



Project title: Realising Increased Photosynthetic Efficiency to Increase Strawberry Yields

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Previous report: N/A

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Location of project: NIAB EMR

Industry Representative: N/A

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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Signature Date

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GROWER SUMMARY

Headline

This project aims to improve strawberry fruit yield per hectare and strawberry fruit quality by increasing leaf photosynthetic performance through genetic manipulation of relevant enzymes.

Background

As the global population continues to rise and climate change threatens current crop yields, new solutions are required to increase agricultural and horticultural productivity. Early studies have suggested that photosynthetic efficiency is a limiting factor on maximised crop growth in C3 plants and thus represents a target for improving yield. Previous work has demonstrated that the overexpression of key regulatory steps in the Calvin Benson Cycle (CBC) results in an increase in biomass yield and grain yield in tobacco and wheat respectively. This enhanced regeneration of the carbon acceptor RuBP (ribulose-1,5-bisphosphate) in the CBC is therefore demonstrative of a viable and effective method for improving photosynthetic efficiency across species. This project continues this line of research where rate-limiting enzyme activities in the CBC will be increased via genetic modification.

This work is being carried out in cultivated strawberry (*Fragaria x ananassa Duch.*), as current research in this area aims to understand how fundamental research in model plants, such as Tobacco and Arabidopsis, can be applied to crops. I will aim to determine if overexpression of CBC genes, independently or simultaneously, results in changes to total biomass, harvestable yield, and developmental characteristics. Another key area of my research is to ascertain if enhanced photosynthesis, increased total biomass and increased fruit yield affect strawberry fruit quality. I will investigate this using a range of analytical chemistry techniques to study if or how key flavour and nutritional compounds differ between genetically modified and unmodified lines.

Summary

In the first year of this project, plasmids (loops of DNA) containing the CBC enzyme SBPase (sedoheptulose-1,7-bisphosphatase) and the starch synthesis enzyme AGPase (adenosine diphosphate glucose pyrophosphorylase) have been constructed. Insertion of these plasmids (transformation) into leaflet explants and subsequent explant regeneration are being tested in a range of cultivars, including the high yielding and commercially interesting but experimentally recalcitrant line EMR 2434-1. Regeneration has shown to be successful for the cultivar Calypso and the experimental line EMR 773-5.

Methods for extracting and analysing flavour components of strawberry fruit have also been developed in preparation for understanding how manipulating primary carbon metabolism in the leaf influences secondary carbon metabolism of strawberry fruit flavour. Initial results have identified the high sensitivity of flavour compounds to different extraction methods, fruit age and cultivar type, highlighting the need for strict controls in this field of analysis.

Financial Benefits

While it is difficult to ascertain exact financial payoffs at this stage of the project, it is reasonable to hypothesise that the project will have similar benefits on fruit growth and quality of carbon dioxide enrichment, as this also improves atmospheric carbon assimilation. This method, employed extensively by the Dutch horticultural industry, has been shown to increase strawberry fruit soluble sugar by up to 20 % ([Wang and Bunce, 2004](#)) and roughly double fruit dry weight production per plant ([Sun et al., 2012](#)). These data imply that genetic manipulation may also be capable of improving both fruit yield and quality, which could improve profitability for growers.

Action Points

There are no action points that must be taken at this stage.

