Blooming Algae:

Does Organic Fertilizer Affect the Growth of Algae in a Contained Environment?

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J-PLNT-001T

Abstract

This study is related to fertilizer runoff and the effect it has on algae. This is important because aquatic life revolves around algae. Without algae, aquatic life would not exist considering it is the base of the food chain. Algae is responsible for fifty percent of the air you breathe in one breath. Previous studies have shown that compost tea is an organic substance that contains natural chemicals to improve plant growth. Compost tea adds beneficial microbes to foliage. The fertilizer helps plants grow both faster and stronger. The objective of this study was to be able to control algae growth and its population. We need to stop algae from entering our local waterways, creating algae blooms. Our hypothesis objective was that the more compost tea added to the water samples and algae seeds, the more algae will grow. Each water sample will contain one quart of pond water. The designated amount of compost tea will be added to each sample, along with the algae seeds. We let the algae grow and produce for three weeks. After three weeks, we calculated the weight of each container. The container with 600 mL of compost tea had a starting weight of 2.1 grams and a final weight of 48.3 grams. The bin with 400 mL of compost tea had a starting weight of 2.1 grams and a final weight of 7.56 grams. The container with 200 mL of compost tea had a starting weight of 2.1 grams and final weight of 5.46 grams. The final bin containing no compost tea had a starting weight of 2.1 grams and a final weight of 5.39 grams. Overall, the algae in the container with the most compost tea grew significantly larger than the other containers. This data supports our hypotheses. For future studies we may need to modify our experiment to keep the algae growing for longer and let it grow heavier.

Introduction

Algae is a type of nonflowering, aquatic plant that grows in ponds, lakes, and even oceans. Algae is a light green plant that is slimy and stringy. Algae can grow anywhere that there is carbon dioxide, sunlight and enough water. When sunlight is limited, algae takes other organic substances (like plant matter) for food. It does this to get more energy to produce more of itself. Pond scum, seaweed and giant kelp are all examples of algae. Algae that lives in the water can be in two different forms, phytoplankton and seaweed. Seaweed is the largest of the two species with many algae cells whereas phytoplankton is a small, single-celled plant. (Harmful Algal Bloom-Associated Illnesses, 2022). The algae that grows in those ponds and lakes are very significant to the ecosystems living in the body of water. Algae helps form the energy base to the food web that aquatic animals need to survive. Algae helps human life by producing oxygen and cleaning drinking water (sciencedirect.com). Algae also helps us survive to a degree. If you take one breath in, about 40% of that oxygen was made by algae. One of the most important roles played by algae in the environment is the production of oxygen as a by-product of the algae performing photosynthesis (Wordlatlas.com).

This experiment is important because aquatic life revolves around algae. Without algae the aquatic food chain would be depleted. Algae is a huge help in the aquatic ecosystem and helps form the energy base of the aquatic food web. Algae is responsible for 50 percent of

the air we breathe in just one breath. Algae removes pollutants from the water and stabilizes sediments. It is also a single cell protein. As auto working organisms, algae can convert water and carbon dioxide to sugar through the process of photosynthesis. Algae is important to monitor because if it grows too much it can turn into a problem by becoming algae blooms. Algae blooms can be toxic. They are harmful to both animals and humans. (sciencedirect.com)

Cyanobacteria is also known as cyanophyta. It can be found as single cells or as groups that form threads or sheets. Cyanobacteria is what makes algae its blue green color. Cyanobacteria can make the water different colors, including green, blue, red, or brown, and look like foam, scum, mats, or paint floating on the surface of any water body (cdc.gov). Warmer water makes cyanobacteria grow faster than they would in cooler water. Warm water gives cyanobacteria a good advantage. This bacteria grows faster in colder temperatures rather than algae in higher temperatures. As blooms grow thicker, the surface of the algae or the “mats” absorb more sunlight, which leads to warmer water and a higher growth rate in the algae (nrdc.org).

Farmers have been feeding their animals a small amount of seaweed and algae mixed in with regular food and their animals have grown bigger and become more productive with that little bit of algae. Algae grows through a process called photosynthesis. During

photosynthesis, chlorophyll (the green pigment in the plants used to make nutrients) absorbs the light energy of all colors but green. The green light is reflected back off of the algae which results in its green color. The photosynthesis process is the means in which algae make food and oxygen for survival. Overall, algae is a huge help in our ecosystem as well as other aquatic ecosystems.

Fertilizer is a natural or artificial substance that contains helpful chemicals and nutrients in order to improve growth and productiveness of plants. Fertilizers help boost crop yields and productivity of plants and crops. Fertilizers provide plants with the nutrients and minerals they need to grow and do so immediately, even if some of those minerals are absent in the soil (friutgrowers.com) When added to crops, fertilizers will produce more nitrogen, phosphorus, and potassium to boost plant growth. If too much fertilizer is used on a plant, it wastes energy and releases gasses into the atmosphere. As long as someone correctly knows how much fertilizer and when/where to use it, the environment will be unharmed and still full of all the nutrients that the ecosystem needs to survive.

Composed Tea is a branch of organic fertilizer. Compost teas are liquid versions of solid compost material. They contain nutrients plants need for stimulation growth. Compost tea helps loosen clay soils for air and water to move. It helps sandy soils retain water and nutrients. When sprayed onto plants, compost tea adds beneficial microbes to foliage. (Compost Tea: A How To Guide 2020). Compost tea makes the benefits of compost go farther. What's more, when sprayed on the leaves, compost tea helps suppress foliar

diseases, increases the amount of nutrients available to the plant, and speeds the breakdown of toxins. Using compost tea has even been shown to increase the nutritional quality and improve the flavor of vegetables. (Gardening Myths: Learn the Truth about gardening).

Algae blooms also occur when algae grow out of control. Algae blooms can also occur when there is a mixture of warm water and sewage runoff or fertilizer from local fields. Algae blooms look and smell unpleasant and can be harmful. They can cause health issues to people who come in contact. The cyanobacteria (blue greens) in some algae blooms release toxins. In this case that is hurtful to animals and human beings living near water. Algae blocks sunlight from marine animals. Eutrophication is a process that happens naturally in ecosystems. This activity can be increased by human activity when fertilizers are washed into bodies of water. These algae blooms are important to monitor because their decaying process involves rapid growth of bacteria in which it uses dissolved oxygen. This causes marine life to have less oxygen for themselves, causes their own population to deplete while algae bloom population rises. Harmful algae blooms can harm the environment, people, and animals when they produce toxins, become too dense, use up oxygen in water, and release harmful gasses.

Hypothesis

The more compost tea we add to the pond water, the more algae will grow. Based on prior research, we think that the container with 600 mL of compost tea will grow the most algae. We think this because algae grows stronger when fertilizer runs off and enters

water. The algae in this container should grow significantly larger than the other sample containers. If we add more fertilizer to the container samples, then the algae will grow more efficiently and more healthy.

Methods

For this experiment, we first weighed an algae bead to determine the weight. After weighing them we put the containers together. First, 2 liters of water were placed in each container, after that, 21 algae beads were placed in each container. Finally, the compost tea was measured out into 200, 400, and 600 milliliters of fertilizer. The compost tea was poured into the bins. Once fully built, covers were placed on the containers and they were set in a window for three weeks. They received about 10 hours of sunlight everyday and were kept at 78 degrees fahrenheit. At the end of the three weeks, the algae beads were removed from their containers and weighed. The starting weight of the algae beads altogether was 2.1 grams per container. This means each algae bead's starting weight was about 0.1 grams.The only piece of this experiment we were able to control was the amount of compost tea and the amount of sunlight each sample was receiving. The growth of the algae was our dependent variable. At the end of that 3 weeks, we extracted the algae from each sample container and weighed it. In the end we determined the amount of algae growth in each container. After that we will set up our sample containers on a window cill allowing them to get on average 10 hours of sunlight each day. Each container was set up the same distance away from the window and the same distance apart from each other. The factors we could control were the temperature of the room, the amount of sunlight each sample gets, the amount of compost tea added to each sample, and how many days

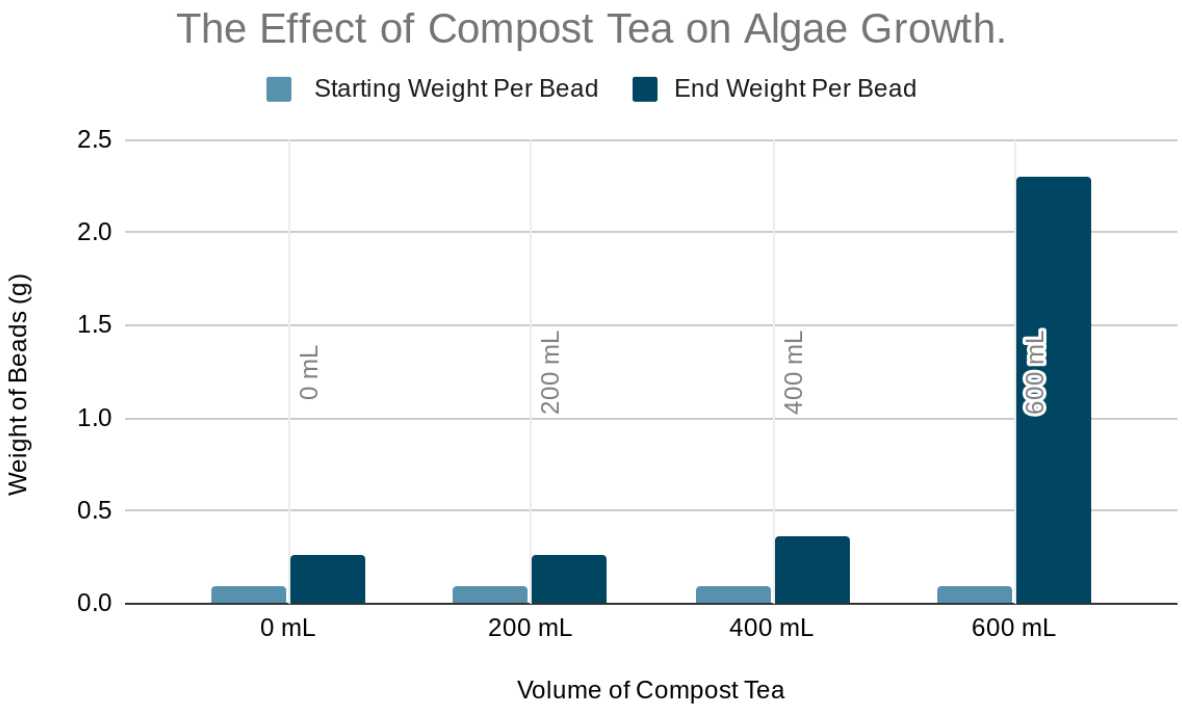
each sample is allowed to grow. Factors that could have affected the growth of algae are temperature, mixing, sunlight, and ratios of nutrients.

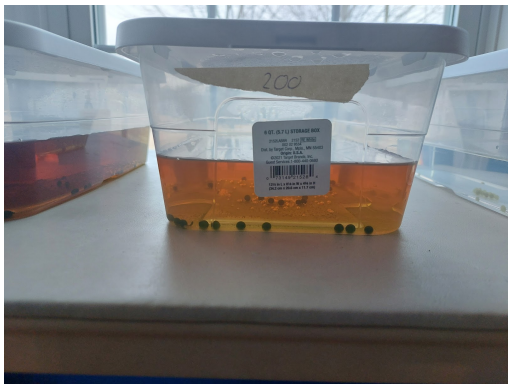
Data

After letting the algae grow for 3 weeks, we removed it from sunlight and started collecting data. There was noticeable growth in all four bins. The container with 600 mL of compost tea gained 2.3 grams per bead for a total weight of 48.3 grams. The bin with 400 mL of compost tea gained 0.36 grams per bead for a total weight of 7.56 grams. The container with 200 mL of compost tea gained about 0.26 grams per bead. That bin had a final weight of 5.46 grams. The bin with no compost tea also gained just about 0.26 grams per bead. That bin was a little lighter with a final weight of 5.39 grams. Overall, every bin had noticeable growth but the bin with the most compost tea had the most growth by far. Our hypothesis was correct, we had made an educated guess that the container with the most compost tea would grow that most. Our experiment proved just that.

Containers holding the amount of fertilizer	Starting Weight Per Algae Bead	End Weight Per Algae Bead
0 mL	0.1 grams	0.26 grams
200 mL	0.1 grams	0.26 grams
400 mL	0.1 grams	0.36 grams
600 mL	0.1 grams	2.3 grams

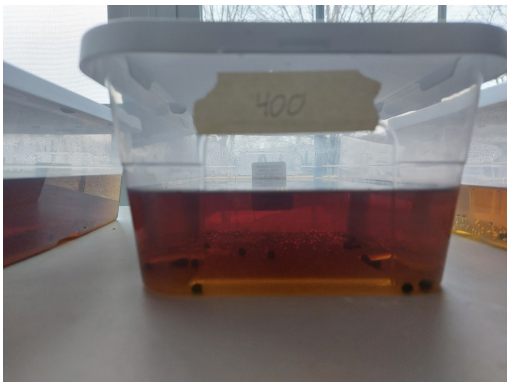
Containers holding the amount of fertilizer	Starting Weight For 21 Algae Beads	End Weight For 21 Algae Beads
0 mL	0.1 grams	5.39 grams
200 mL	0.1 grams	5.46 grams
400 mL	0.1 grams	7.56 grams
600 mL	0.1 grams	48.3 grams



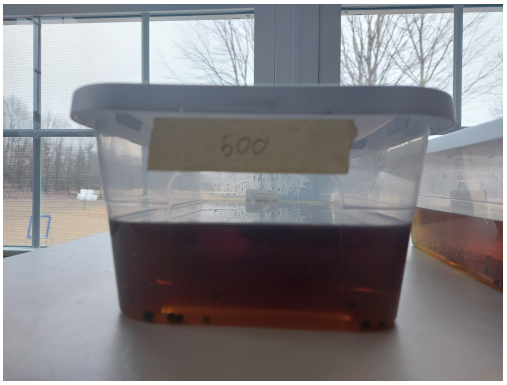


This shows the container with 200 milliliters of compost tea and all 21 algae beads receiving sunlight. This container was holding the lowest amount of compost tea, besides the container holding no tea at

all, therefore causing the algae beads to grow the least.



This shows the container with 400 milliliters of compost tea including its set of 21 algae beads, receiving the same amount of sunlight as the photo above (200 mL). As shown, the algae beads have sunk to the bottom of the container. Because there was more fertilizer added to the water and algae beads, the water containing 400 milliliters of fertilizer is a darker color.



This shows the container with the same amount of algae beads and 600 milliliters of compost tea receiving about 10 hours of sunlight, the same as the previous examples.

Discussion

Overall the algae in the container with the most compost tea grew the most. This happened because Compost tea has bacteria and fungi in it that plants love and greatly benefit from. In order to help our earth and its ecosystems, monitoring algae growth is important. We need to protect marine animals and their habitats. That means that this bin had the most bacteria and fungi in it, which helped the algae way more than the others. Every container did grow but the container with the most compost tea clearly grew the most. The trend the algae created when growing was steady, everyday for three weeks, the algae grew almost the same amount each day.

Limitations

One limitation that greatly affected this project was sunlight. This project took place during late December and early January, so sunlight was scarce at times and some days we were very limited to sunlight. One way that we could redo this project for better results is to perform this project during the summer. We would have much better sunlight and the algae would most likely grow a lot heavier and for a longer time period. We also had to deal with temperature. These containers were kept indoors and were kept at a temperature from around 79 to almost 83 degrees fahrenheit. Algae grows best when it is kept at at least 85 degrees, so our algae was a little colder than it should have been.

Future Studies

If we were to recreate this project, we would most likely have it take place in late July or early August. The algae would still be covered, but it would be in a warmer climate, therefore reproducing faster because of the heat it would be consuming. These containers

would be able to grow for longer and receive more sunlight. If this was performed during the summer, the bins would stay much warmer and the algae beads would grow a lot larger. We can further this project by helping our environment go green. We can use compost tea to help not only algae, but vegetables as well. The faster the vegetables grow, the faster people have healthy food on their dinner tables. To take this project a step further, we can talk to local farmers about using less manure and more compost tea when fertilizing their crops. Farmers can get the same results, healthy crops, while keeping harmful fertilizers out of our local waterways and streams.

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