamic adaptation of leaf physiology both during and after the priming treatment. Furthermore, we have explored innovative light delivery methods to mitigate diurnal carbon fixation losses, potentially optimizing overall plant productivity and resource use efficiency in strawberry cultivation.

3. Summary of results from the reporting year

This project has successfully demonstrated the benefits of blue light priming on strawberry photosynthetic performance and used innovative light delivery methods to optimize carbon fixation. Our research revealed that plants exposed to high proportions of blue light during priming exhibited enhanced leaf photosynthetic capacity under both steady-state and dynamic light conditions, primarily due to alterations in leaf biochemical and anatomical attributes. We identified significant limitations on efficient carbon assimilation due to stomatal limitation of gasous diffusion and observed rapid adaptations of various photosynthetic traits to changing light conditions post-priming. By leveraging the anatomical asymmetry of guard cell distribution on strawberry leaves, we developed a novel lighting treatment approach that mitigated gas diffusional limitations and improved daily carbon gain by approximately 18% under short photoperiod conditions. Additionally, we produced transgenic plants overexpressing key components of the guard cell light signalling pathway. Preliminary results indicate enhanced gas exchange capacity and increased responsiveness to blue light, offering promising strategies for following research works on improving crop productivity through optimized light management and genetic manipulation.

4. Key issues to be addressed in the next year

As I approach the final stages of this three-year research project, my focus has shifted to comprehensive data analysis and the consolidation of our findings into a cohesive narrative. With the bulk of data collection completed in the past 3 years, I am now engaged in in-depth data mining to extract additional insights that will help elucidate our observations from the past few years research. This process will give new perspectives on strawberry photophysiology and the effects of blue light priming. Concurrently, I am also prioritizing the selection of transgenic lines exhibiting significant phenotypic changes related to enhanced gas exchange capacity and blue light responsiveness. These selected lines will form the core of the final data chapter in my PhD thesis and will be providing a genetic component to our exploration of optimizing strawberry photosynthetic performance.

5. Outputs relating to the project

(events, press articles, conference posters or presentations, scientific papers):

Output	Detail
Presentation at Plastid preview conference 2022 at John Innes Center	**Results and methdology on first year experiments**
Poster presentation at gradute forum UEssex	**Results demonstration of first year outcomes.**
Oral presentation at SEB centenary conference	**Manipulating Stomatal Density in Bread Wheat: Differential Impacts on Photosynthesis and Blue Light Responses Across Leaf Surfaces**
Poster presentation at SEB birthday event	**Manipulating Stomatal Density in Bread Wheat: Differential Impacts on Photosynthesis and Blue Light Responses Across Leaf Surfaces**
Oral Presentation - Graduate Forum	**Photonic Phenotype Induction to Optimise Plant Response to Changing Climate**
Submitted Book Chapter	**Using Infrared Thermography For High Throughput Plant Phenotyping**
Poster Presentation	**New Phytologist Symopisum, Kaifeng, China (Planned for Oct 2024)**

6. Partners (if applicable)

Scientific partners	
Industry partners	
Government sponsor	