Using GLOBE Protocols to Compare Soil Quality and Tree Height

Authors: Pinole Earth Team

PINOLE VALLEY HIGH SCHOOL
NEW SCHOOL. SAME EXCELLENCE

EARTHTEAM
Leadership. Stewardship. Service

The GLOBE Program

Table of Content

3 - Abstract

4 - Research Question/Hypothesis

5 - Background Information

6 - Information on CCC (Contra Costa County) Pepper Tree

7 - Data Collection Plan

8 - Using GLOBE Protocols

9-13 - Tree Height Data

14 - Data Analysis

15 - Interpretation of Data

16 - Conclusion and Next Steps

17 - Acknowledgment

Abstract

- Our research project investigates the relationship between soil quality and tree height. The reason Pinole Earth Team chose this topic is because we were interested in learning more about what factors contribute to plant growth.
- Our proposed research question is: Does soil quality and soil type affect the height of the California Pepper Tree in Contra Costa County?
- While carefully following COVID-19 In-Person Guidelines, some members on the team were able to meet and use different GLOBE Protocols to determine the soil type, measurements of NPK macronutrients, and find out the height of various trees.
- By using these protocols, the team could soon determine that California Pepper Trees do in fact grow best in clay soil. In addition, some macronutrients, such as Nitrate levels, were not as indicative of a relationship between soil quality and tree height.

Research Question/Hypothesis

Research Question: Does soil quality and soil type affect the height of the California Pepper Tree in Contra Costa County?

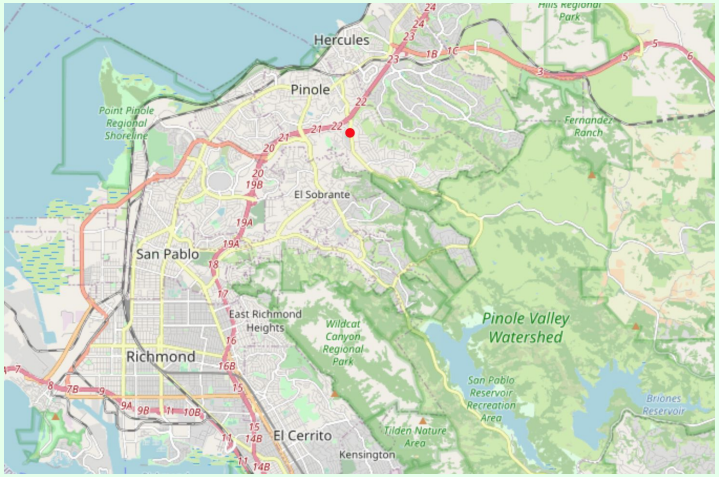
Hypothesis: California Pepper Trees grow best in Clay soil. The amount of N-P-K nutrients affect the roots and can prevent adequate growth of the California Pepper Tree in Contra Costa County.

Background Information

Soil Scientists use soil data to better understand the potential for plant growth;
Hydrologists use soil data to determine potential sedimentation in water bodies;

Meteorologists and Climatologists use soil data in climate prediction models as soils can affect humidity and temperature
Atmospheric scientists want to know the effect of soils on humidity, temperature, reflected light, and fluxes of gases such as CO2 and methane
Biologists use soil data to understand its potential for supporting plant and animal life;

Contra Costa County and the California Pepper Tree



- We focused our research in Contra Costa County, located in the San Francisco Bay Area
- We chose to study the California Pepper Tree (*Schinus molle*) because it is a common tree found in Contra Costa, there are several planted near our high school campus.
- During our background research, we learned that the California Pepper Tree is not native to California, but it is native to the Peruvian Andes
- The California Pepper Tree can grown up to 15 m tall and grows best in well-draining clay soil.

Data Collection Plan

Step 1: Locate a California Pepper tree in Contra Costa County.

Step 2: Fill a small bag with soil directly under the tree careful not to damage any roots.

Step 3: Measure the tree using the Globe Observer App.

Step 4: Test the soil using the Soil Fertility and Soil Characterization protocols.

Step 5: Record the data.

- We collected the soil from two different locations in Contra Costa County for a total of four soil samples overall.
- Most of the trees we tested soil for were growing along the same street so, in order to set a control, we made the assumption that they were planted around the same time.

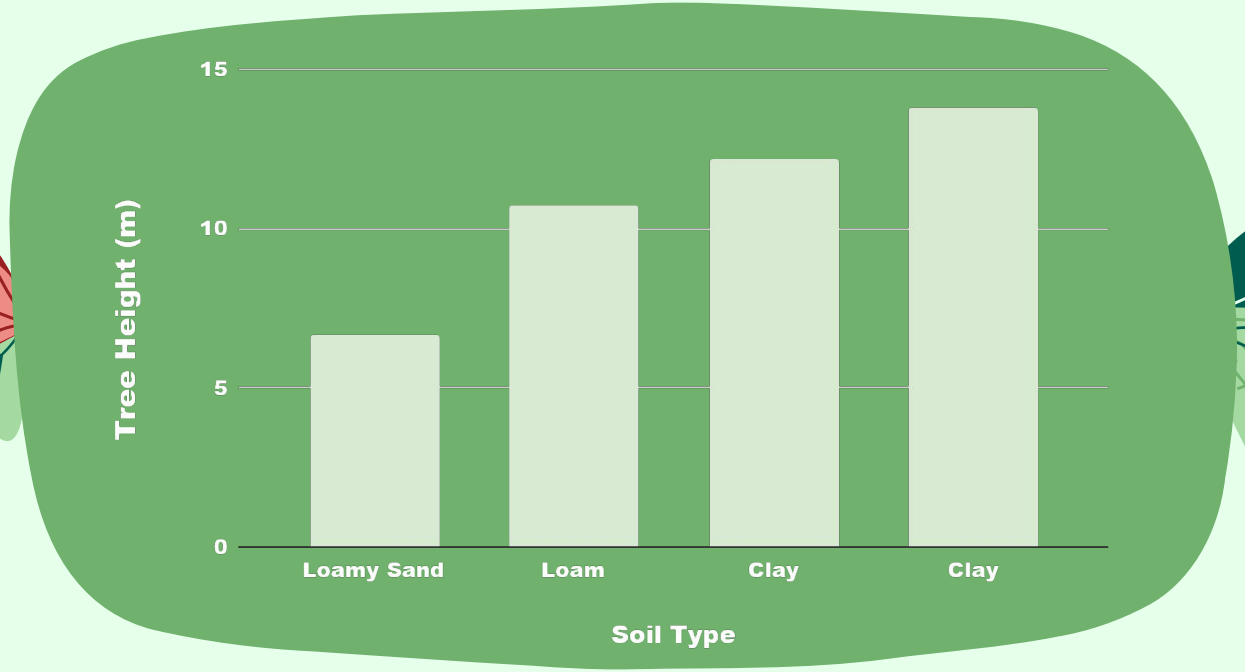
Using GLOBE Protocols

Soil Characterization Protocol: used to determine soil type

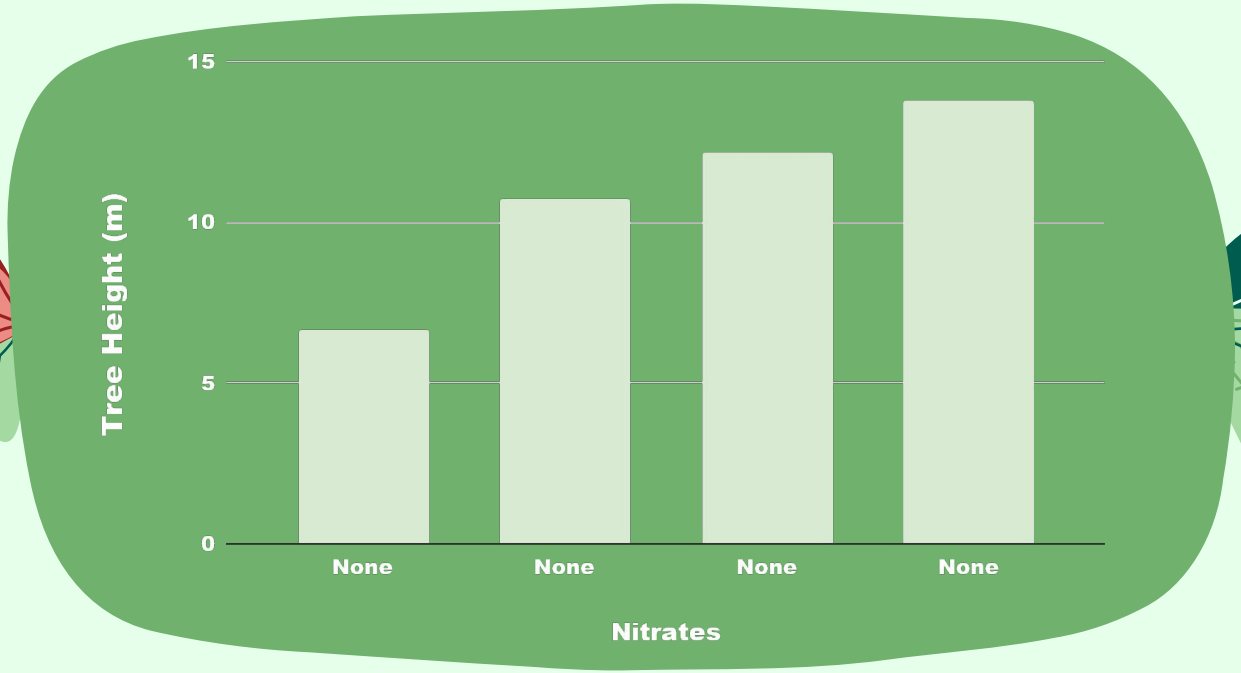
Soil Fertility Protocol: used to measure levels of macronutrients including: nitrates, potassium, phosphates, and pH in the soil

GLOBE Observer App-Trees: used to measure the height of a tree

Tree Height v. Soil Type

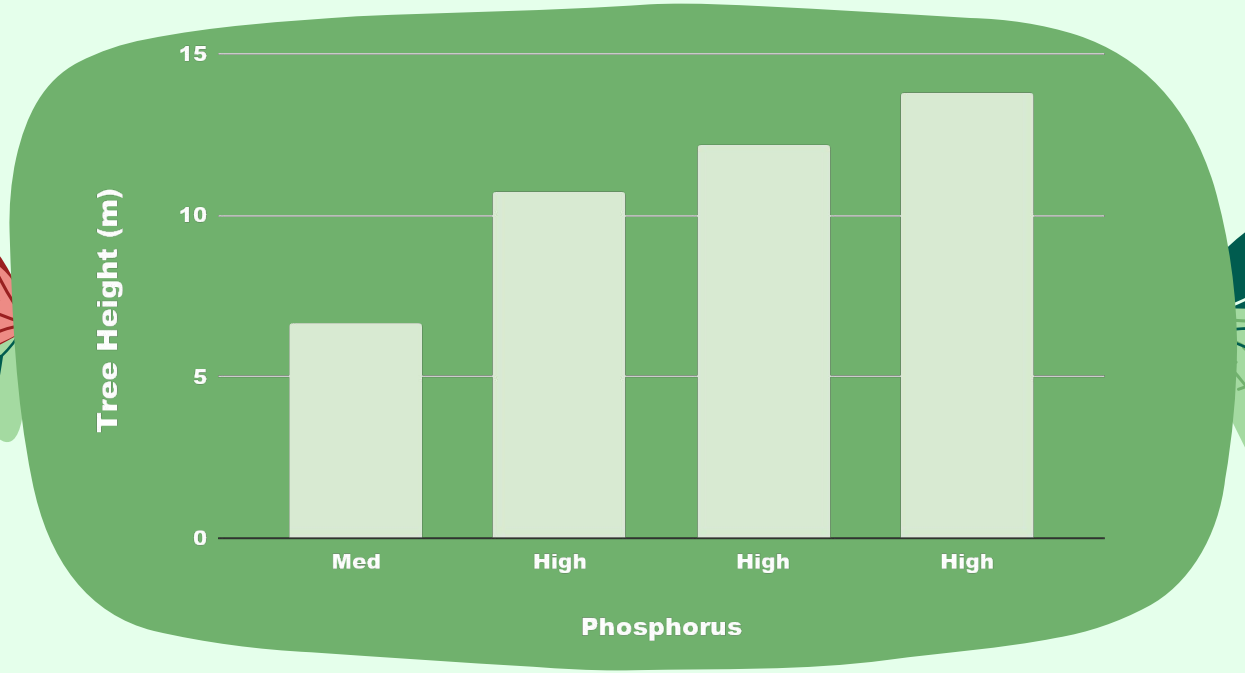


Tree Height v. Nitrates

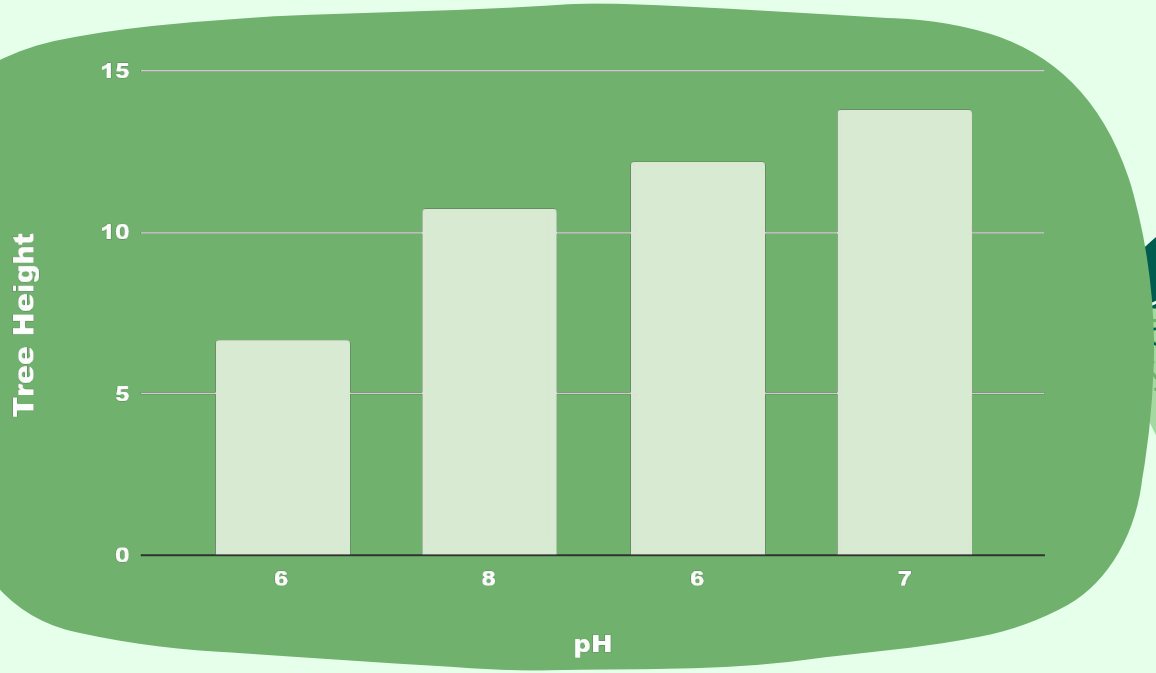


Tree Height v. Potassium

Tree Height v. Phosphorus



pH v. Tree Height



Data Analysis

- As shown in our discoveries, we have concluded that Clay soil does have a better growth rate than does Loam soil or Loamy Sand soil.
- Levels of Nitrates were all “trace” or “none” which tells us that measuring Nitrates does not reveal much about differences in tree height
- We found that tree height can be influenced by higher levels of phosphorus and potassium in the soil
- According to our results, soil with a neutral pH turned out to correlate to the tallest tree in our data set which could mean that these trees require a balanced pH to thrive.

Interpretation of Data

- According to our data, we were able to discover that the soil type, measurements of NPK macronutrients, and find out the height of a tree.
- As a result, we soon discover that the Pepper Trees prefer clay soil to grow in. Furthermore, some macronutrients, such as nitrate levels, were not as predictive of a connection between soil quality and tree height as others.

Conclusions & Next Steps

We can conclude that the nutrients in clay soil had a better impact on pepper trees than the other soil types did. This allowed pepper trees to grow significantly taller.

We appreciated doing this research for GLOBE and NASA because it gave us a better understanding on how different types of nutrients and soils affect the growth of pepper trees.

Upon concluding our research investigation, we can encourage cities in Contra Costa County to continue to plant California Pepper Trees in clay soil to ensure successful growth rates.

Continuing to use the GLOBE Observer App will us a better understanding of the types of trees found in our cities and help us determine the benefits of CO_2 sequestration

Improvements to our research can be to collect more data points to ensure that our conclusions are true across a wider area.

Acknowledgements

- Thank you to the GLOBE Program for providing our team with the materials and resources. We couldn't have completed this project without your support and materials.
- Also, to our team, we have learned so much together in our time working on this fantastic project. We couldn't have done it without your commitment and dedication to this project and to all the activities we've had over the year.