THE SEARCH FOR THE MISSING PLANTS

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Inspiring World-Class Academic Achievement

THE GLOBE PROGRAM
Global Learning and Observations to Benefit the Environment

Abstract

"Why don't plants seem to grow under black walnut trees (*Juglans nigra)*, but seem to grow under American elm trees *(Ulmus americana)*?" is the experimental question. This project was done because there were not so many plants growing under black walnut trees. This research is important because this could be a way to help walnut farmers better use the land under their walnut trees and be able to produce a second crop. The hypothesis is the soil under black walnut trees will have a lower pH (more acidic) than soil under American elm trees. This study was conducted by testing the pH of soil from one meter and two meters away from black walnut trees and American elm trees using the GLOBE Program protocol for soil pH testing. The results were very confusing because the difference in pH between black walnut trees and American elm trees was statistically insignificant, indicating the results did not support my hypothesis. Therefore, there must be another variable which accounts for the seemingly lack of plants growing under black walnut trees compared to American elm trees. Even though the data does not support the hypothesis, pH should be able to be eliminated as a potential factor in determining plant growth under these two plant species. As a consequence, other factors such as water use, toxins, or possible symbiotic relationships should be considered for further study.

Research Question

The research question is "Why don't plants seem to grow under black walnut trees (*Juglans nigra)*, but seem to grow under American elm trees *(Ulmus americana)*?"

My research is important because this could be a way to help walnut farmers better use the land under their walnut trees and be able to produce a second crop. Research shows farmers rotate their crops. Before this practice, farmers would plant the same crop year after year until the nutrients were taken out of the soil and that crop would fail. Farmers would then go to the next land, clear it out and plant until the soil became exhausted. Farmers now plant crops horizontal on hill sides. They used to plant vertical rows because this was easier, but during rain, the soil would erode, leaving gullies and rendering the field unable to be planted. Horizontal planting helps to prevent erosion by providing rows to slow the rainfall.

Most crops grow with soil pH around 7 (neutral). Around where I live, when the fields become too acidic, the farmers will apply lime to raise the pH to more neutral, making the fields look snow white.

When observing black walnut farms, there is a lack of plants growing in the soil beneath them. By taking pH levels beneath black walnut trees, I am trying to either confirm or deny black walnut trees affect the pH of the soil around them.

Introduction

The reason to do this project is because I noticed not many plants were growing under black walnut trees where we go to look for gold along the Clear Fork River. Also, people at the Bug Zoo at the Ohio Agricultural Research and Development Center in Wooster, Ohio said plants would not grow under black walnut trees when I asked, but didn't really explain why. I remained confused and curious. Therefore, I decided to test this out. I looked on the GLOBE website to find a soil protocol and there was one on how to test for soil pH!

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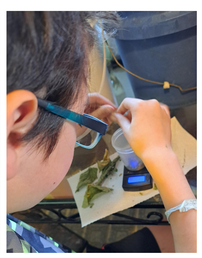
During the dustbowl, drought and high winds made life on the plains almost unlivable and soil erosion by wind was very severe. Farmers now plant windbreaks, that is, a row of trees to separate out fields and slow down the wind. This best practice slows down soil erosion by wind.

Most crops grow with soil pH around 7 (neutral). Around where I live, when the fields become too acidic, the farmers will apply lime to raise the pH to more neutral, making the fields look snow white.

I really want to find out if it is possible to grow more than one crop on land for walnut tree farms. We need to find ways to be better stewards of our land. Best practices such as crop rotation, horizontal crop rows on a hillside, and wind breaks are some proven ways we have been using to conserve our soil resources. Since there is so much land between trees, I would like to find a way to use this soil better.



Research Methods

The research methods are as follow:

SOIL pH TEST PREPARATION

1. Dry and separate soil samples from 1 and 2 meters away from Black walnut and American elm trees respectively
2. Weigh 40g of soil
3. Measure 40 ml of distilled water
4. Put 40g of soil and 40 ml of distilled water into cup
5. Put lid on and shake for 30 seconds then let sit for 3 minutes
6. Do step 5, 5 times, then let sit for 5 minutes
7. Record pH with paper test strips

LEAF pH TEST PREPARATION

1. Crush leaves and measure 1.83g of crushed leaves
2. Put crushed leaves into tea bag
3. Put container into cup
4. Boil 250 ml of water
5. After boiling water let sit for 30 seconds
6. Pour water into cup
7. Let steep for 2 minutes
8. Record pH with paper test strips

GLOBE Data Used

I decided to base my project around the GLOBE Program Soil pH protocol.

Carrying Out Investigations

Description of the Study Site: I found out there were 68 trees along the bank of the Clear Fork River, where I put the leaf packs (1 box elder, 48 American elms, 9 walnuts, 8 cherry trees, 1 sugar maple, 1 weeping willow). There were a lot of black walnuts lying around and I rolled my ankle. The whole creek was owned by the GPAA (gold prospecting site) and close to the creek was a stair case leading down to the river so the gold prospectors could easily get down to the river. The climate in the study site area is cool in the fall. When I was doing the project, it was during the fall so the overall temperature was in the mid 50s-60s degrees Fahrenheit and was not too windy. Overall, it was pleasant to be out in the creek doing my project, soaking up the sun in the fall.

Clear Fork River (GPAA)

Results

Analyzing Data

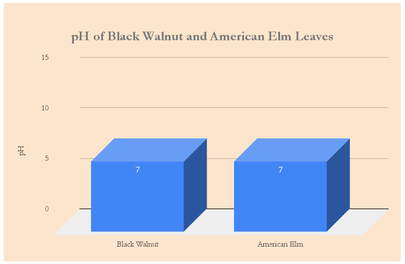
The research question is: Why don't plants seem to grow under black walnut trees *(Juglans nigra)*, but seem to grow under American elm trees *(Ulmus americana)*?

The research hypothesis is the soil under black walnut trees will have a lower pH than soil under American elm trees bordering the Clear Fork River.

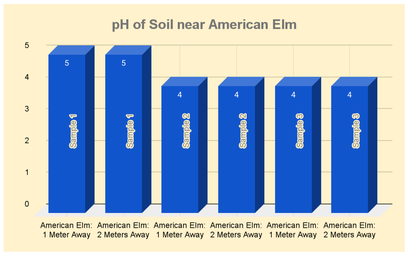
Graphs one and two represents the pH of soil one meter and two meters away from three different black walnut and American elm trees. I found the overall soil was much more acidic than I originally thought (I thought the soil around black walnut trees would be more acidic than the soil around American elm trees).

The first black walnut tree had a pH of 4.3 at both locations. The first American elm tree had a pH of 5.0 at both locations. This data supports my hypothesis. The second black walnut tree had a pH of 4.3 at both locations. The second American elm tree had a pH of 4.0 at both locations. While this data does not support my hypothesis, I do not feel there is such a big difference to matter. The third black walnut tree had a pH of 5.0 one meter away and 5.6 two meters away. The second American elm tree had a pH of 4.0 at both locations. This data does not support my hypothesis.

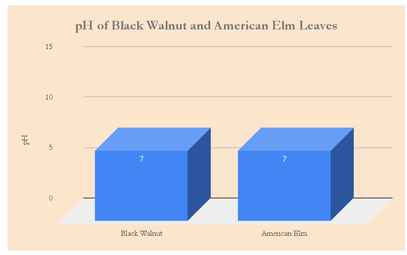
Graph three shows the pH of black walnut leaves and American elm trees to both be seven (neutral). This data does not support my hypothesis. I thought black walnut leaves would be more acidic than American elm leaves. This even further compounds the soil results. With neutral pH leaves falling samples onto the soil, I thought the leaves would help the soil to not be so acid. While soil were taken in the fall, very few leaves had fallen to be able to prove or disprove my theory. Regardless, it does not seem black walnut leaves would contribute to the acidification of surrounding soil.



Graph One



Graph Two



Graph Three

Discussion

Every location tested had a pH level too acidic for plants to grow. From what I understand, plants need close to neutral soil in order to grow. Perhaps because my testing site was on a flood plain, when the Clear Fork River floods in the spring, it causes the acid to be washed out of the soil. My samples were taken in the fall of the year, perhaps allowing the acid levels to build of over the summer. The results are almost the opposite from each other. Black walnut tree one was more acidic than American elm tree one. Both number two trees were very close in pH. Black walnut tree three was less acidic than American elm tree three. Tree-pairs were fairly close by each other. Was one tree influencing the other? This lack of consistency led me to graph number three, where I tested the pH of the tree leaves.

My research is important because this could be a way to help walnut farmers better use the land under their walnut trees and be able to produce a second crop. I really want to find out if it is possible to grow more than one crop on land for walnut tree farms. We need to find ways to be better stewards of our land. Best practices such as crop rotation, horizontal crop rows on a hillside, and wind breaks are some proven ways we have been using to conserve our soil resources. Since there is so much land between trees, I would like to find a way to use this soil better.

Conclusions

In conclusion, I learned the pH of soil around black walnut and American elm are very similar. The data does not support my hypothesis. The black walnut graph shows pH levels ranging from 4.3 to 5.6, which is actually a little more neutral than American elm. The American elm graph shows pH levels ranging from 4 to 5. When I tested the leaves, I found both had a pH of 7. The results tell me pH of black walnut and American elm trees do not determine whether or not other plants will grow in the soil beneath them. These results made me very confused. Upon digging deeper, I later found out black walnut trees produce juglone which makes toxins in the tree.

NEXT STEPS

This project was very fun and exciting. I got to test out different things, go outside and get dirty! I did struggle with the "book" parts of this. For my next steps, I would like to get some juglone to test on which plants might be able to survive with this toxin. This would be a way to help walnut farmers better use the land under their walnut trees and be able to produce a second crop. All together this project was very fun and exciting. I had the opportunity to talk to adults who also like to go outside and get dirty.

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