

Studentship Project: Annual Progress Report October/2021 to October/2022

Student Name:	Ece Moustafa	AHDB Project Number:	SF/TF 170a
Project Title:	Improving cane crop resilience by overcoming the legacy effects on photosynthesis from short-term stresses.		
Lead Partner:	NIAB East Malling & University of Essex		
Supervisor:	Dr Mark Else, Professor Tracy Lawson, Dr Amanda Cavanagh, Dr Andrew Simkin, Harriet Duncalfe		
Start Date:	October 2020	End Date:	October 2024

1. Project aims and objectives

Abiotic stresses are becoming more prevalent with the changing UK climate, and this is likely to have major impacts on crop yields and quality. In cane crops such as raspberry, the legacy effects from temporary rootzone water deficit stress could limit marketable yields and berry quality. If these legacy effects could be predicted and overcome more rapidly, the risks to productivity and profitability could be better managed.

The aim of the project is to improve raspberry resilience to climate change by overcoming the legacy effects on photosynthesis from short-term stresses. The objectives of this project are to better understand: 1) leaf physiological responses to coir drying episodes and associated water deficit stress, 2) the persistence of leaf adaptive responses following re-wetting, 3) the impact of legacy stress effects on berry yield and quality, 4) the signalling process(es) that regulate recovery from a rootzone water deficit stress and 5) whether it is possible to overcome the legacy effects on photosynthesis to reduce losses in Class 1 yield and berry quality.

2. Key messages emerging from the project

The legacy effects of transient water deficits on leaf gas exchange may be more persistent than originally thought. Twelve days after rewetting the coir following a period of drying, stomata were again fully open by midday and conductances were similar to well-watered values, but in the afternoon, stomata closed more rapidly compared to well-watered plants. The impacts of this prolonged recovery phase, likely regulated by chemical and/or hydraulic signals, on plant growth, Class 1 yield and berry quality are being investigated.

Irrigation to commercial raspberry crops should be scheduled effectively to ensure that coir water availability is optimised throughout the day, avoiding transient rootzone water deficits. Also, those growers who choose to implement a water deficit stress to control cane vigour should be aware that unintended legacy effects may limit marketable yields and berry quality.

3. Summary of results from the reporting year

The results described in this summary report are interim and relate to one year. In all cases, the reports refer to projects that extend over a number of years.

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Diurnal responses to a rootzone drying treatment and the subsequent recovery phase were investigated to better understand the possible legacy effects on plant water balance and leaf gas exchange. An initial response to a rootzone water deficit stress was first detected by a change in midday stem water potential values, followed by a fall in stomatal conductance values and a reduction in berry fresh weight and Class 1 yield.

Changes in midday stem water potential values were observed two days after coir drying was initiated and subsequently recovered two days after rewetting of the coir.

Differences in midday stomatal conductance values occurred five days after drying down commenced, and stomatal conductances were low and unchanged by day 22. However, partial recovery took much longer, and signs of recovery were only observed 12 days after coir rewetting. To better understand the effects of rootzone water deficits on diurnal patterns of stomatal conductance, more detailed measurements were made five times a day during daylight hours. On day 0, values of stomatal conductance in well-watered plants (WW) and those that were to be dried down (DD) rose in the morning and peaked around midday before falling progressively during the afternoon to low values in the evening. By day 4, stomatal closure (inferred from lower conductance values) occurred earlier in DD plants around late morning, and by day 7, significant differences in stomatal conductance values between WW and DD plants were noted. Nine days after rewetting the coir, morning stomatal conductance values in DD plants had recovered to those measured in WW plants. However, even fifteen days after rewetting, stomatal conductance values at all five time points in DD plants had not returned to WW values.

The drying down treatment resulted in a reduction in Class 1 yield of 200 g per pot, caused by a 2.9 g difference in average berry fresh weight. Soluble solids content (%Brix) was 2% higher in these berries, presumably due to the concentrating effect of smaller berries in plants subjected to rootzone water deficits.

4. Key issues to be addressed in the next year

Over the next year, the causal signals that regulate the recovery of photosynthesis will be investigated.

5. Outputs relating to the project

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

Output	Detail
Poster Presentation	A poster was presented at the BCPC Congress 2021 (Providing policy and regulatory support for multi-functional UK agriculture) at Harrogate, UK on the 2 nd November 2021.
Poster Presentation	A poster was presented at the CTP Autumn Student Event on the 3 rd November 2021.
Poster Presentation	A poster was presented at the Berry Gardens Annual Research and Agronomy Conference 2021 on the 11 th November 2021.
Oral Presentation	A PowerPoint presentation was presented at the CTP Summer Student Event on the 18 th July 2022.
Oral Presentation	A PowerPoint presentation was presented to the SCI Horticultural group visiting NIAB East Malling on the 23 rd September 2022.
Oral Presentation	A PowerPoint presentation was presented at the Graduate Forum at the University of Essex on the 28 th September 2022.

6. Partners (if applicable)

Scientific partners	NIAB East Malling (Dr Mark Else) & University of Essex (Professor Tracy Lawson & Dr Amanda Cavanagh)
Industry partners	Berry Gardens (Harriet Duncalfe)
Government sponsor	