How does soil pH affect microorganisms in Central Park

[1]Bryant Jimenez, [1]Ernie Cuesta, [1]Nowshad Al Reza, [1]Rocheli Apilan
[1]High School for Health Professions and Human Services

Abstract:

Central Park, an iconic urban green space, is a habitat hosting a rich diversity of microorganisms, which play pivotal roles in ecosystem functions and health. Soil pH, a fundamental environmental factor, has the potential to significantly impact these microorganisms. In this DNA barcoding project, we have investigated the relationship between soil pH and the microorganisms' biodiversity within Central Park. We have collected soil samples from two contrasting locations, characterized by varying pH levels, and we have uncovered the influence of pH on microbial diversity and composition. Using DNA barcoding techniques, we have analyzed the DNA of microorganisms and identified species inhabiting these distinct pH environments. This project has deepened our understanding on how soil pH can shape the ecosystem of Central Park's microorganisms and contribute to our understanding of DNA barcoding.

Introduction

The introduction to the Urban Barcoding Project proposal highlights Central Park as a unique blend of nature and city life, focusing on the critical role of soil pH in influencing the park's diverse microbial ecosystems. The project aims to investigate how soil pH variations across different areas of Central Park affect microorganisms like bacteria, archaea, and fungi, which are essential for ecological balance and environmental cleanup. By collecting soil samples from two distinct locations with different pH levels, the research seeks to measure soil pH accurately and use DNA barcoding to identify microorganisms. The hypothesis is that soil pH variations will significantly influence microbial diversity, with less acidic soils supporting a higher diversity of microorganisms than highly acidic soils.

Methods/sampling:

1. Use a spade or shovel to dig 1-6 inches into soil, make sure soil is dry.
2.Cut a ½" slice from the face of the hole and trim the sides so you have a vertical slice of soil.
3. Place soil into ziplock bag
4. Repeat for 25-30 samples in areas needed.

Culturing Method

One commonly used method for sampling and cultivating soil samples is the grid sampling technique. Grid sampling involves dividing the area of interest into a grid pattern, typically with evenly spaced sample points. At each sample point, soil samples are collected at a consistent depth, usually down to a depth of 6-12 inches, using a soil probe or auger. These samples are then combined to create a composite sample for each grid cell. Once the samples are collected, they are air-dried and homogenized to ensure a representative composite. Cultivating the soil samples involves analyzing their physical and chemical properties, such as texture, pH, nutrient content, and organic matter, to assess the soil's fertility and suitability for various agricultural practices. This information is valuable for making informed decisions about soil management and optimizing crop production.

Serial Dilution: Serial dilution is a dilution of a concentration to obtain a reduced concentration, we will use it to make it easier to see the amount of bacteria, viruses, microorganisms etc. To use serial dilution a solution must be put into a substance, this substance now is used to keep diluting until there are many.

PKJ-003-F	proteobacterium partial	Enterobacteriaceae bacterium	Burkholderiales bacterium	Escherichia coli strain
PKJ-003-R	Pectobacterium carotovorum subsp. brasiliense strain	Pseudoalteromonas	Photobacterium damselae	Pantoea
PKJ-004-F	Bacillus paranthracis	Bacillus thuringiensis	Bacillus cereus	Bacillus toyonensis
PKJ-004-R	Bacillus cereus strain	Bacillus thuringiensis strain	Bacillus paranthracis strain	Bacillus proteolyticus strain
PKJ-010-F	Pseudomonas sp. strain	Pseudomonas koreensis strain ya	Pseudomonas reinekei strain	Pseudomonas moraviensis strain
PKJ-010-R	Pseudomonas brassicacearum	Pseudomonas frederiksbergensis	Pseudomonas brassicacearum	Pseudomonas koreensis

Discussion:

Our DNA barcoding project revealed that soil pH significantly impacts microbial diversity and composition in Central Park. In less acidic soils (higher pH), we observed a higher diversity of microorganisms, particularly various Bacillus species known for their roles in nutrient cycling and plant growth promotion. In contrast, more acidic soils (lower pH) showed a dominance of Pseudomonas species, which are well-adapted to such environments but may not provide the same broad ecological benefits as Bacillus species. These findings highlight the critical role of soil pH in shaping microbial communities and their functions within the park's ecosystem.Understanding the influence of soil pH on microbial diversity is crucial for managing and maintaining the health of urban green spaces like Central Park. While our study offers valuable insights, it is limited by the number of samples and the range of pH levels examined. Future research should encompass a broader spectrum of pH environments and additional locations within the park to provide a more comprehensive picture. Integrating advanced genomic techniques could also enhance our understanding of the functional roles of these microorganisms, informing strategies to conserve and enhance biodiversity and soil health in urban ecosystems.

References: Reside, A. E., Beher, J., Cosgrove, A. J., Evans, M. C., Seabrook, L., Silcock, J., Wenger, A. S., & Maron, M. (2017). Ecological consequences of land clearing and policy reform in Queensland. *Pacific Conservation Biology*, *23*(3), 219. https://doi.org/10.1071/pc17001 Marizzi, C., Florio, A. M., Lee, M., Khalfan, M., Ghiban, C., Nash, B., Dorey, J. E., McKenzie, S. K., Mazza, C., Cellini, F., Baria, C., Bepat, R., Cosentino, L., Dvorak, A., Gacevic, A., Guzman-Moumtzis, C., Heller, F., Holt, N. A., Horenstein, J., . . . Micklos, D. (2018b). DNA barcoding Brooklyn (New York): A first assessment of biodiversity in Marine Park by citizen scientists. *PLOS ONE*, *13*(7), e0199015. https://doi.org/10.1371/journal.pone.0199015
Radziemski, M., & Fronczyk, J. (2015). Level and Contamination Assessment of Soil along an Expressway in an Ecologically Valuable Area in Central Poland. *International Journal of Environmental Research and Public Health*, *12*(10), 13372–13387. https://doi.org/10.3390/ijerph121013372
How To Take A Soil Sample. (n.d.). Cornell Cooperative Extension. https://warren.cce.cornell.edu/gardening-landscape/soils-climate/how-to-take-a-soil-sample