CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

S1517

Project Title

The Effects of Different Transition Metal Micronutrients on Carbon Fixation and Silica Intake of T. pseudonana Diatom

Abstract

Objectives/Goals

Our project aims to extend the Iron Hypothesis, a potential solution to climate change, originally proposed by oceanographer John Martin. We tested the effectiveness of using metals besides iron to bolster carbon fixation and silica intake of diatoms.

Methods/Materials

In order to do this experiment, we simulated an ocean environment by using ocean water from the Pacific Ocean and by controlling temperature, light, and air. We then cultured our strain of diatom, Thalassiosira Pseudonana, in our simulated marine environment. After the strains had been cultured properly, we then introduced transition metls iron, zinc and copper nitrates, each at different concentrations of 0.001, 0.01, and 0.1 g/L (these metals are cofactors in photosynthetic enzymes). As a control, we introduced sodium nitrate because sodium ions have no biological effect on the diatoms. EDTA was added as another control because it is a metal chelating agent that prevents the metals from affecting the diatoms. To measure cell growth, we performed cell counts at least twice a week. After the experiment, we filtered our culture to measure the dry weight of our diatoms. Using the remaining filtered medium, we placed it under spectrophotometry at 803 nm to measure the diatoms' silica intake.

Results

Our results showed that the diatoms in iron have the highest average weight compared to the diatoms in other solutions. However, diatoms in iron are weak absorbers of silica and their rapid growth from 300,000 to 650,000 cells over the course of 6 days foreshadows diatom blooms, which are detrimental to the environment. Zinc solution diatoms are the strongest absorbers of silica with absorbances from 0.001 to 0.002, and, with the exception of iron, they have the highest average weight at 0.01 g/L. Copper solution diatoms, on the other hand, can fixate the highest carbon, but the diatoms are unable to absorb much silica and begin to die after exposure.

Conclusions/Discussion

In conclusion, a mixture of the metals in fixed proportions will maximize the carbon fixation and silica intake. Iron should be added first to promote cell growth at 0.001-0.01 g/L along with the same concentration of zinc to maximize silica intake. After between six to nine days when the highest growth rate occurs, 0.1 g/L or more of copper should be added to maximize the carbon fixation right before it inhibits growth by killing the diatoms.

Summary Statement

We discovered zinc increased silica content of the diatoms, iron increased the carbon fixation of the diatoms, and copper inhibited detrimental diatom blooms.

Help Received

We designed the experiment completely by ourselves. We used lab equipment at our high school, Lynbrook High School under the supervision of Kathleen Loia and Lester Leung.