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, KNO₃ and NH₄Cl, 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 KNO₃ and NH₄Cl 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 NH₄Cl, Spirogyra sp. showed no growth at all. Although there is not enough data to prove that KNO₃ is the direct cause of its growth rate, this study shows that the presence of KNO₃ 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). 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 (Manuyama et al., 1988), if two different species of algae are grown in KNO₃ and NH₄Cl then there would be more growth of algae in KNO₃ than in NH₄Cl. In addition, since Spirogyra sp. is the most common species 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 (Manuyama et al. 1988).

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 KNO₃ and NH₄Cl. However, both algae species did not live past the second day in the NH₄Cl solution. In 0.1 M concentration of NH₄Cl, Zygnema sp. showed little growth while Spirogyra sp. did not grow at all. Both died in 0.5 M (highest) concentrations of NH₄Cl and KNO₃. Zygnema sp. showed an exponential growth in the first two concentrations of KNO₃ as compared to Spirogyra sp. which showed some growth but tapered off at its maximum growth level.

DISCUSSION and CONCLUSION

The outcome of the experiment and the initial hypothesis agree on the expected growth of algae in KNO₃, than in NH₄Cl because of the presence of potassium in the solution. However, Spirogyra sp. did not show more growth in the KNO₃ 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 NH₄Cl in which Spirogyra sp. did not show growth and 0.5 M of KNO₃ and NH₄Cl in which both species 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 the 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 (Manuyama 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 KNO₃ 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, KNO₃ should be considered as a compound that can potentially help with the growth of algae.

LITERATURE CITED


Natasha measuring out masses of NH₄Cl 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.

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