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, marketable yields, and berry quality 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 explore pathways of improving strawberry photosynthesis and to overcome yield bottleneck through understanding plant physiology in response to blue light and using genetic manipulation.

2. Key messages emerging from the project

The impact on yield and the cost benefit of physiological adaption to high percentage of blue light treatment.

3. Summary of results from the reporting year

First year experiments subjected strawberry plants to a range of different percentage of blue light in a controlled environment room, using multiple LEDs. After the initial priming period, plants were moved to either a greenhouse or polytunnel for further growth. Current findings show that plants grown under a high percentage of blue light in the spectrum had increased leaf photosynthetic capacity both under steady state and dynamic light condition. Changes in leaf biochemistry and anatomical traits most likely contributed to this enhancement, along with increased gas exchange between the external atmosphere and leaf interior. Further, these findings revealed strong stomatal limitation and the weak stomatal responses to blue light in the tested commercial strawberry cultivars. To address these identified bottleneck hindering strawberry photosynthesis and for a deeper understanding of stomata limitations on photosynthetic performance, transgenic plants were designed targeting specific stomatal targets. These include the transcription factor SPECHLESS (SPCH), a guard cell plasma membrane H^+-ATPase protein pump, a chlorophyll degradation enzyme (Chlorophyllase), and Chlorophyll a oxygenase, with the last two targeted only to the guard cells. Construct design and construction has been completed using golden gate cloning and transformation via Agrobacterium is currently underway.

4. Key issues to be addressed in the next year

Following the work from first year, plans in the next year are divided into two main work packages. The first components of work package 1 is to repeat the first year 'blue light priming' experiment in a commercial relevant setup at the university. The aims are to test reproducibility and quantifying light response in more details. Measurements will include physiological quantification of leaf photosynthesis, leaf optical measurement, pigments and protein quantification, yield and fruit accessment. The second work package will continue the tissue culture work from first year to produce transgenic strawberry plants. Successfully transformed plants will eventually be examined for their expression level of target genes and copy number. Once the insertion is confirmed and with sufficient leaf expansion, initial phenotyping of these plants can be scheduled to examine the performance of these transgenic plants.

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.

6. Partners (if applicable)

Scientific partners	
Industry partners	
Government sponsor	