Green Gold

How Microbes Will Impact Biofuel Production

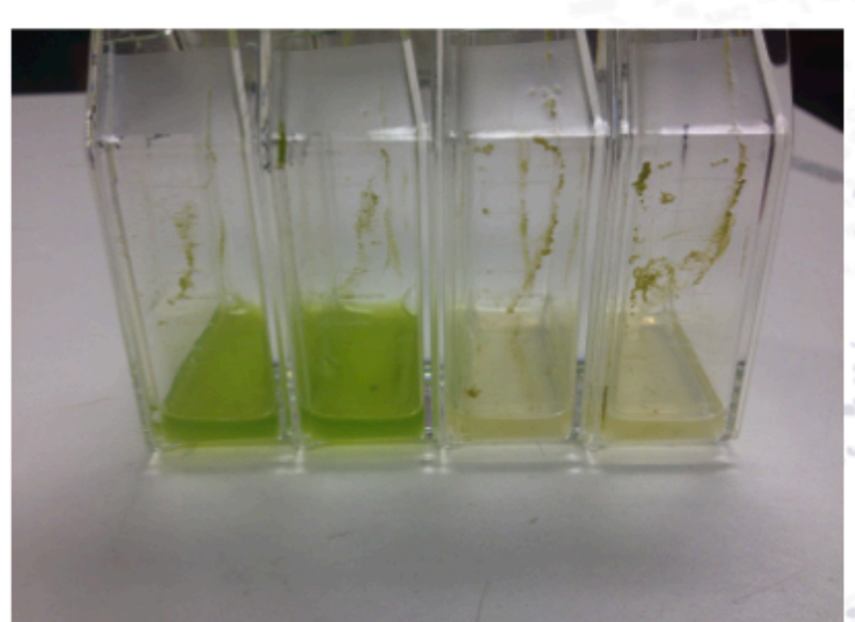
Adam Robbins-Pianka

Interdisciplinary Quantitiative Biology, and Department of Computer Science, University of Colorado at Boulder

Abstract

This project focuses on microbial interactions with algae, which are an attractive candidate for mass-scale biofuel production because they can grow rapidly on non-arable land using waste water. A more complete understanding of microbial interactions will lead to higher yields and lower cost, for example by reducing the susceptibility of algae crops to invasion by unwanted microbes or algae strains. Building better models of interactions between individual species, as well as models of interactions between more stable multi-species assemblages, will therefore be crucial in the development of more cost effective and productive energy crops. To begin to address these points, hundreds of samples from Solix bioreactors have been collected.

SOLIX



Samples taken from Solix growth systems. Some of the algae has grown densely (left two containers), while some of the algae has grown to a lower density (right two containers). What role microbial interactions play in the determination of growth rate, final density, and yield will be investigated.

Investigating Bacteria-Algae Interactions

With Scott Fulbright, a PhD student in Ken Reardon's lab at Colorado State University, I am beginning to investigate potential interactions between bacterial populations and algal growth. We are preparing to sequence more than 300 samples that Scott collected from Solix between June 2011 and April 2012, representing five different types of growth chambers, different seasons, and varying levels of success (determined by the size of the population of *Nannochloropsis salina* at the time of sampling).

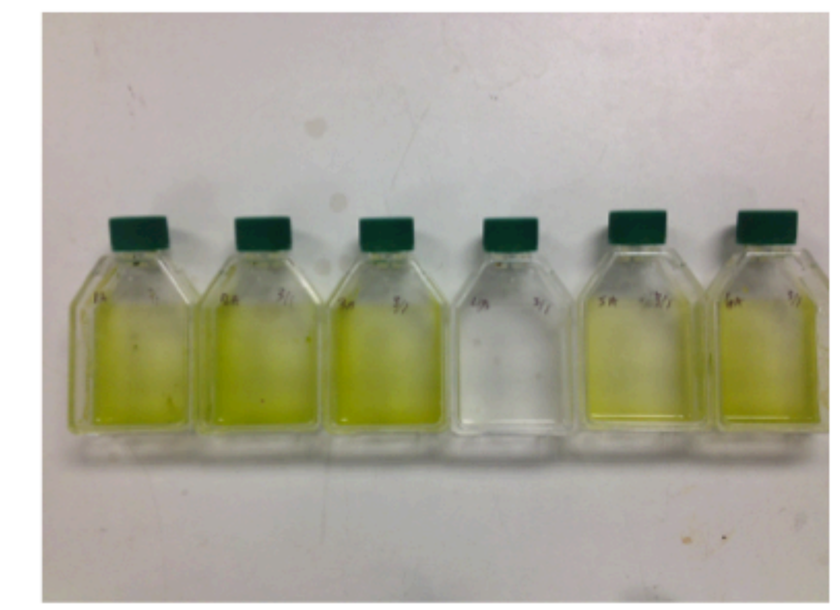
5ml	2L	4L	40L	200L
4	7	3	98	191

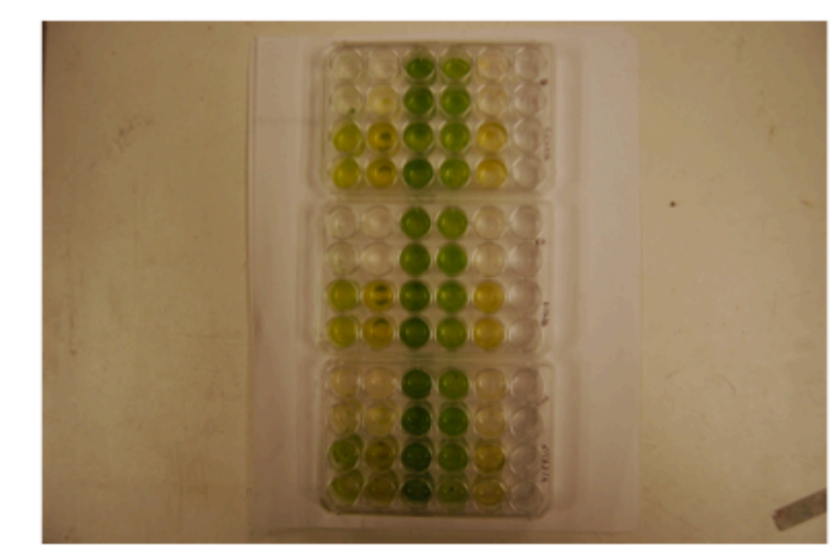
Shown above are the number of samples (bottom numbers) taken for each growth chamber size (top). More samples were collected from larger growth chambers because previous results have shown that larger vessel sizes exhibit a larger number of bacteria and undesirable algae. One important question will be how we can make biofuel-producing algae cultures more resistant to invasion and "culture crash," a costly failure to retain a healthy and productive population of the desired algae strain, *Nannochloropsis salina*.

200L growth systems at Solix. A main goal is preventing biofilm buildup and invasion by bacteria and unwanted algae strains in these large-scale systems.

Culture Crashes

One very costly and time-consuming occurrence at algae farms are so-called "culture crashes," during which crop species of algae are unable to persist and instead die out.





In the images above, we can see that the algae in some flasks (top) and 96-well plates have died. Common causes include pathogens such as viruses, fungi, and harmful bacteria.

Future Directions

- Sequence Samples and analyze the data
- Incorporate transcriptomics and metagenomics data
- Identify beneficial and detrimental microbes

Acknowledgements

Solix Biofuels for photographs and production data
This work was supported in part by the Interdisciplinary Quantitative (IQ Biology) program at the Biofrontiers Institute, University of Colorado, Boulder. IQ Biology is generously supported by NSF IGERT grant number 1144807. Sequencing will be paid for by the Department of Bioagricultural Science and Pest Management