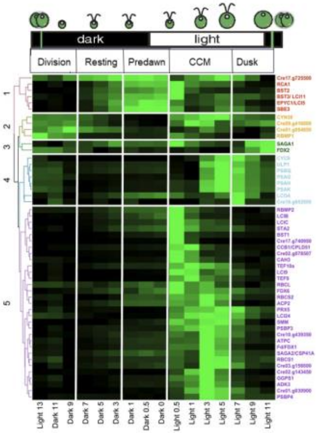
TIGR²ESS
Transforming India's Green Revolution by Research and Empowerment for Sustainable food Supplies

1.7 Understanding Genetic Regulation of Photosynthetic Mechanisms to Enhance Plant Productivity

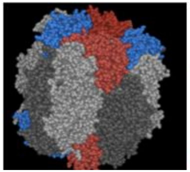
Measuring and monitoring gene expression provides fundamental insights for plant photosynthesis *Food security for a burgeoning global population, facing the threat of a changing climate, will require a paradigm shift in crop production and stress resilience. Major efforts are being directed at understanding how we might turbocharge crop productivity; perhaps by augmenting photosynthesis with a carbon concentrating mechanism (CCM). Current approaches range from incorporating elements of maize photosynthesis into rice, but in a collaboration between Cambridge and NIPGR, New Delhi, we have defined novel highly productive algal traits prior to transfer into higher plants.*

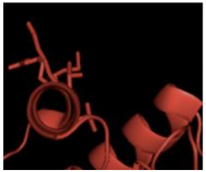


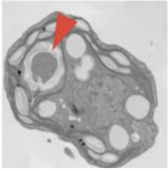
GRAPH EMBEDDING THE DYNAMIC LANDSCAPES OF CCM GENE OPERATION

> *"Recommendations to funders and policy makers: support for individuals is crucial in order to conduct high quality research, and to train upcoming generations that are the future researchers in a developing country"*
>
> **Prof Nyovani Madise**
> **Director of Research for Sustainable Development Policies AFIDEP**

The Microbial Carbon Concentration Mechanism could enhance Agricultural Production The key enzyme driving carbon uptake by plants (RubisCO) is slow and rather inefficient. Algae have evolved a CCM which helps to turbocharge photosynthesis. Using the model green alga, *Chlamydomonas reinhardtii,* a partnership between Cambridge and NIPGR has been investigating the molecular basis of the mechanism which allows RubisCO to aggregate within a subcellular microcompartment, the **pyrenoid**. We have been characterising how a specific protein, EPYC1, acts as a molecular glue to facilitate pyrenoid assembly, and using outputs from the GRN analysis to identify key molecular factors which co-ordinate CCM operation. In future, these carbon capture mechanisms (CCMs) could be transferred to higher crops to increase photosynthetic efficiency and resilience to environmental stress.







Revolutionising genomics though modelling and empirical studies Tremendous advances in the availability of high throughput Omics- datasets demand new analytical protocols for sifting and sorting genes related to specific traits. Colleagues at NIPGR are pioneering new algorithms and computational methods to find the proverbial needle (key regulators) in the haystack of hundreds of millions of transcriptional reads. Spatio-temporal mapping of changing relationships between genes allows key regulatory hubs to be identified at important stages of plant or algal development, using Gene Regulatory Networks (GRN) and graph embedding methods for transforming nodes and edges into numerical representations.

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