Urban Soil Suitability Analysis and Recommendations for Phytoremediation

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Introduction

Soil, a fundamental and often overlooked natural resource, forms the very foundation of terrestrial ecosystems, underpinning nearly all life through its critical roles in facilitating plant growth, driving essential nutrient cycles, and regulating the intricate flow of water. However, the escalating global issue of soil contamination, characterized by the accumulation of harmful chemicals or physical substances, poses a significant threat to environmental integrity, the delicate balance of soil functions, and ultimately, the health and well-being of human populations. This contamination is predominately a consequence of diverse anthropogenic activities.

Within urban environments, soils face a unique confluence of pressures, often acting as historical sinks for a wide array of pollutants stemming from industrial legacies, transportation networks, and diverse human activities. Our group decided to test for soil pollution on the vacant lot across from the Alumni building to see the urban impact on soil. Recognizing the potential for soil contamination stemming from the former Dara's gas station operations, particularly the leakage of lead gasoline and other petroleum-derived products, we hypothesized that soil samples collected from the study site would reveal significantly elevated concentrations of lead, alongside the potential presence of other heavy metal contaminants such as cadmium, chromium, and arsenic, commonly associated with such activities.

Methods and Materials

For this project, our team decided to focus on soil health and regenerative options. For this project, the plot of land at the corner of Anderson Ave and Denison Ave, with the geographic coordinates being 39°11'08" N and 96°35'03" W, was selected. Historically, a local gas station chain, Dara's Corner Market, was located on the northeast corner of this plot.

One of the most important sampling methods in soil study's is Bulk Density. Bulk density is important for soil health as it is essentially a measurement of soil, water, and air pores within a specified volume. For this test, we used a bulk density sampler, which we borrowed from the Kansas State University Soil Lab. Healthy soil is composed of a low bulk density, due to the high number of pores found within the soil that contain air and water, which evaporate during the drying process. Porosity is another important measurement of the soil. Porosity refers to the amount of water, air, and soil found within a soil sample. This calculation allows us to understand the relationship between pores and pore space within a soil sample

Soil texture is also important to understand for soil health. As soil science has progressed through the years, research has shown that soil texture is correlated with soil porosity and soil bulk density. To test this, the hydrometer method was conducted to receive readings of sand, silt, and clay in percentages of makeup in the sample

Image 1. *Soil Texture and Particle Size Analysis*

Image 2. *Soil Sample Collection at the Study Site*

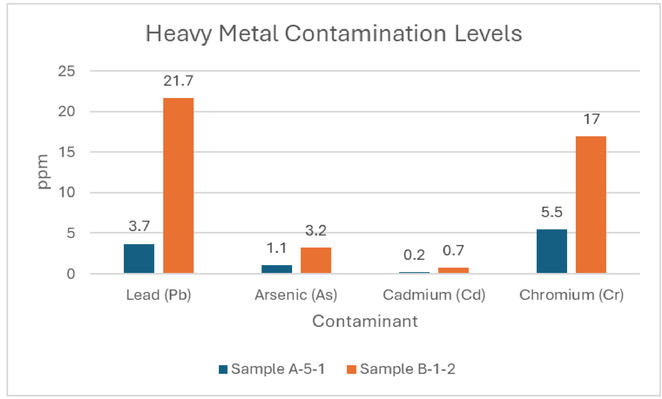

Figure 1*: Heavy Metal Contamination Graph.*

Results

3.1 Soil Physical Properties

•Bulk density analysis revealed compaction (1.7 g/cm3) in the western, clayey portion of the plot, exceeding the threshold for root restriction (>1.47 g/cm3).

•Middle (silty) and eastern (sandy) sections showed no compaction, with bulk densities of 1.47-1.49 g/cm3 and 1.67 g/cm3, respectively.

3.2 Soil Texture

•Soil textures varied across the plot, including sandy loam, clay loam, and silty clay loam.

•Clay loam and silty clay loam textures suggest moderate water retention.

3.3 Chemical and Functional Properties

•**Potassium:** Potassium levels varied (123-366 ppm), indicating heterogeneous distribution.

•**Cation Exchange Capacity (CEC):** Clay loam and silty clay loam had higher CEC than sandy loam, consistent with their greater organic matter content and retention capacity.

•**Carbon and Nitrogen:** Sample A-4-2 had the highest Carbon (3.74%) and Nitrogen (0.20%) content. Carbon percentages were higher than nitrogen, with C:N ratios ranging from 11.3 to 18.7.

•**Heavy Metals:** Heavy metal concentrations were generally low and below US EPA cleanup levels. Clay-textured soils had higher concentrations than sandy soils.

•**Electrical Conductivity:** All samples were classified as non-saline, indicating suitability for agriculture.

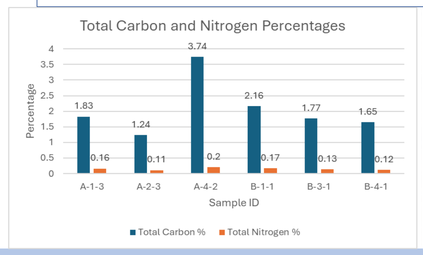

Figure 2: *Total Carbon and Nitrogen Percentages Graph*

Figure 3: *Aerial View of Study Site*

Discussion

We personally tested for bulk density, porosity and texture. Our texture test indicated we had Clay Loams in upper quadrant of our plot (section 3), silty clay loams in the middle portion (section 2) and sandy loams in the lower third of the plot. Soil texture is an important property that can aide in determining water movement, nutrient enrichment, root behaviors and erosion potential.

Our bulk density results showed the western, clayey portion of the plot was highly compacted at a 1.7 g/*cm3.* This is notable because bulk density values higher than 1.8 g/cm in sandy soil types indicate compaction which is detrimental to root growth and infiltration. The samples pulled from the middle; silty section of the plot was at 1.49 and 1.47 g/*cm3*, suggesting no compaction. Lastly the third section resulted in 1.67g/*cm3* suggesting no compaction which correlates to its sandy texture.

Conclusions

Although our test results did not correspond as we originally hypothesized, this location could still be used for research on soil fertility and the relationship between urban environments and their impact on local soils. Today's research on enzymes and the effectiveness of using plants for decontamination is strongly understood. This research could potentially lead to an understanding of how enzymes can be manipulated to use phytoremediation in polluted areas. By adding this research project at this location, not only is an educational service provided by the environment, but also an aesthetically pleasing environment for the community