CCSF lunch summary: July 16, 2008

To start of the discussion organizer Beth Ahner (BEE) presented some of the advantages of growing algae for biofuel production and some of the technological challenges. She also presented a list of several venture capital-funded companies in the field along with some potential connections to Cornell.

The group discussed:

1. Which species of algae should be cultivated and what is the best way to grow them? (including diatoms vs greens; GMO vs natural; pure closed systems vs mixed open pond cultures).

Ahner presented a few species currently under consideration. A lipid-rich but slow growing type of algae, Botryococus, was specifically discussed. Chlamydomonas was mentioned as an organism that is genetically tractable.

The use of genetically modified organism was discussed versus the merits of finding an organism through selection or in nature.

2. What type of biofuel is it possible to produce with algae and how does that choice influence downstream processing and optimization of growth conditions?

There was discussion about the various ways that energy could be derived from algae: direct burning of dry biomass, extraction and generation of biodiesel, or conversion of cellulose to sugar for fermentation to an alcohol.

Manuel Villa-Garcia (MBG) asked about similarities to yeast and noted that they are currently manipulating growth conditions to manipulate triglyceride composition of yeast in bioreactors.

There was a question from Betta Fisher (M&AE) about what is known about the types of lipids made by algae and how variable they might be and how this might affect combustion.

3. What are the specific growth needs and conditions of optimal growth?

For autotrophic growth (CO_2 + light), there is the benefit of CO_2 capture and free sunlight but the disadvantage of low culture densities. Regional light availability for large scale systems cited as important and the use of LEDs for was mentioned. Carbon dioxide can be captured from combustion or fermentation systems. High carbon dioxide concentrations can decrease the pH of growth medium to below maximal for algae growth.

It was mentioned that we might talk with Lou Derry (EAS, not present) about the carbon sequestration project being discussed with NYSEG people for power plant on Cayuga Lake.

For heterotrophic growth there is the benefit of high cell density but it requires fixed carbon (sugars or organic acids) as substrate. David Stern, BTI Director, relayed some of his insights from his recent conversations at Solazyme, a company currently growing algae commercially for secondary chemical markets. He noted that they grow everything heterotrophically.

All cultures require a source of nitrogen and phosphorus: Ruth Richardson (CEE) mentioned the possible use of waste N and P to feed algae systems. Water reuse was also discussed.

4. Reactor design issues were discussed very generally:

The problem of maintaining mono-cultures in open systems was discussed.

The feasibility of semi-open systems in surface seawater was discussed. Light penetration cited as problematic, harvesting challenges mentioned. It was mentioned that this is done with kelp farming.

Steve Beer's (Plant Path) introduced the idea of introducing a protein that stimulates angiosperm growth in algal systems.

Chris Barrett (AEM) asked about location of production and potential transport issues for moving fuel to where it is needed.

<u>Attending the meeting were:</u>
Beth Ahner, BEE, baa7@cornell.edu
Lutz Becks, E&EB, Post-doc, lb273@cornell.edu
Lars Angenent, BEE, la249@cornell.edu
Aldo Barriero Felpeto, E&EB, Post-doc, ab785@cornell.edu
Maureen Hanson, MBG, mrh5@cornell.edu
Georg Jander, BTI, gj32@cornell.edu
Ruth Richardson, CEE, rer26@cornell.edu
Manuel Villa-Garcia, MBG, mv73@cornell.edu
Marshall Hayes, Plant Path, Post-doc, mlh66@cornell.edu
Steve Beer, Plant Path, svb1@cornell.edu
Elizabeth Fisher, M&AE, emf4@cornell.edu
David Stern, BTI, ds28@cornell.edu
Frank DiSalvo, fjd3@cornell.edu
Chris Barrett, cbb2@cornell.edu
Sidney Leibovich, sl23@cornell.edu
Dave Dieterich, dd355@cornell.edu

Laura Janka, writer intern for Cornell Chronicle Publications