Crop Protection from Rotifers in an Outdoor Algae Cultivation System

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Abstract

Open pond raceway systems provide a low cost solution to generating large volumes of an algae crop. A major issue faced by these open-type systems is inadequate crop protection from the outside environment. ICARUS is an algal cultivation system that employs the use of a fine pore membrane to separate the desired algal crop from potential contaminants. Through this experimentation, ICARUS was tested against an infamous algal grazer, the rotifer. Results show that ICARUS is able to maintain separation from rotifers in background media from the algae crop. Algal growth is maintained at comparable levels to other systems.

Drivers for Research

Outdoor Algae Crop Protection

Large-scale algal crop are most commonly cultivated in ponds, or similar systems open to the environment. With such vulnerability, algal crops are highly susceptible to a variety of contamination, e.g. bacteria, other algal species, viruses, and perhaps most infamous, grazers, including rotifers. A crop protection solution is needed.

Hypothesis

With the use of fine pore membrane separation, the ICARUS technology will provide adequate crop protection from rotifers (and other organisms larger than the membrane pores) for the cultivation of algae; however end uses for the algae bioproduct may be limited.

The ICARUS Concept

ICARUS is a Membrane Photobioreactor that floats on the surface of a body of water. The membrane bottom allows for the passage nutrients and dissolved constituents, while protecting the algal crop from potential threats. This entire process is passively powered by the sun. The purpose of ICARUS is to generate an algal biomass crop as well as to passively clean up impaired waters.

Crop Protection Testing

In order to test ICARUS crop protection, 18 trial runs were conducted; each trial was run for 8 days. Stock rotifers were cultured in conical reactors and fed cryo-preserved Nannochloropsis sp prior to experimentation. ICARUS testing was performed using Chlorella vulgaris due to its robust nature, fast growth rate, and extensive available comparable market research. Rotifers were concentrated via a 50um sieve and inoculated into the background media. Monoculture algae was inoculated into the ICARUS pods (see Figure 3 & 4). Algal growth was monitored bi-daily throughout the trials. ICARUS culture was ICARUS pods (see Figure 3 & 4). Algal growth was monitored bi-daily throughout the trials, ICARUS culture was...

Results and Discussion

Algal Growth. Results indicate comparable growth between ICARUS algae grown with and without the presence of rotifers in the background media. This represents a lack of infiltration of the grazing rotifers on the algal crop. The decline in ICARUS algal growth at the end of the trial runs may represent a reduction of mass transfer across the membrane due to settled algae cells at the membrane surface. Periodic backwashing may help to prolong adequate mass transfer and will be tested in future studies of the system. It may also be of value to test the system against different contaminants, such as ciliates.

Crop protection. Proliferation of rotifers were seen in the background media over the course of the trial runs. However, throughout the 18 trial runs, no rotifers were observed within the ICARUS-contained algae crop. These results imply a possible solution to the outdoor crop protection problem.

Acknowledgments: We thank support from the U. S. National Science Foundation (Award 1239746) and NSF I-Corps (Award 1542494). We also thank staff from the City of Tampa’s Howard P. Curren Advanced Wastewater Treatment Plant, as well as Anna Quinones, Judian Duran and Sarah Browle, for their support.

References:

Fig. 1 ICARUS concept diagram
Fig. 2 Rotifer, algae grazer
Fig. 3 Conceptual ICARUS diagram
Fig. 4 Bottom side of ICARUS pod membrane
Fig. 5 Experimental Set-up: ICARUS pods in raceway during Rotifer Experiment trial
Fig. 6 & 7 ICARUS Rotifer Experiment Average Growth Results