Combating Harmful Algal Blooms by Promoting Diatom Growth Via Silica-Solubilizing Bacteria

Harmful Algal Blooms have become a serious problem for water bodies worldwide. One potential method of inhibiting the growth of the blooms is through competition for resources. Diatoms are present in nearly every body of water and compete for similar resources as harmful algae. However, diatoms do not typically limit algae due to scarcity of soluble silicon, which is needed for the glass shell (frustule) and division of diatoms. Silicon is abundant, but rare in a soluble form, monosilicic acid. One natural source of monosilicic acid is created by silica-solubilizing bacteria associated with roots of plants with siliceous stalks. It has previously been found near the roots of rice and sugar cane plants. We hypothesize that these bacteria can be grown in large quantity in a controlled environment, and the monosilicic acid they produce can be dispersed into a body of water, greatly enhancing diatom growth. Diatoms will then be able to naturally outcompete the harmful algae, reducing their abundance.

II. Methods

- We collected soil samples from the roots of ~20 different plant species in an attempt to find silica-solubilizing bacteria.
- We diluted 1.0 g of fresh soil in 10 ml water then streak plated the samples on growth media containing diatomaceous earth. We incubated samples at room temperature for three days, then assessed whether there was any clearing of diatomaceous earth around the colonies.
- When we saw no clearance of diatomaceous earth, we repeated our efforts using media containing talc, which has a different form of silica (magnesium silicate).
- Water from Mantua reservoir was collected and placed in an empty aquarium under grow lights to provide a source of algae for controlled experimentation.
- Media preparation was done according to specifications in, but some modifications were made according to cost and availability of ingredients.

III. Results

Upon allowing the soil specimens to grow for what should be an adequate time, we observed no clearance of diatomaceous earth or talc, suggesting we had not isolated any silica-solubilizing bacteria. With the first failure we wondered if the form of silicon (silicon dioxide) was perhaps not soluble to bacteria. In the second attempt, bacterial growth was minimal due to the omission of a suitable nitrogen source for the target bacteria to grow. The bacteria that did grow showed no signs of silica solubilization.

IV. Conclusions and Future Work

With the failure to identify the target bacteria in the samples that were collected locally, we have decided that a proof of concept is needed to justify the search for a local source. We found a commercial source of silica-solubilizing bacteria (Bacillus mycoides) in India and will be purchasing a sample to test our hypothesis. Once the sample arrives, we will grow them in various conditions to assess the growth capacity and silica-solubilizing capacity. We will microscopically assess algae and diatom density in the aquarium sample of water taken from Mantua reservoir, and then run a series of experiments to determine the effects of monosilicic acid supplementation from our lab-grown bacteria. Our goal is to optimize for growth of diatoms and create conditions where competition from diatoms significantly reduces the density of harmful algae. If we can optimize our growth methodology and application rate, then we will do larger-scale, in situ tests at Mantua reservoir next summer.

V. SOURCES