The Effect of Potassium Nitrate and Ammonium Chloride on the Growth of Fresh Water Algae in the Waco Wetlands

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ABSTRACT

The purpose of this experiment is to compare the intake of two different nitrogen sources, KNO_3 and NH_4Cl, in the two most abundant algae species to find the optimal concentration and variation between the two species. Two species of algae, *Spirogyra sp*. and *Zygnema sp.*, were obtained and grown in three different concentrations of KNO_3 and NH_4Cl respectively. The mass of algae was initially recorded and then recorded every other day for 14 days. Growth was observed in the first two concentrations of KNO3 for both *Zygnema sp.* and *Spirogyra sp*. However although *Zygnema sp.* exhibited little growth in the first concentration of NH_4Cl, *Spirogyra sp*. showed no growth at all. Although there is not enough data to prove that KNO_3 is the direct cause of its growth rate, this study shows that the presence of KNO_3 in fresh water bodies can be beneficial to the growth of algae.

INTRODUCTION

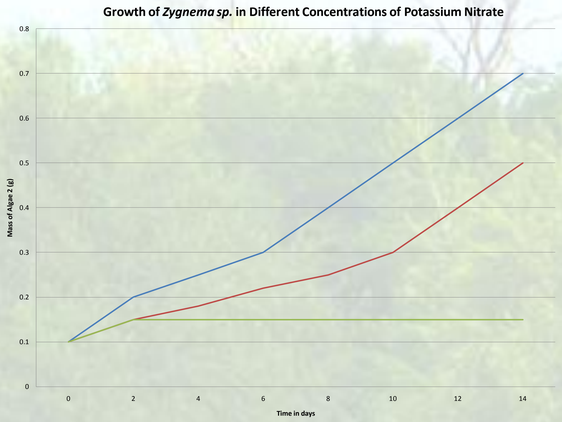
Nitrogen from the nitrate molecule is generally considered to be more readily available to plants than nitrogen from ammonium (Chu, 1943). However, several investigations have shown that certain plants show better growth with ammonium salts (Chu, 1943). Both forms of nitrogen occur in natural waters, but in the surface layers the majority of the nitrogen is often in the form of nitrates. These experiments conducted under known, controlled conditions with an objective of determining the relation between the development of planktonic algae and the nitrogen concentration of the medium —whether supplied as ammonium or nitrate compared in the two most abundant algae species to find the optimal concentration and variation between the two species. Based on the knowledge of the positive effect of potassium on the growth of algae (Kratz et al, 1955) and the adverse effect of chlorine on their growth (Maruyama et al. 1988), if two different species of algae are grown in KNO_3 and NH_4Cl, then there would be more growth of algae in KNO_3 than in NH_4Cl. In addition, since *Spirogyra sp*. is the most common specie in the Wetlands it would have more growth than *Zygnema sp*. Optimal growth would be expected in the solution with 0.01M concentration which is close to that found in natural water (Maruyama et al. 1988).

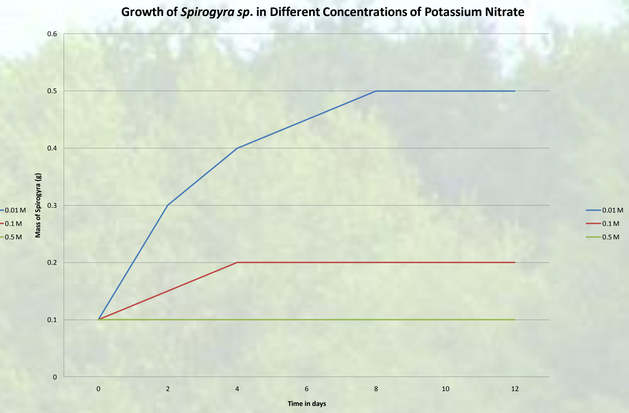
MATERIALS AND METHODS

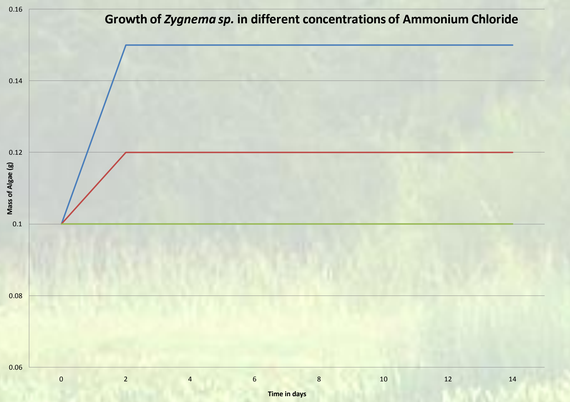
1. Two algae species were obtained from two different cells in the Waco Wetlands using a net.
2. Using a microscope, the algae species were identified as *Spirogyra sp*. and *Zygnema sp*.
3. The two algae species were grown in separate jars under florescent light with an aquarium air pump for one week.
4. Pellets of NH_4Cl were dissolved in 50 mL of water using beakers to create solution concentrations of 0.01 M, 0.1 M, and 0.5 M.
5. Pellets of KNO_3 were dissolved in 50 mL of water using beakers to create solution concentrations of 0.01 M, 0.1 M, and 0.5 M.
6. Each of the six solutions was stored in labeled jars.
7. 36 petri dishes were labeled: type of algae and concentration.
8. 0.01 grams of *Spirogyra sp*. were added to 18 (first half) petri dishes.
9. 0.01 grams of *Zygnema sp.* were added to 18 (second half) petri dishes.
10. 15 mL of 0.01 M of NH_4Cl were added to the first 3 of the 18 petri dishes containing *Spirogyra sp*., 15 mL of NH_4Cl 0.1 M to the next 3, and 15 mL of NH_4Cl of 0.5 M to the last three petri dishes.
11. 15 mL of 0.01 M of KNO_3 were added to the first 3 of the 18 petri dishes containing *Spirogyra sp*., 15 mL of KNO_3 0.1 M to the next 3, and 15 mL of KNO_3 of 0.5 M to the last three petri dishes.
12. The mass of each petri dish was measured and recorded on the label.
13. The algae species were allowed to grow in petri dishes under florescent light for 14 days.
14. The mass of each petri dish was recorded every other day for 14 days.

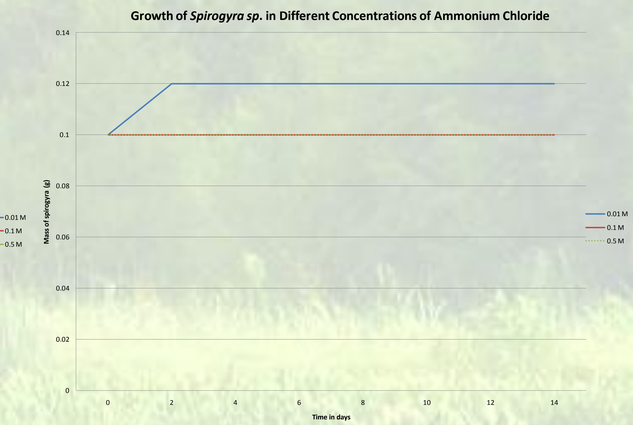
RESULTS

Data represented in Fig. 1, Fig. 2, Fig. 3 and Fig. 4 shows that there was growth in the two algae species in the 0.01 M (lowest) concentration of both KNO_3 and NH_4Cl. However, both algae species did not live past the second day in the NH_4Cl solution. In 0.1 M concentration of NH_4Cl, *Zygnema sp.* showed little growth while *Spirogyra sp*. did not grow at all. Both died in 0.5 M (highest) concentrations of NH_4Cl and KNO_3. *Zygnema sp.* showed an exponential growth in the first two concentrations of KNO_3 as compared to *Spirogyra sp*. which showed some growth but tapered off at its maximum growth level.









(a)

(b)

(c)

(d)

a) Natasha measuring out masses of NH_4Cl to be used in preparation of the solution. (b) Sheena weighing out the masses with an analytical scale. (c) Oddie preparing the solutions, (d) A layout of the experiment.

DISCUSSION and CONCLUSION

The outcome of the experiment and the initial hypothesis agree on the expected growth of algae in KNO_3 than in NH_4Cl because of the presence of potassium in the solution. However, *Spirogyra sp*. did not show more growth than *Zygnema sp.* despite the fact that it is the more abundant species at the wetlands. In terms of concentration, as predicted 0.01M was the concentration with optimal growth for both in both nitrogen sources compared to 0.1M of NH_4Cl in which *Spirogyra sp*. did not show growth and 0.5 M of KNO_3 and NH_4Cl in which both spices died. These outcomes are similar with the results of the experiment by Kratz et al, which explains how potassium requirements have been reported to help in the growth of algae (1955). When potassium and nitrogen ions are in solution, the presence of potassium ions help the algae in optimizing their intake of nitrogen hence the growth of the algae. However, in high concentrations of these ions, the algae species cannot efficiently take in nitrogen. On the other hand according to another study, chloramine, which forms when chlorine and ammonia ions are in solution, has been found to inhibit the intake of nitrogen by the algae because of its high level of toxicity (Maruyama et al. 1988). These results show the same trend as our predictions and results.

The proliferation of algae can be harmful to water quality because the blooms deplete oxygen levels in aquatic ecosystems. However research has shown that planktonic algae are critical to a pond's fish life and must be present for newly hatched fish to survive. In addition to this, medical research organizations and petroleum engineering research organizations are looking into some other benefits of algae such as their use in drugs and biofuel. To be able to control the growth of algae can be handy to either lessen the amount of algae in water that has an overabundance or to even increase algae where there is insufficient growth. Although this experiment shows positive outcomes in relation to the proposed hypothesis, one cannot conclude that KNO_3 is the cause for the growth of algae in the wetlands. However, it would be safe to say that in the proposed need of algae, KNO_3 should be considered as a compound that can potentially help with the growth of algae.

A special thanks to:
Dr. Marty Harvill, Baoqing Ding, Dan Daugherty, Alex James, and the Lake Waco Wetlands

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