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COMPARISON OF SOIL FROM DECIDUOUS AND CONIFEROUS ENVIRONMENTS

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ABSTRACT

One of the most important aspects of plant development is the quality and health of the soil in which a plant resides ~~in~~. Plants rely on the soil for nutrients, as well as a source of ground water. Soil pH is another relevant factor in determining plant health, playing an important role in what nutrients are available to plants. A specific range of pH values are generally preferred by certain plants. These factors can play major roles in the distribution of species in terms of both range and density in an area. What this study aims to answer is if there is a significant difference in these metrics between coniferous and deciduous trees Groupings of said tree types were found in a centralized area and soil samples were taken from the surrounding ground for moisture and pH level testing. These values were compared to determine if there is correlation between moisture and pH in the types of trees present. Trees are essential to the ecosystem and that begins with the soil. Understanding the soil composition and the uses in tree distribution allows a deeper understanding of ecological communities.

Keywords: Soil, Coniferous and deciduous trees, pH, Moisture.

INTRODUCTION

Deciduous and coniferous trees are both able to share the same environment, though they have different geographical ranges. Deciduous trees have wide leaves, ideal for gathering sunlight, an adaptation that comes with a tradeoff, as deciduous trees must shed their leaves during winter, relying on energy accumulated during summer months to endure the winter cold. They are found in temperate climates at generally lower elevations. By contrast, coniferous trees are more abundantly found in higher elevation. They prefer cold and mountainous environments but also are commonly found in the same temperate climates alongside their deciduous counterparts. They retain large amounts of energy and water at all times to maintain their green foliage and rely on other factors for reproduction. The factors that distinguish between these differing environments can be seen in the soil as that is where the tree draws its nutrients from and is what we believe to hold the differences in between the abiotic environment of deciduous and coniferous tree clusters living in the same climate.

The factors measured should show a difference in what type of tree is growing in a specific location based on the competition of suitable soil composition. Considering the preferred environment of the deciduous trees, these species will out compete the coniferous in their most suitable habitable zones where coniferous are pushed into those least suited for development, but thrive due to their hardy nature. We hypothesize that deciduous trees should prefer the more moist and less acidic soils while coniferous trees should prefer less moist and more acidic soils (Abdullah et al, 2024).

MATERIALS AND METHODS

Samples were collected from Peace Chapel on April 15th 2024. To collect the samples, a soil core sampler was used. Samples were placed in an oven safe bakers tin. The core sampler was driven into the ground until it stopped moving, and the soil core was

placed into its container. This was repeated twice per sample. There were a total of six sampling sites, three for coniferous trees, and three for deciduous trees. There were three samples per site. The precise location of sampling sites was decided at random. A researcher would face a cardinal direction and two random numbers were generated. The researcher would then take the first number, and move that many paces forward, turn 90 degrees to the right, and do the same for the second number. Sample sites selected for a given tree type had no trees of the other type within a radius of at least 20 meters. Each sample was then weighed shortly after it was taken, then weighed again after being dried for 48 hours. The pH of each sample was obtained by using a probe on dirt that was suspended in water. Each sample was mixed with 1 mL of water per gram of sample present, measured with a graduated cylinder, and mixed in Erlenmeyer flask. Erlenmeyer flask was manually mixed for 30 seconds, then samples were transferred through a mesh filter to remove large pebbles, into a small glass vial, that was then assayed with a pH probe. After this, the Erlenmeyer flask and the vial were extensively washed with water.

FIELD SITE DESCIPTIONS

Peace Chapel has multiple patches of deciduous and coniferous trees. Different field sights we found varied slightly. The site for pine group 1 had a thin layer of top soil, with a layer of shale underneath. The site for deciduous group 1 had far less inhibition from rocks. The soil here on the top layer was black, and brown in a lower layer. The site for pine group 2 was deep into a pine forest, the area was covered in moss, though not directly where we sampled. There was a thick layer of top soil that resembled that of deciduous group 1. Deciduous group 2's site had some shale, comparable to the first pine site. Pine group 3's site had soil that was easy to work with. It was also mossy. The site for deciduous group 3 was unique in that it was on an incline. It was also mossy.

RESULTS

Generally, the soil around coniferous trees was drier than that found surrounding deciduous trees. This can be seen in Table 1. These empirical results were proven to be statistically significant. Little to no difference was found when comparing the two tree types as seen in Table 2. This lack of a difference was verified through statistical studies.

Table 1: the water percent of each sample in each group in each tree type. Rows are samples 1-3, and columns are the groups. The negative value seen in coniferous group 1 sample 3 was likely the result of an error when transcribing the data, and will be exempt from future analysis.

The mean water percentage of soil around deciduous trees was 23 % +/- 0.2 %, the mean water percentage of soil around coniferous trees was 18 % +/- 0.3 %.
The results of a 2 sample paired t-test with 15 degrees of freedom gave:
t = 1.965
p-value = 0.034 (statistically significant α = 0.05)

	% water					
	Deciduous			Coniferous		
	Group 1	2	3	1	2	3
Sample 1	21%	25%	31%	13%	19%	31%
2	19%	18%	27%	14%	16%	19%
3	23%	20%	23%	~~36%~~	15%	20%

Table 2: The pH of each sample in each group. Mostly uniform across all samples, aside from an outlier at deciduous group 2 sample 1 which may have been the result of faulty equipment.

The mean pH of soil around deciduous trees was 4.03, the mean pH of soil around coniferous trees was 4.37

The results of a 2 sample paired t-test with 10 degrees of freedom gave:
t=-1.29
P-value 2 tailed = 0.11 (not statistically significant α = 0.05)

	pH					
	Deciduous			coniferous		
	Group 1	2	3	1	2	3
Sample 1	4.5	2.25	3.82	4.28	4.13	3.91
2	4.29	4.27	3.98	4.79	4.26	4.52
3	4.9	4.13	4.11	4.63	4.55	4.23

DISCUSSION

A statistically significant difference in the water content of the soil surrounding deciduous trees compared with the water content of the soil surrounding coniferous trees. Because this is a correlational study, there is a need for further investigation before direct causal links can be established. There are many possible causes for this discrepancy however that can be tested. It is possible that due to the role pine trees play in ecological succession as intermediate species, the soil they inhabit will naturally be more arid and less developed than that of a deciduous "climax" community (Britannica, 2019). It is also possible that due to the physical qualities of pine needles when compared with the leaves of deciduous trees, that soil covered with pine needles has significantly less water retentive capabilities. While this makes intuitive sense, more research needs to be done to confirm that this is the case. It is also possible that deciduous trees are better competitors. If this is the case, then pine trees are only able to inhabit areas of forest that are not already occupied by deciduous trees. This may be due to deciduous trees being able to out-shade their coniferous counterparts or may be due to chemical warfare. There are many examples of plants inhibiting the growth of other plants by releasing chemicals that inhibit the growth of other plants (Illinois Extension, 2018).

As for pH, we failed to reject our null hypothesis, indicating that there wasn't a significant enough difference in pH levels in the soil to determine a correlational relationship. This does not line up with our expectations, nor what was found in literature, as generally coniferous trees are found in more acidic soils (Abdullah et al, 2024). Due to the relative proximity of the samples taken between the clusters, we hypothesize that there was not enough geological difference in sites to result statistical significance. To further this experiment, additional factors such as elevation would be relevant to determine the gradients of distribution found in tree species, as well as additional soil tests on nitrogen and ammonia levels, and soil classifications. With this additional data and a more widespread sampling locations, this experiment would be significantly more viable and gain more impactful results.

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