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Abstract

Our Research tests what variables can affect the pH of soil the most significantly. In our background information it was more commonly found for the variable to increase the pH rather than decrease the pH. Our hypothesis was if we use different organic materials to alter the pH of soil, then lemon juice will alter the pH the most significantly, because it has the greatest contrast in pH compared to soil. In our experiment, we tested the effect on the pH of dirt when mixed with pH altering variables.In our results, we found baking soda had the most significant effect on the pH. Followed by coffee and eggshells with little change to the pH. Finally, lemon juice had no final change in the pH of soil. Overall, our hypothesis was proven to be incorrect however, these results overall matched our predictions for all but one variable.

Introduction

For our research project we have chosen to observe which materials will alter the PH of soil the most after a one week study. We will be testing the hypothesis of; If we use different organic materials to alter the pH of soil, then lemon juice will alter the pH of the post significantly, because it has the greatest contrast in pH compared to soil. The average pH of healthy soil is around 6.0-7.5. When environmental factors or manmade factors are added to the mix it can affect the pH of soil resulting in changes to plants. In this experiment we will be testing the effect on pH with the additions of eggshells, coffee, lemon juice, and baking soda on natural soil as well as measuring what the PH of just regular soil. The goal of our experiment is to determine how the pH of soil can be organically altered & how we can use our research to keep the flower industry clean and toxin free. Once we have finalized our data, we can use the data to come to the conclusion of how florists can gain more control over the colors of their flowers.

For our experiment we had 4 independent variables: eggshells, coffee, baking soda, and lemon juice. We also had a control group of soil. For each data collection we used 3.5 grams of the given variable mixed with 20 grams of soil, and an additional 10 mL of water for the best results. Each mixture was in a separated beaker, in a closed space immune to unaccounted factors. We first decided to use a standard Ph strip to see around where the soil ranked on the Ph scale, based on those results we were able to find the range and be able to test the Ph more precisely. Some of our control variables included: temperature, soil source, water source, brand of pH strips, light source, and more. Keeping a controlled environment allows for us to accurately obtain results to help florists nationwide.

Our first material we chose to use was egg shells. Egg shells work to increase PH because they are made of mostly calcium carbonate, a natural alkaline compound, with a high pH of 8.4-8.75. Crushed eggshells can be mixed and combined into soil very efficiently when they are crushed into small pieces and/or powder.

Our second material we chose was lemon juice. Lemons naturally have a low, acidic PH, so when added to soil the lemon juice they should lower the soils PH. According to Source 4, “Lemon juice, due to its citric acid, lowers soil pH, making it more acidic.” Our third natural substance was baking soda.

Baking soda or sodium bicarbonate is a natural base, so when we add it into soil it will increase the PH of our soil.

Besides regular soil our fourth and final material we used were coffee grounds. Pure unbrewed coffee grounds are highly acidic and work to lower the Ph of soil.

Methods and Materials

Materials-

- Lemon juice (3.5 g)
- Coffee (3.5 g)
- Crushed Eggshells (3.5 g)
- Baking soda (3.5 g)
- Soil (total of 100 g)
- Water (total of 50 mL)
- Beakers (total of 5)
- pH strips (total of 20)

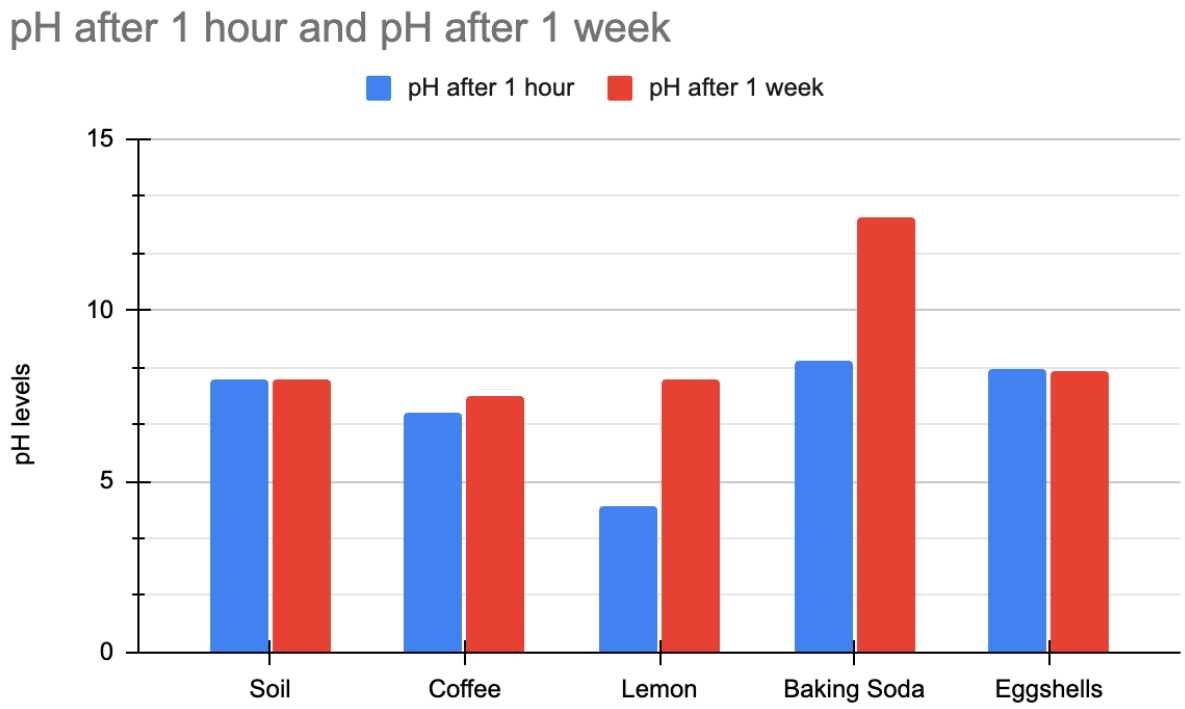
Method-

We tested our hypothesis of "If we use different organic materials to alter the pH of soil, then lemon juice will alter the pH of the post significantly, because it has the greatest contrast in pH compared to soil." and then connect and allow our results to help florists and ordinary people looking for an organic way to change the colors of their hydrangea. We used 200 mL beakers each with 20 g of soil, 10 mL of water, and 3.5 g of either eggshells, coffee, lemon juice, or baking soda. We also had one control group of 20 g of soil plain mixed with 10 mL of water. We measured 20g of soil on a scale, and placed it into a 200 mL beaker, measured 3.5g of our additives and added it into the beaker with our soil. Then, we added 10 mL of distilled water and used a stirring rod to stir and make sure the components were fully mixed. After one day we tested the pH of each soil mixture with broad range pH strips to see a basic pH of each material and then with the results of the initial pH we used Narrow range pH strips in order to receive specific decimals. One week later we tested the pH of each mixture again using the same testing method. At the end of the experiment we observed what additions led to the highest change in pH from the original.

Data Collection-

We plan to run 2 N of trials, in order to collect our data. We placed our soil slurry with crushed eggshells, lemon, coffee, baking soda, and regular soil under Dr. KG's fume hood, to protect them from outside elements like students,temperature fluctuation, and evaporation. The day we made the samples we measured their PH using a regular PH strip and then went in with a more precise PH strip to get the exact PH. This data was then later entered into Globe. We left our project under Dr. KG's fumehood, and came back 1 week later to test which substance offers the greatest change in PH. We collected the PH first with our regular PH strips and then with the more precise strips, using this new data we entered it into Globe. To finalize our calculations we will need to subtract the final PH by the initial PH to find the number of changes.

	Soil	Coffee	Lemon	Baking Soda	Eggshells
pH after 1 hour	8.0	7.0	4.3	8.5	8.3
pH after 1 week	8.0	7.5	8.0	12.7	8.2



Analysis-

Our data we captured over a week-long period shows that certain organic additives high, or low in pH will alter the pH of soil when combined together. Our hypothesis, "If we use different organic materials to alter the pH of soil, then lemon juice will alter the pH the most significantly, because it has the greatest contrast in pH compared to soil." Our hypothesis was proven false because lemon had a pH change of 3.7 and baking sodas pH changed by 4.2 In all Soils pH remained the same at 8.0 throughout the experiment, coffees pH changed slightly from 7.0 to 7.5, proving it to be non beneficial for a great pH change when altering the color of Hydrangea, Lemon offered a Ph change of 3.7 however the pH changed from an acid to a base, we most likely believe that this was a result of the lemon juice molding, however the large shift makes it optimal for an organic pH shifting method. Baking soda offered the highest change from 8.5 to 12.7, a shift of 4.2, making baking soda the most effective method in changing the pH of soil.

Eggshells offered a slight pH change from 8.3 down to 8.2 making it the least beneficial for a safe and organic way to change pH.

Conclusion

In conclusion our pH was tested false because we hypothesised lemon juice would alter the pH the most significantly. However, the baking soda had the most significant effect with a change of 4.2, while lemon juice had a mass immediate change but over the span of a week it returned to the starting pH of soil, implementing no change.

We successfully tested which independent variable had the biggest and smallest immediate and long term effects of the pH of the soil. Most variables, with the exception of baking soda, had a higher immediate change before the pH went back to closer pH of the soil. If we were to do this experiment again, I would also use covers to the bears in order to seal the air and keep the contents of the container strictly within the container. I would also use the same state of matter for each variable to eliminate absorption as an unaccounted for factor. If I had the opportunity to expand the testing on this experiment I would test more variables & test to see if the type of state of matter used has an effect on altering the pH.

Discussion

According to our original base sources, baking soda and lemon juice performed the most accurately to what we expected. While coffee ground and eggshells performed similarly but not quite as much as to what we expected. Baking soda was the most accurate because it was expected to raise the pH by source 3, and it executed by raising the end result pH by 4.7. Lemon juice also performed accurately to what we expected because according to source 4, “Lemon juice temporarily lowers soil pH, making it more acidic due to its citric acid content” and our results showed a significant temporary increase of -3.7 but by the end of the week had no change

in pH. The coffee grounds were expected by source 2 to not change the pH but in the end it was altered by 0.5, which is not a significant change but still not as we had predicted. Lastly, in source 1 eggshells were said to increase the pH of soil efficiently however at the end of the experiment they only affected the pH by 0.2.

Overall our results did not support the hypothesis because we expected lemon juice to have the most significant effect, but it turned out to have one of the least effects on the soil. We discovered an error with evaporation and mold when we came back to our experiment 1 week later. To combat this issue next time we conduct this experiment we will use beaker covers to help prevent mold and evaporation. We obtained these results because from our background information and research we learned that the natural pH of soil is 6-7.5 since our sample of soil had a pH of 8.0 and was already a base we can conclude that some of our additives didn't change the pH very much because of that factor, however our materials that were very far left or right on the pH scale resulted in a huge change, more specifically lemon and baking soda. Our experiment accurately represented our hypothesis because we found out which material changed the pH the most, and we also concluded which material would be best for organic florists based on how much the material changed the pH.

Acknowledgements

Dr. Gloria Kreischer-Gajewicz

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