Development and characterization of stress resistance microalgae using molecular genomics of natural population

Jae-Hyeok Lee
(jae-hyeok.lee@botany.ubc.ca)

Univ. of British Columbia

Research Goals

- For high-capacity capture of carbon dioxide, development of high-efficiency microalgae which can survive under stressful conditions will be pursued. Our strategy is to generate randomly recombined strains via a designed mating procedure that is intended to maximize phenotypic diversity within a population. A library of those mating progeny will be studied to identify the regulatory genes responsible for regulation of photosynthesis upon nitrogen- starvation. Together with the collection of mutant strains from insertional mutant library, we will generate microalgal strains performing highly efficient photosynthesis under various stress conditions.

Research Contents

To achieve our goal of developing highly resistant microalgal strains in stressful environment,

- Examine natural algal strains for their photosynthetic efficiency in response to nitrogen-starvation and other stress conditions, and quantify variations of their phenotypes in order to verify causative genetic variations existing in the natural strains.
- Generate high-value strains via continuous breeding of selected individuals exhibiting optimal phenotypes, and characterize their mechanisms to cope with the stressors while maintaining photosynthetic activities.
- Build a strain library for quantitative trait loci analysis by random mating among divergent natural strains, and identify candidate loci involved in determining stress resistance, controlling photosynthetic efficiency, and nitrogen-starvation responses.
- Identify and characterize mutants defective in nitrogen-responses by non-invasive molecular probes that enable real-time examination of the degradation of cytochrome-b6f complex during starvation.
- Building a road-map to guide engineering strategy to maximize photosynthetic capability of microalgae in fluctuating environments.

Expected Effects

- The genetically improved strain will be utilized for the commercial utilization of microalgae for value added compound as well as reducing carbon emission.
- Useful algal genes are potentially powerful tools for improving microalgal crops by increasing photosynthetic efficiency; thereby, our research will aid our society to secure clean and renewable biological resources.
- Biological conversion of released CO2 will become an important goal as our society is urgently seeking natural and sustainable solutions for the global warming due to anthropogenic green house gases.