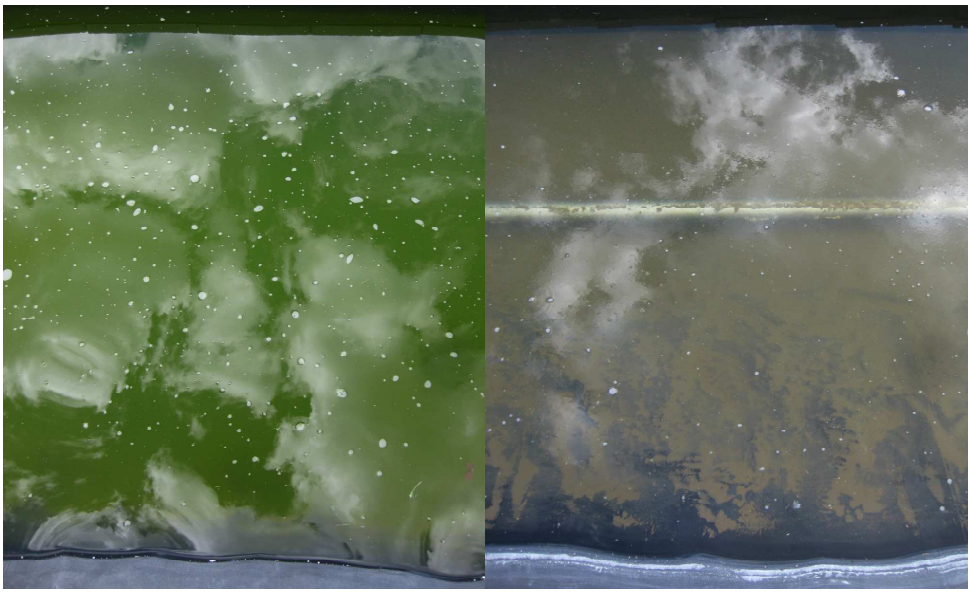
Sun Grant Western Regional Center
Oregon State University

Biofuels from Salt Basin Algae: A Renewable Energy Crop for Carbon Sequestration

John Cushman, University of Nevada, Reno

Overview

The long-term goal of this research project is to optimize the use of halophytic microalgae as a biofuels crop. Halophytic algae are an ideal renewable energy resource because they can be grown on marginal lands with brackish or saline water and have been shown to be thirty times more productive than terrestrial feedstocks. Dr. Cushman and his co-PIs will screen algae strains and mutants for high production of triacylglycerols (TAGs) under different growing conditions and identify genes related to oil production by microarray analysis. Ultimately, this project will provide an assessment of the potential of algae as a biodiesel feedstock. The PIs will educate the public of their results with a room-size demonstration production facility and develop a pilot-scale proof-of-concept algae-based biodiesel production system.



Comparison of *D. salina* growth with simulated geothermal heating (left) and without (right).
Material visible in bottom of right pond is dust, not algae.

Collaborators

Co-PIs: David Shintani and Jeff Harper, University of Nevada, Reno

Industry Partners: John Bebout, Bebout & Associates, Jeffrey Eppink, Enegis, LLC.

Academic collaborators: Juergen Polle, Department of Biology, Brooklyn College of City University of New York, Chuck Coronella, Department of Chemical Engineering, University of Nevada, Reno

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Progress to Date

The team has made good progress on all objectives. Analysis of growth rates, lipid content and insoluble starch content has been completed for nineteen (19) strains of halophytic microalgae. Data were collected and analyzed for both fresh weight and dry weight of the microalgae. Also, the team has initiated the profiling of fatty acid and starch content of these same strains and has observed large differences in fatty acid and starch content among the various strains. Quantitation of these differences is currently in progress. Early results suggest that various algal strains vary widely in both lipid and starch production. This indicates that the investment in this project is important and has great utility.

Documentation of the natural variability present in different strains also indicates that mutagenesis and selection of oil- or starch-rich feedstocks is a viable strategy for obtaining elite feedstocks. Preliminary analysis of wildtype and ethyl methyl sulfonate (EMS) mutagenized *D. Salina* cells indicate that the natural variability can be exploited and the researchers can capture such variability through transgressive selection strategies.

Dr. Cushman and his team reached a major project milestone with the successful completion of a pilot-scale, "proof-of-concept" production facility. With in-kind support from industry partners, the team constructed two raceway ponds, with approximately 20,000 L capacity each. Design features include angled pond walls to reduce shading, integrated heat-exchange heating system using a natural gas-fired swimming pool heater as a surrogate for geothermal heating, and an aeration/circulation system. A second major milestone was reached with the first production run of *D. Salina* growth in these outdoor ponds. In December 2008, the team harvested 2.56 Kg of biomass, which yielded 0.22 gallons of lipid and 0.34 pounds of starch. On an annual basis, it is estimated that this would result in the production of at least 131 gallons/acre of biodiesel, which is 2.7 times as productive as soybean biodiesel (48 gallons/acre). A second experimental run was completed to compare the effects of heated versus non-heated ponds. The results indicate that without heating, essentially no growth is obtained in winter months, whereas with heating provided by simulated geothermal resource, production would be possible on a year-round basis in northern Nevada (see photos on reverse).

Technology Transfer

- Four lay articles
- Numerous presentations and poster sessions
- Coverage on television news reports

Funding Sources

- U.S. Department of Transportation, Research and Innovative Technology Administration
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