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High School Research Project

25 June 2023

High School Research Project with Woodcock Nature Center

Research Question:

How do seasonal changes affect soil pH?

Background:

Soil pH is a fundamental part of gardening and wildlife, with different levels dramatically affecting the plants that use the soil. Soil pH is directly related to the amount of nutrients that are in the soil, with the optimal level being relatively acidic at around a pH of 6. If the pH level is not right for the plant, it can cause iron chlorosis, which is an iron deficiency that causes yellow coloring ("Changing the pH"). I chose to start this data collection on soil pH because of its importance to gardeners, farmers, and the Woodcock Nature Center.

Experiment:

The testing sites for the experiments were located within the Woodcock Nature Center, at three different areas: Next to a pine tree behind the pavilion near the lake, underneath a pile of leaves next to the part of the red trail close to the pavilion, and an open area next to the red trail that got plenty of sunlight each day.

Each of these locations was outside and completely uncontrolled, with environmental factors being the only influence on them. To get the soil pH, slurry pH tests were conducted rather than direct soil pH tests. Samples from each location were brought to the Woodcock Nature Center and were mixed with distilled water until there was an equal amount of milliliters as there were grams of soil. After about 10 - 15 minutes, the slurries were stirred with the Nature Center's pH meter. Rainfall data was collected by using the nature center's rain gauge to track the amount of rainwater that had been collected between each sample. Temperature and humidity data were gathered using Ridgefield's weather forecast on AccuWeather each time the soil samples were collected and tested. This project started on September 24, 2022, and went until May 23, 2023.

Data and Analysis:

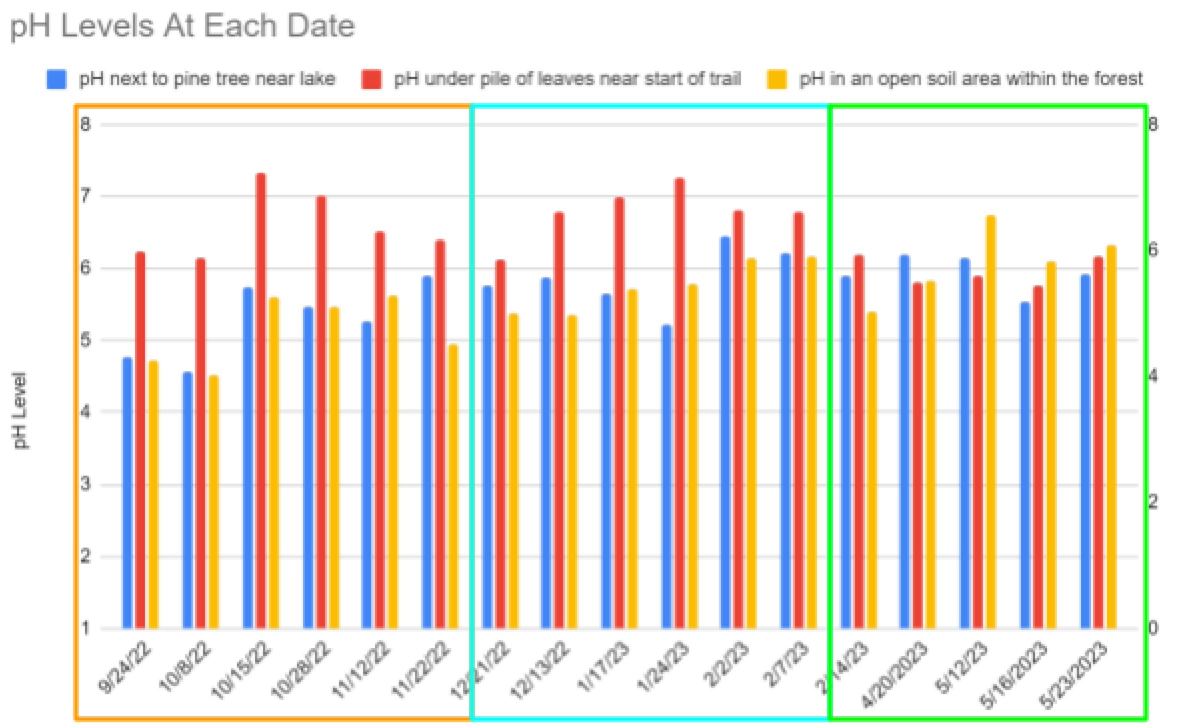
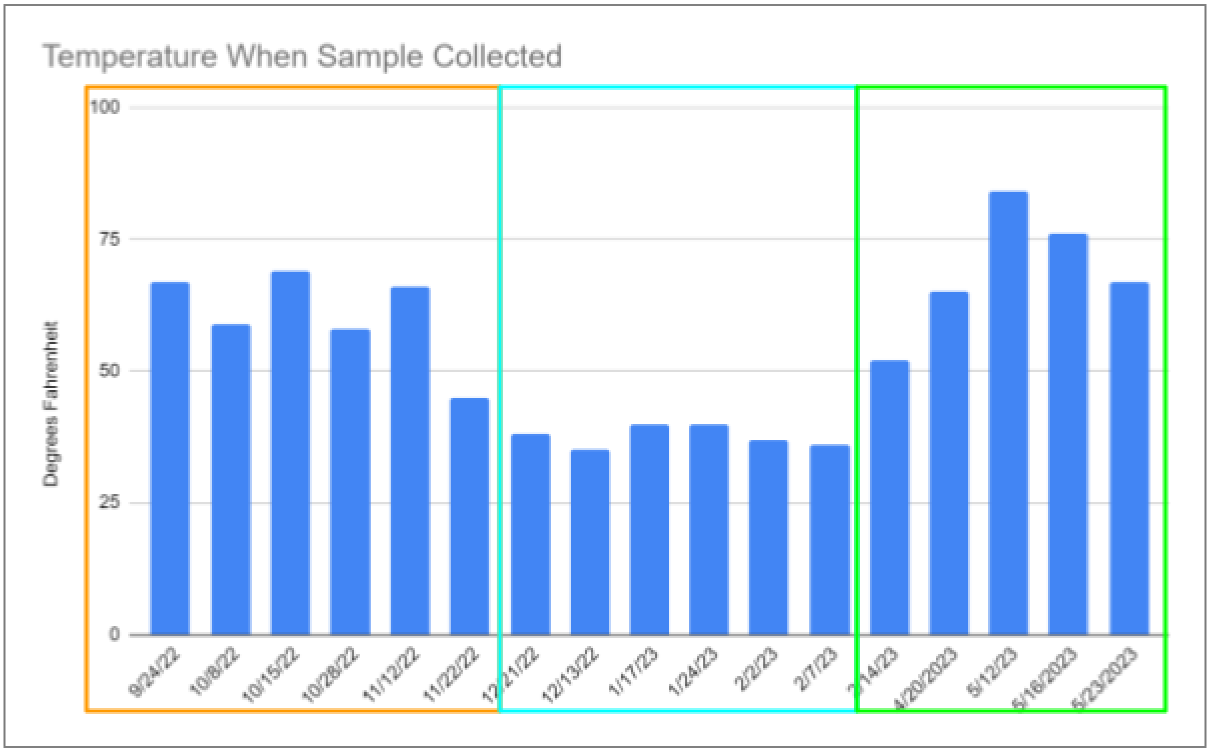


Figure 1: This is a graph of all of the pH data that was collected during the experiment. The data is organized into three different boxes based on seasons. The data in the orange box was collected in autumn, the data in the cyan box was collected in winter, and the data in the green box was collected in spring.

One of the most prevalent trends in Figure 1 is the pH level of the “under leaves” area being consistently higher than the other pH locations. It was common for the area under a pile of leaves to have the highest pH level and the open soil area to have the lowest pH level, but in spring this trend began to change. In late spring, a few small trees (no picture evidence) had begun to sprout over the open soil area, but it still was not as shaded as the dirt under a pile of leaves. The pH of each area also seems to increase at roughly the same amount from each date, but the pH levels become similar in late winter. One of the locations being near a pine tree did not seem to affect the data heavily, if at all.



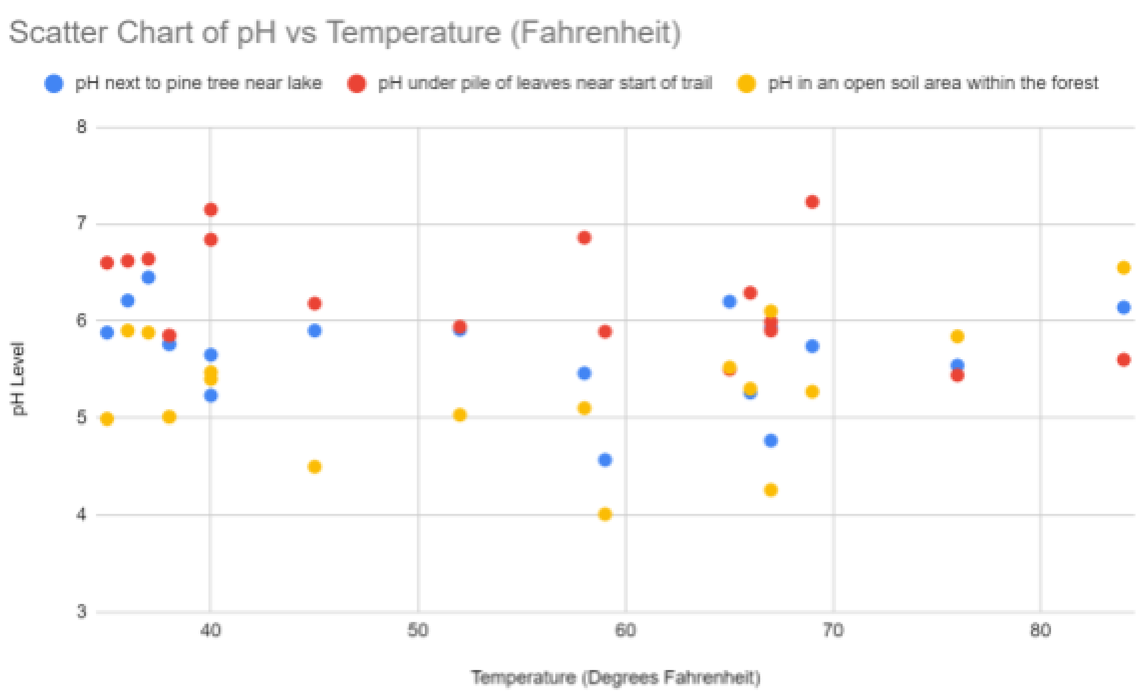
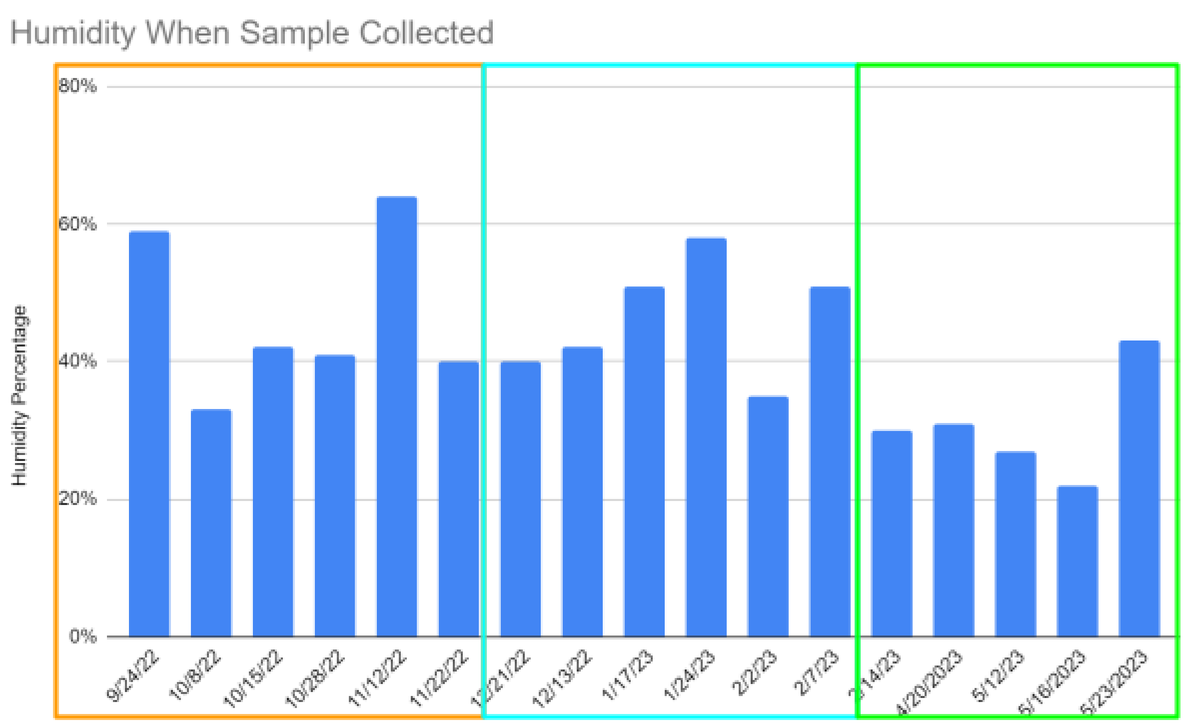


Figure 2: The bar graph covers the temperature data that was collected during each experimentation day. It is organized in a similar manner to the pH graph where each box represents a different season. The scatter chart shows the correlation between the pH levels and the temperature, making it easier to see patterns and how temperature might affect pH.

The main connection between Figures 1 and 2 that I noticed was in the scatter chart. In the scatter chart, the under leaves location consistently has a higher pH at lower temperatures. At higher temperatures, the pH levels begin to deviate from this trend. With the temperature bar graph, it is shown that these higher temperatures appear only in mid to late spring. This phenomenon could mean that as seasons change from fall to spring, pH levels of open soil areas rise along with the temperature. It also seemed that as temperatures changed, the pH generally followed in the same direction.



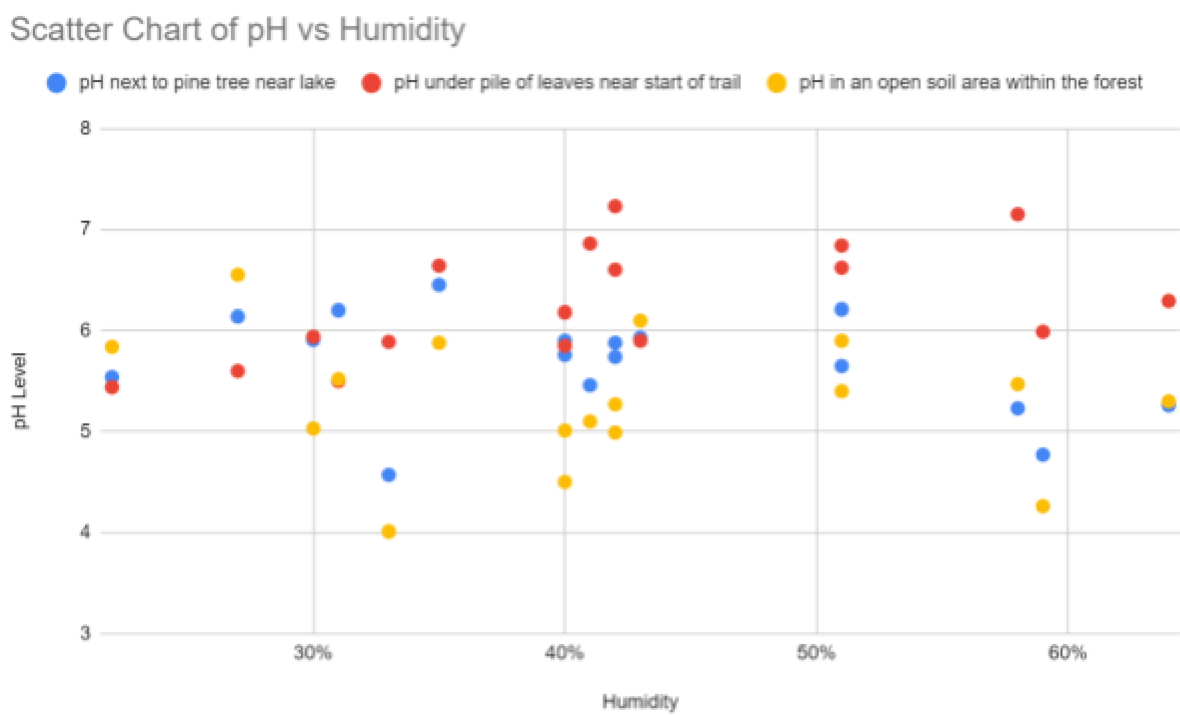


Figure 3: The bar graph in Figure 3 is all of the data on humidity that was gathered each day during experimentation. It is organized in the same way as the other bar graphs where each box is a different season. The scatter chart shows the correlation between the pH levels and humidity.

Temperature is a big factor in humidity because higher temperatures create hotter air that can hold more water vapor, allowing for higher humidity ("Discussion on Humidity"). In spring, the data shows the opposite of this relationship between temperature and humidity. Figure 2 shows that temperatures rose in spring, but in Figure 3, it shows that the humidity actually dropped. This specific situation where the temperature goes up and the humidity goes down could be part of why the open soil area started to have a higher pH level than the area under a pile of leaves.

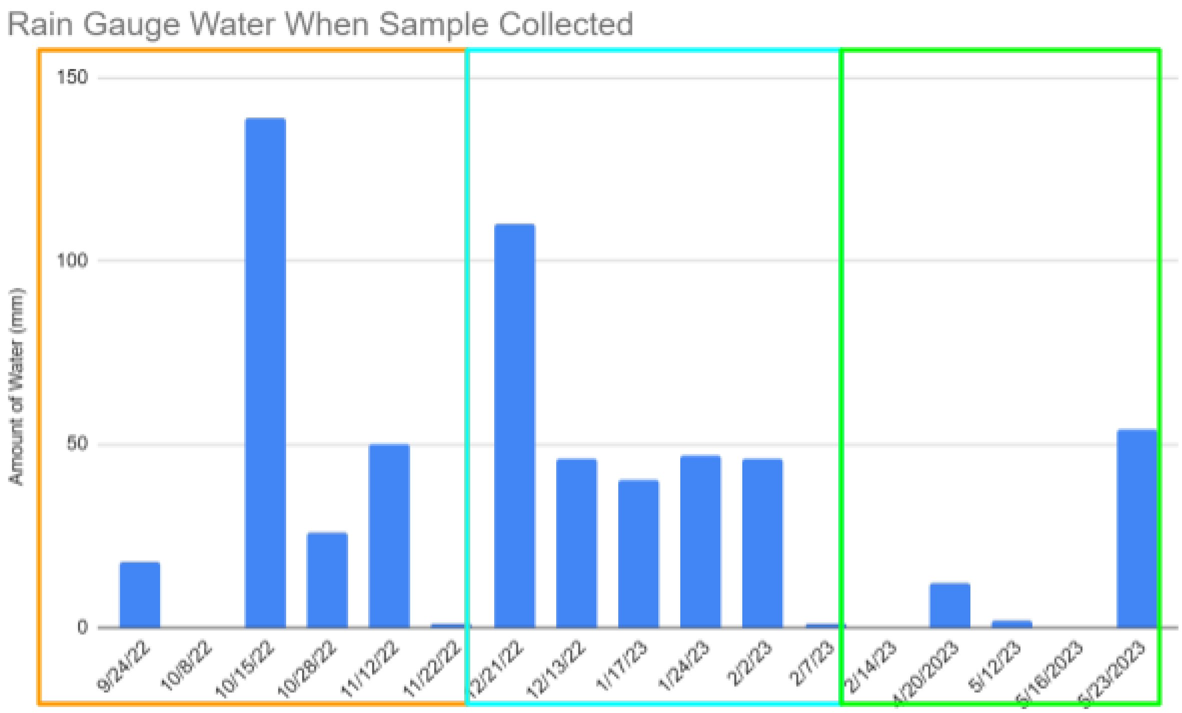


Figure 4: The bar graph shows all of the rain gauge data that was collected during each day that data was collected. The values in the graph represented the water collected in the rain gauge over the course of a week.

Figure 4's data is erratic, with many weeks not seeming to have any rainwater. As a result, there have not been any conclusions or theories that could be drawn about Figure 4's correlation to pH. Because the rain gauge was made public, and not put at each individual location, it is possible that it was emptied before its data was collected.

Conclusion:

Based on Figures 1, 2, and 3, it seems that pH tends to follow the path of temperature, rising and falling when the temperature does. The spring data in the Figures also support the claim that in the situation where temperatures rise and humidity falls, open soil areas rise in pH and heavily shaded areas drop in pH.

Future Works and Acknowledgement:

In the future, this project could be expanded by setting up a controlled environment indoors with the soil starting at neutral (7), and temperature being the only variable that is changed. Rain gauges could also be placed at each area to get more accurate rain gauge data so that conclusions can be made. Data from the summer could also be collected, to extend the time period of the collection data. The pH meter should also be calibrated frequently and the pH probe should be changed regularly. I would like to thank the Woodcock Nature Center for providing time and space in their facilities each week and for lending me the pH meter. I would also like to thank Mr. McCarthy for helping me organize and start this project and for answering all of the questions that I had.

Works Cited

"Changing the pH of Your Soil." *Home and Garden Information Center*, 20 Oct. 2012, hgic.clemson.edu/factsheet/changing-the-ph-of-your-soil/. Accessed 25 June 2023.

*"*Discussion on Humidity.*" National Weather Service*, www.weather.gov/lmk/humidity#:~:text=Warm%20air%20can%20possess%20more,if%20the%20air%20is%20warmer. Accessed 25 June 2023.