Photosynthetic Enhancement of Algae to Increase Food Production

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Throughout history, famines have been one of the most common, yet also one of the most devastating, problems faced. Today, food shortages cause an estimated 9 million deaths annually. The threats of these crises are only deepened by global warming, limited space, rapidly increasing population size, and other factors of the modern world. Many of the attempts to find solutions to this problem have been through utilizing synthetic biology. Researchers have focused on enhancing traditional crops to increase food production. As a team, we aspire to build on and recontextualize these pursuits by enhancing algae– which has been proven to have many advantages over traditional crops– with components native to diverse fields of study. The systems designed tentatively promise improved light capture, carbon fixation, and starch production, through three distinct but interdependent mechanisms. Phycobilisomes (large light-harvesting structures found in red algae and cyanobacteria) will be expressed for their incredibly efficient ability to capture sunlight. A multicopper oxidase will be leveraged to reduce O2 into water, freeing RuBisCO to operate more efficiently by conducting less photorespiration. Finally, overexpression of CmGLG1 (which initiates starch and glycogen synthesis) and its regulator (target of rapamycin) are predicted to leverage the augmented resources. With development, such systems may circumvent the causes of famine that arise from traditional farming methods, or contribute to famine relief efforts.