SPIDER PLANT SENSITIVITY TOWARDS WATER UPSTREAM AND DOWNSTREAM OF A WATER TREATMENT PLANT

Elizabeth Marilyn Yang Frantz

ABSTRACT

The purpose of this project was to find out if spider plants (Chlorophytum comosum) were to be more or less sensitive with water upstream and downstream of the Smithville Wastewater Treatment Plant. The hypothesis was that the water from upstream will affect the spider plant positively while water collected downstream of the Treatment Plant will affect the spider plant negatively. My research question: Are spider plants positively or negatively affected from water collected upstream and downstream of the Wastewater Treatment Plant?

There were twenty spider plants separated into two different groups, one for water collected upstream and the other water collected downstream of the treatment plant. The data did not support the hypothesis. The plants were under observation for twenty-one days. Eighteen of the plants decreased in mass, not mattering if they were watered with water from upstream or downstream of the water treatment plant. Only two plants increased in mass, which occurred because of root growth. The data shows the plants' mass were not affected by the water types, though the plants watered with water from upstream of the plant seamed to wilt faster. Other relevant research can be done in the future such as using indicator fish species such as are used at the Ashland Water Treatment Plant.

Key Words: spider plants, upstream water, downstream water, water treatment plant

MY QUESTION

Are spider plants positively or negatively affected from water collected upstream and downstream of the Wastewater Treatment Plant? If I water spider plants with water upstream and downstream from a water treatment plant, will I see a difference between the two groups of spider plants? Could this experiment be applied to areas such as East Palestine?

Water quality helps us understand what is going on in the subsurface. We need to understand water quality so we can protect our health and the health of the ecosystem. If we use spider plants, or other more sensitive plants, you can tell how clean the water is. Further studies can be done using different organisms to test the water to see if it is okay for human consumption.

My materials will include a camera for taking pictures, water from upstream and downstream of the treatment plant to water the plants, a pencil to record data, a balance to measure the mass of each plant before and after the experiment, a notebook to record observations, some plants so I could do my research, and jugs to hold water so I could transport the water safely without making a mess.

My experimental methods include getting twenty spider plants, removing the dirt from each, washing the roots, drying the roots, measure the mass of each plant, replanting the plants, and collecting water from upstream and downstream of the Smithville Wastewater Treatment Plant. Water plants one through ten with water from upstream of the treatment plant. Water plants eleven through twenty with water from downstream of the treatment plant. Fill two tubs with all the plants according to their water types. After twenty-one days remove dirt from each plant, washing and drying the roots, then measure the mass of each plant.

LITERATURE REVIEW

I wanted to do something about water pollution. Next, I started looking through some of Connie Atkinson's GLOBE Program students' research around Flint, Michigan and the lead contamination of the water in the area. I had never heard of lead pollution in my area, so I began looking at water treatment plants and their possible role in generating of reducing water pollution.

A friend of my father's runs a water treatment plant in South Carolina. We visited him during Christmas break and I had an opportunity to ask him questions about his job. A tour of the Ashland, Ohio Water Treatment Plant was arranged. I was surprised at the response of Mr. Michael Valentine, Chief Scientist there. I thought the plants would do worse downstream, however, Mr. Valentine thought plants might do better because of the phosphorus released from the treatment plant would benefit the plants. I began to question my hypothesis, but decided to continue on to see how plants would actually respond. During my tour of the Ashland, Ohio Water Treatment Plant it was recommended I look into the research of Fair of Ashland University.

One of the projects found is called "Is There A Difference in Urban River Water Quality Between Michigan and Ohio Rivers". This project addresses the Flint, Michigan water quality. It was written by student number 1221. His report was to see if any of the four rivers tested would have a more improved environment for benthic macroinvertebrate life.

Another project I have found is called "Benthic Macroinvertebrates as Bio Indicators of Water Quality" written by Marianela Pepe. Her project was to use macroinvertebrates as indicators in the Chimehuín River Basin, since it is changing. This study as a basis for

monitoring changes in water quality. She can determine if the water is at a certain water quality by taking samples of the water and putting certain macroinvertebrates in the water to see if they live or die. Three years ago, I did study involving macroinvertebrates title, “Macroinvertebrates Leaf Species Preference: A Comparative Study.”

The final GLOBE Program project I read is called “Comparative Analysis of Water Quality in the Pollo River in Three Points of its Course” written by Mauricio Vargas Montero and Angie Araya Zúñiga. Their project was to determine if water quality changes throughout the Pollo River’s course in the district of Paraíso. They used macroinvertebrates to determine if the river is cleaner and healthier in some points. Some macroinvertebrates are more sensitive than others, so they identified different macroinvertebrates to see the changes in the river’s course. This project relates to mine because we both are using living creatures, whether animal or plant, as a basis to tell if different parts of a river or creek are healthier, cleaner, or better for different species.

In a research journal, Sewerage Water Treatment Using Phytoremediation, Noor Omar, Muhamad Wahap, and Zubaidi Johar, used aquatic plants to test wastewater from a treatment plant. In the European Journal of Chemistry, Mohammad Suhail was trying to figure out the easiest way to remove pollutants from polluted water. In the Water Quality Index Prediction for Improvement of Treatment Processes on Drinking Water Treatment Plant, Goran Volf, Ivana Čule, Elivix Žic, and Sonja Zorko were testing parameters, such as temperature, pH, turbifity, KMnO4, NH4, Mn(magnesium), Al (aluminum), and Fe (iron). In the Water Treatment Process, Szilárd Bucs, Nadia Farhat, and Luca Fortunato were using Membrane technology to employ the production of drinking water. In the Water Treatment journal, Elsa Veberm Nanang Yulistio,

Qoriatul Fitriyah, and dan Muhammad Prihadi Eko Wahyudi used different power of pumps to see how fast each one would take to clean water.

In conclusion, all these research papers helped me decide and prepare for my science project. The professionals I talked to also played a huge role in completing my science project.

METHODS

PREPARATION

1. obtain twenty spider plants (they were selected because of their sensitivity to water pollution and/or chemicals)
2. remove dirt from each plant
3. wash the roots with distilled water
4. dry the roots with a paper towel
5. obtain the mass of each plant using a PCC digital pocket scale (this model was selected because it will record mass to the 0.001 of a gram)
6. replant the spider plants into plastic pots
7. collect water approximately 100 meters (safety of collection was foremost here) upstream and downstream from the Smithville Water Treatment Plant

WATERING

1. water spider plants 1-10 with water upstream of the treatment plant every 7 days as recommended by Oakland Nursery
2. water spider plants 11-20 with water downstream of the treatment plant every 7 days as recommended by Oakland Nursery
3. fill the two tubs 30cm wide by 43cm long by 5cm deep with all of the repotted plants according to their water types

DATA COLLECTION

1. repeat steps 2 – 6 from the preparation steps
2. record dead or yellowed leaves for each plant

3. compare data from before and after this research and between each study group

Each plant was measured on a scale being weighed for mass using grams.

20 plants were measured before the experiment, 20 plants were measured after the experiment, 10 plants watered from upstream and 10 plants watered from downstream of the water treatment plant. Observation logs were made every day for 21 days as part of the data collection procedure.

During my research, the data did not support the hypothesis. The hypothesis was: Water upstream would positively affect the plants while water downstream would affect the plant negatively. During all twenty-one days of testing and observing, nothing really changed, but upstream had ninety-two healthy leaves, nine dead leaves, and thirty-eight withering tips. Downstream had ninety-three healthy leaves, sixteen dead leaves, and thirty-eight withering tips. According to the results, downstream was slightly negatively affected.

Figure 1. Study Site: Smithville Water Treatment Plant

Study Site: Smithville Water Treatment Plant: There are farm fields on one side and houses on the other. The treatment plant is surrounded by a wire fence. It was quite crisp out when I went there to collect water. The grass was crunchy, yet there was no snow. Sugar Creek has trees on both sides of the bank with rocks all over. The Sugar Creek waters were rushing very fast due to the rain that happened overnight before collection of the water.

GLOBE Protocol used: Soil Fertility was used to see if any of the important minerals were missing from the soil of the twenty plants. The minerals tested included nitrogen, phosphorus, potassium, magnesium, sulfur, and calcium. I would be able to tell if any of the missing minerals had an impact on my results.

RESULTS

UPSTREAM

Plant One

Before: 13.13g

After: 11.44g

Plant Two

Before: 18.03g

After: 20.13g

Plant Three

Before: 5.95g

After: 4.95g

Plant Four

Before: 10.71g

After: 9.78g

Plant Five

Before: 5.28g

After: 4.94g

Plant Six

Before: 4.01g

After: 3.78g

Plant Seven

Before: 31.70g

After: 27.63g

Plant Eight

Before: 10.74

After: 10.22g

Plant Nine

Before: 7.19g

After: 7.02g

Plant Ten

Before: 8.80g

After: 8.02g

AVERAGE

Before: 11.554g

After: 10.791g

DOWNSTREAM

Plant Eleven

Before: 10.32g

After: 11.02g

Plant Twelve

Before: 6.10g

After: 4.60g

Plant Thirteen

Before: 26.71g

After: 22.85g

Plant Fourteen

Before: 11.96g

After: 6.46g

Plant Fifteen

Before: 12.07g

After: 10.20g

Plant Sixteen

Before: 7.11g

After: 7.33g

Plant Seventeen

Before: 11.69g

After: 11.98g

Plant Eighteen

Before: 4.87g

After: 3.99g

Plant Nineteen

Before: 3.86g

After: 3.38g

Plant Twenty

Before: 8.04g

After: 7.84g

AVERAGE

Before: 9.441g

After: 8.965g

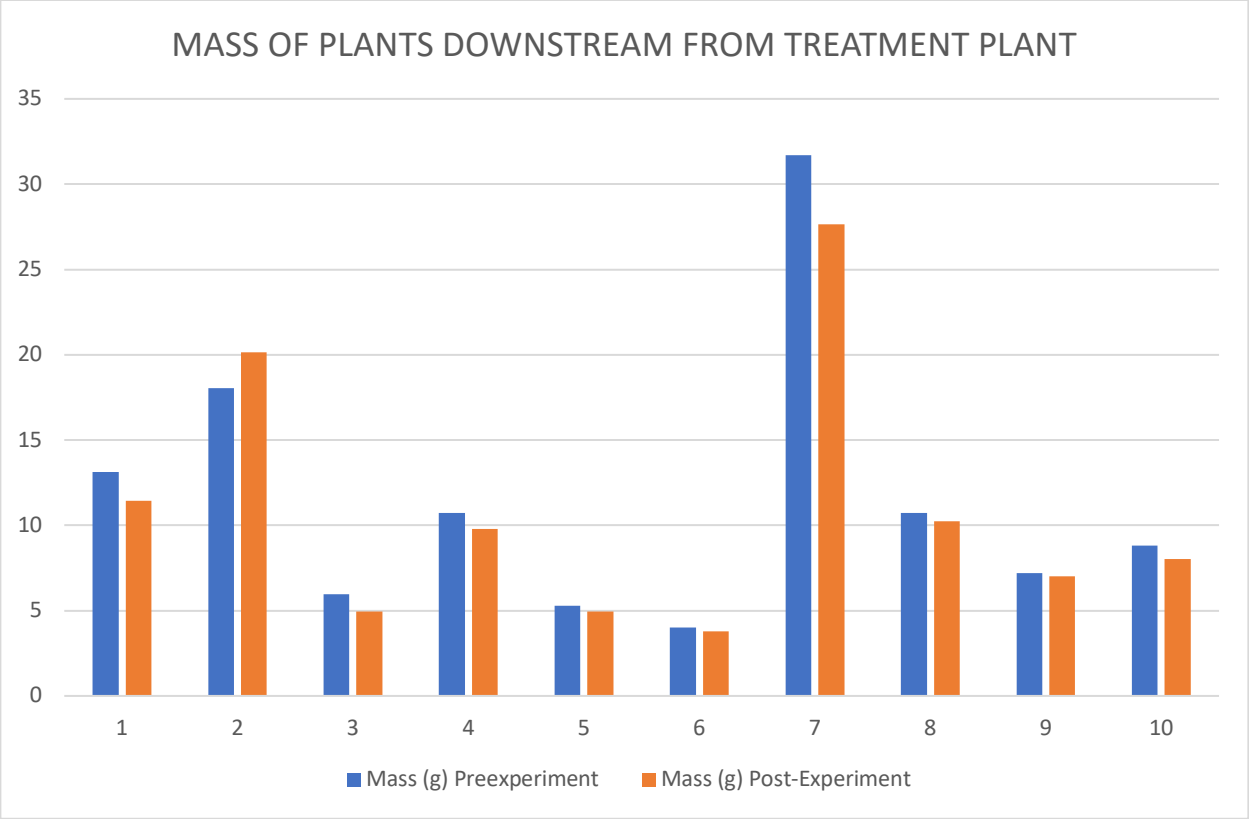
TOTAL AVERAGE

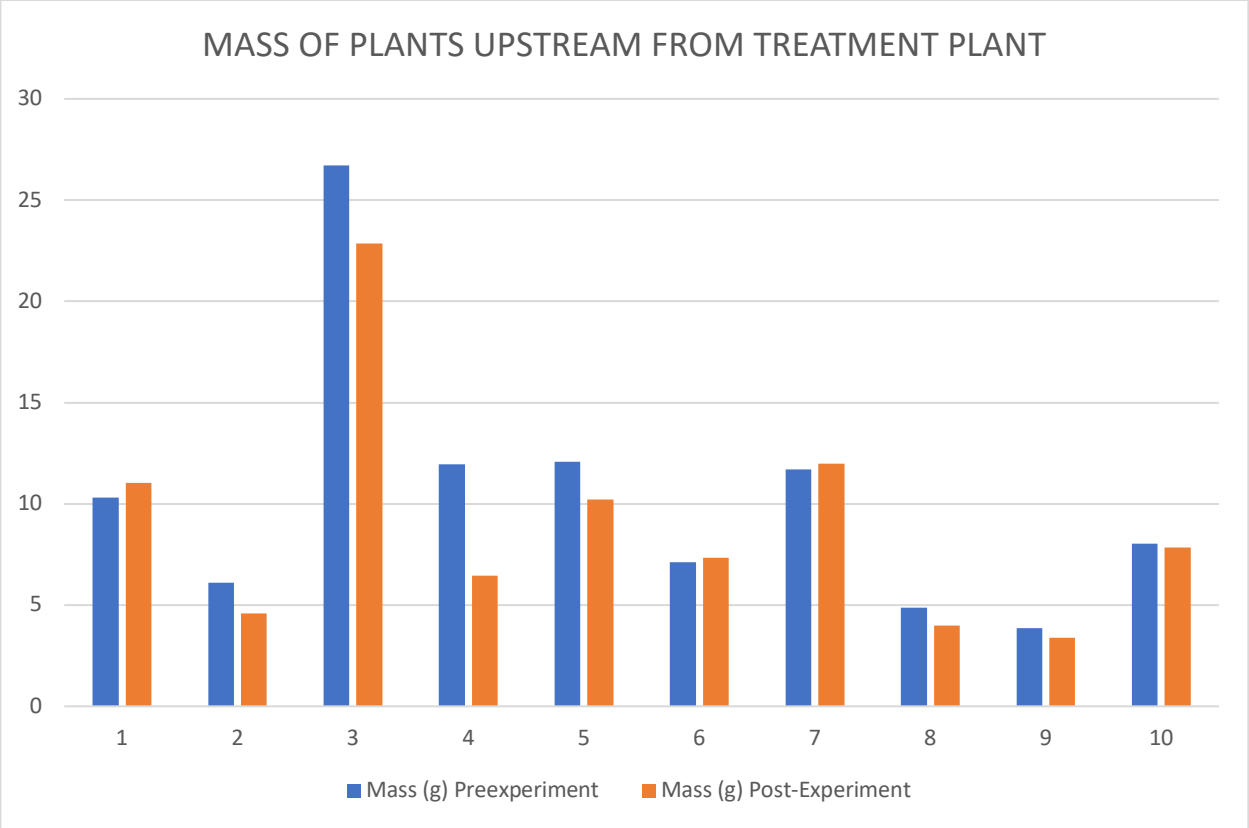
Before: 10.9135g

After: 9.878g

The data collected did not support the hypothesis. Neither upstream nor downstream positively or negatively affected all of the twenty spider plants. The data confirmed two out of the twenty spider plants increased in mass while the other eighteen decreased in mass.

Graphs


MASS OF PLANTS DOWNSTREAM FROM TREATMENT PLANT
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Mass (g) Preexperiment
Mass (g) Post-Experiment


MASS OF PLANTS UPSTREAM FROM TREATMENT PLANT
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Mass (g) Preexperiment
Mass (g) Post-Experiment

DISCUSSION OF RESULTS

During my research, the data did not support the hypothesis. The hypothesis was: Water upstream would positively affect the plants while water downstream would affect the plant negatively. During all twenty-one days of testing and observing, nothing really changed, but upstream had ninety-two healthy leaves, nine dead leaves, and thirty-eight withering tips. Downstream had ninety-three healthy leaves, sixteen dead leaves, and thirty-eight withering tips. According to the results, downstream was slightly negatively affected.

The procedure involved obtaining twenty spider plants, removing the dirt from each, washing the roots, drying the roots, measuring the mass each plant, replanting plants, and collecting water from upstream and downstream of the Smithville Wastewater Treatment Plant. Plants one through ten were watered every seven days with water from upstream of the treatment plant. Plants eleven through twenty were watered every seven days with water from downstream of the treatment plant. Two tubs were filled with all the plants according to their water types. After twenty-one days, the dirt was removed from each plant, the roots were washed and dried, and each plant was measured again for the mass. The procedure was effective to the question except, I believe, the plants didn't get enough time to actually have significant changes. If the project were to be done again, the procedure would have been over more than two months, instead of twenty-one days.

I light of the tragedy at East Palestine, studies such as mine are even more relevant, at least to me. Concerns there are now being mentioned as to what we may see in the coming years or decades with possible ground water contamination. We have all seen the damage to the fish, crawfish, and stream water locally. This is another confirmation of me doing longer studies

instead of just for a few weeks. Water truly affects us all, both in good and bad ways. It is up to all of us to diligently be watchful stewards of, again, at least to me, one our most precious, fragile, and valuable of resources: water.

Reflecting on the conversations I had with Mr. Valentine and Mr. Blowers, they said that Phosphorous would be high in the water after the water treatment plant. I decided to test the dirt out for myself. The soil testing kit I got tested pH, Nitrogen, Potassium, and Phosphorus; the three elements necessary for a plant to grow.

The results were: The control dirt, or regular soil for the bag, was a pH of 6.0, Nitrogen was high, Phosphorous was low, and Potassium was low. The dirt water with water from before the water treatment plant was a pH of 6.5, had a high Nitrogen, a low Phosphorus, and a high Potassium. The dirt watered with water from after the water treatment plant had a pH of 7.0, medium in Nitrogen, medium in Phosphorous, and high in Potassium.

Mr. Valentine and Mr. Blowers were correct. The soil that was watered with water from after the water treatment plant increased in Prosperous.

CONCLUSION

The data collected did not support the hypothesis. Neither upstream nor downstream positively or negatively affected all of the twenty spider plants. The data confirmed two out of the twenty spider plants increased in mass while the other eighteen decreased in mass. I feel I did not give the experiment enough time (three weeks), so nothing major really happened.

The findings of this project are important because then you can run some simple tests to see if the water if safe. You can take even more complicated and exact research to see more accurate results. Future protocols could be added by taking temperature, pH, and salinity. You could also use freshwater macroinvertebrates and mosquitos to determine if the water is safe or not. You could also use minnows, of which is used at the Ashland Wastewater Treatment Plant.

My mentor is my father, who is a retired middle school science teacher. My father used to work with his students on individual and group science projects to participate in GLOBE programs and district and state science fairs. He and his students travelled in The United States and to other countries in the world such as South Africa and Ireland. My father has helped me with four different science fair projects. My father can be stern sometimes, but he always pushes me and my brother to get the science fair project done. This is how my father is a mentor to me. I believe I will continue to use GLOBE protocols in the future because it is a great experience.

REFERENCES

Ashland Source. Data retrieved from https://ashlandsource.com/sherry-fair/image_e527f978-8dea-11ed-96c9-67f808c3fbd0.html. March 3, 2023.

Ashland water treatment plant. https://www.ashland-ohio.com/departments/city utilitieswater/ashland-water-pollution-control-facility. Data retrieved December 2022 to January 2023.

Ashland University. Data retrieved from https://www.ashland.edu/environmental-science-program-lecture-series

Blowers, A. Personal Communication. January 8, 2023.

Fausch, K.D. 2015. For The Love of Rivers: A Scientists Journey. Oregon State University Press.Corvallis, Oregon.

GLOBE Program. Data retrieved from https://www.globe.gov/do-globe/research resources/student-research-reports/-/projectdetail/globe/does-watering-raphanus sativus-plants-with-polluted-water-negatively-affect-their-growth-. December 15, 2022.

GLOBE Program. Data retrieved from https://www.globe.gov/documents/18720200/44089955/Presentation+for+GLOBE+IVSS+%281%29.pdf/23438c0c-6330-7b37-51b1-09a01d75ee66?t=1618357782340. March 3, 2023

GLOBE Program. Data retrieved from https://www.globe.gov/documents/10157/5815f763-f8fe-40c0-9e56-d-ea46802065. March 3, 2023

GOOGLE Maps. Data retrieved from https://www.google.com/maps@40.8588763,818476602, 3a,75y,8.2h,90.06t/data=!3m6!1e1!3m4!1sdngu.BNDpgadl8mLOL9ZBrw!2e0!7i16384! 8i8192. December 2022.

GOOGLE Maps. Data retrieved from https://www.google.com/maps/@40.8588763,81.8476602 ,3a,75y,163.64h,89.43t/data=!3m6!1e1!3m4!1sdnguBNDpgadl8mLOL9ZBrw!2e0!7i163. 84!8i8192. December 2022.

Hunter, M. Personal Communication. January 8, 2023.

Kencsan, D. Personal Communication. December 2022 to February 2023.

Mauricio, M. Zúñiga, A. Comparative Analysis of Water Quality in the Pollo River in Three Points of its Course.

Oakland Nursery. Personal Communication with several staff. January 2023.

Reid, G.K., Wood, R.D. 1976. Ecology of Inland Waters and Estuaries. D. Van Nostrand Company. New York, N.Y.

Spellman, F.R., PhD. 1996. Stream Ecology and Self-Purification: An Introduction for Wastewater and Water Specialists. Technomic Publishing Co., Inc. Lancaster, PA.

Voshell, J. 2002. A Guide to Common Freshwater Invertebrates of North America. The Macdonald and Woodward Publishing Co. Granville, OH.