

Globe to Erasmus project

Effects of acid rain on plant growth

Group 3

Preface:

This project is part of the Globe To Erasmus project. There has been a collaboration between 3 schools in Europe: Wolfert Tweetalig in Rotterdam, High School Buzet in Buzet and 2 Liceum Ogólnokształcące im. Emila Godlewskiego w Nysie in Nysa.

We have been working on this project for about 3 months in which we developed a research question, did the experiment and wrote a report.

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Introduction:

We came up with the idea of researching the effects of acid rain on plant growth and development because of the world problem global warming. Acid rain is one of the worst consequences of global warming. Because of this we want to know if plants are still able to grow, even if they are watered with acid rain. To do this we also have to research the pH level of rainwater and compare it with acid rain and tap water.

Acid rain is formed when sulfur dioxide and nitrogen oxide react with chemicals like H₂O, oxygen and carbon dioxide in the atmosphere to form sulfuric acid and nitric acid. Water containing these acidic compounds fall back to the earth as rain, harming plants and other immobile objects below. Although the level of acid in acid rain is low, normally not more acidic than vinegar (pH = 5), it can seriously harm the environment, damaging plants and aquatic ecosystems. Eventually plants exposed to acid rain will die, but unless the plants are incredibly sensitive, the damage is not fatal. Acid rain damages plants in a very subtle way. The acidic water alters the pH level of the soil where the plants grow, binding and dissolving vital minerals.

Theme of the project: Effects of acid rain on plant growth

Research question: How does acid rain affect the growth and development of plants?

Hypothesis: Acid rain negatively affects the growth and development of plants.

Plan of action:

Our plan started off with choosing one of the four spheres. We decided to go with the Hydrosphere as that was in our common interest. After that we brainstormed about types of experiments we could do and what our specific theme would be. We decided to test the effect of acid rain on the growth and development of plants. When we agreed on the research question and hypothesis we planted 2 or 3 bean plants in all three countries. Then, we will observe the plants for about one month in which we will carefully look at the reaction of the plants on the different types of water. One plant will be watered with tap water, one with acid rain and one with normal rainwater. Unfortunately it won't rain enough in the Netherlands during the project so we will probably only plant 2 plants there. For our experiment we will create our own acid rain, to do so we have to mix tap water with lemon juice. We are going to use 200 mL of tap water and 50 mL of lemon juice. While the plants grow we will take a closer look at how they grow and develop. We will take pictures of different stages of our project to clearly see the changes and use them for our report and to answer our research question.

Materials and equipment:

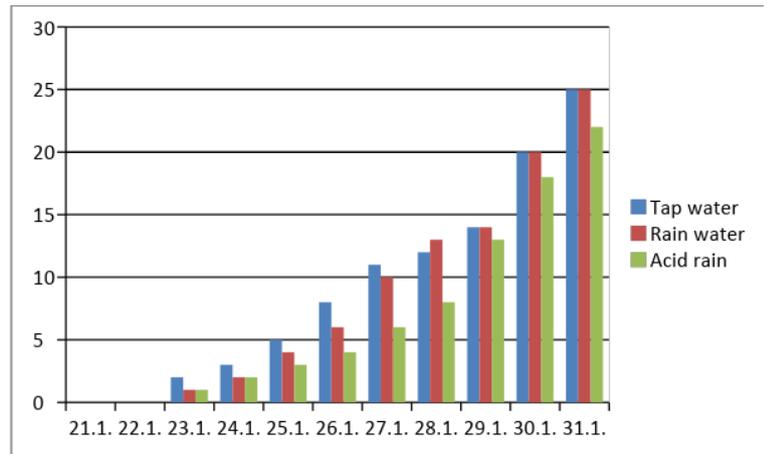
- Three flower pots
- Bean seeds
- Soil
- Lemon juice
- Rainwater
- Tap water
- Tools for measuring pH
- A ruler

Results and conclusion Croatia:

After doing the pH measurements (pH level for tap water was 6,76 and for acid rain was 3) and the plant observations, we concluded that our artificially made acid rain did not have an overwhelming impact on plant growth and development. We also saw that rainwater from Croatia, is approximately the same as normal tap water so we concluded that our country is suitable for plant growing. We also did some research on the internet and read about the effect of acid rain and we realized that acid rain definitely has a negative impact on plant growth and development. We suppose that our artificially made acid rain was not sufficiently harmful for our plants because real acid rain contains nitrogen and sulfur oxides and we used normal lemon juice to make our own acid rain.



Throughout the experiment, we measured the length of the bean plants. The plants that were watered with tap water grew the fastest but eventually the bean plant watered with rainwater did catch up. The bean plant that was watered with acid rain grew the slowest



but there is not a major difference in their length compared to the other two plants.

Results and conclusion The Netherlands:

Due to the weather



conditions in Rotterdam in the period of our project, we only planted two plants. One for acid rain and one for tap water because there was no rainfall in the first week after we planted our seeds which would mean we had to plant the third plant more than a week later and that would cause unequal measurements. The acid rain seed germinated first, but didn't grow further than a small stem with a dead bud on top of it. Only after the acid rain plant had grown as far as on the picture, the tap water plant started to germinate. The biggest difference between the two plants was that the tap water plant had green bud and the acid rain plant had a dead brown bud. After two weeks

two healthy green leaves grew out of the tap water plant. After one month this was the result. →

Watered with tap water

Another difference between the tap water and the acid rain plant was that in the flower pot with tap water, a second plant started to grow. This was not the case for the acid rain plant. Unfortunately there was not enough time for the plants to fully grow. The weather conditions in Rotterdam also had an influence in the growth of both plants. Especially the first weeks after we planted the seeds, the weather conditions were cold which meant that the plants had to grow inside where they had less fresh air and sunshine. Despite that, we expect that if the plants had more time to grow, they would have grown to a full-fledged plant especially the tap water plant.

Watered with acid rain

Because the acid rain plant already had a dead bud, we don't expect that one to grow any further. We also think the fact that the plants had to grow in a city with a lot of emissions and air pollution had an influence on their growth and development.



To compare, we measured the pH level of the lemon juice we used to make acid rain. This was 2. The pH level of our acid rain was 3 and the pH level of tap water was 7 which is the normal acidity for aqueous liquids. The lower pH level of acid rain means that it has a higher acidity rate, and that again has a negative effect on the growth and developments of plants.

Results and conclusion Poland

We used three jars with gauze to plant beans. In one of the jars we watered the beans with tap water. The whole jar was filled with water so the beans would touch the water. In the second jar the beans were watered with artificial acid rain, created by mixing tap water with lemon juice. The third jar with beans was watered with rain water. Our plants started to grow after 5/6 days. We watered them about 4 days a week.

Because there was a very big difference in length between the three plants we decided to measure them. The beans that were watered with tap water grew the most, 110 cm. The beans that were watered with a mix of lemon juice and water grew 42 cm. The beans watered with rainwater, which probably already contained chemicals that caused a lower pH level grew the smallest. They grew 37 cm.

The reason for this being the result of this experiment is the fact that water is the main chemical component of cells and has the best effect on plant development. Irrigation with acid rain, that contains sulfur in chemical compounds causes a reduction in pH.



Evaluation:

The aim of this project was to find out what effects acid rain has on the growth and development of plants. In order to find out we created a research question: How does acid affect the growth and development of plants? We based our hypothesis on this and concluded the following: Acid rain negatively affects the growth and development of plants. After finishing the experiment we can conclude that our hypothesis was correct. However, we also found a different factor that affected the growth and development of plants.

In all three countries, the plants watered with our self created, artificial acid rain grew less big compared to the plant watered with tap water. In Croatia and Poland this was clearly visible in the length as the plants were much shorter, in The Netherlands this was visible through the development of the plant. It didn't grow any leaves or multiple stems. The only thing that grew within the 4 weeks of the experiment was one stem with a dead bud on top of it. Even though our research was about the effect of acid rain on the growth and development of plants, we think that the environment were the plants grew also played a big role.

A major difference in length can be seen between the plants from Poland and Croatia and the ones from The Netherlands. The plants from Poland and Croatia are much more developed whereas the plants from the Netherlands are still very small. Also the growth of the plant watered with acid rain differs a lot: In Poland and Croatia the acid rain had a very small effect on the growth of plant, whereas it had a major impact on the plant in The Netherlands. As the acid rain was created with the similar proportions in every country, we believe that environment has played a role in the growth of the plants. The plants from The Netherlands were planted in Rotterdam which is one of the biggest cities in The Netherlands. It is commonly known that Rotterdam is a city with a lot of air pollution. In our opinion, this air pollution has affected the growth of the plants as there was much less fresh air. Since Nysa, Poland and Buzet, Croatia are smaller towns where there is less pollution in the area, we think that had a positive effect on the growth and development of the plants.

Because of this result we came up with the following question: How does air pollution affect the growth and development of plants? This would be a good research question to answer in a follow-up research as we concluded from our project that air pollution must have a negative effect on the growth and development of plants.

Sources:

We have only used one source as it gave us all the information we needed. Also we believe that our own experiment gave us enough information and evidence to answer our research question and prove whether our hypothesis was wrong or right.

Waterworth, K. (2019). *What Is Acid Rain: Tips For Safeguarding Plants From Acid Rain Damage*. [online] Gardening Know How. Available at: <https://www.gardeningknowhow.com/plant-problems/environmental/acid-rain-damage.htm> [Accessed 21 Feb. 2019].