Comparison Between the Health of Forest Soil and Landscaped Soil

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Abstract

The soil is seen as an environment on its own and just like an environment it needs to remain healthy in order to properly function. Unfortunately, human activities are the major cause of soil health deterioration. This can be done by spraying fertilizers and insecticides, getting rid of organisms entirely from the soil, or by replacing the beautiful land with huge buildings, houses, or artificial landscapes (Li et al., 2023; Soil Quality National Technology Development Team with contributions from North Dakota NRCS, 2010). The hypothesis is that the soil in the forest will have better pH, NPK, and overall health compared to lawn soil. The health of the lawn soil (LS) and forest soil (FS), and to do that the New Jersey Soil Health Assessment Guide developed by the Ocean County Soil Conservation District will be used. Three holes will be randomly dug in two different locations, 12 inches down from the surface, when it's relatively nice weather and placed into a ziplock bag. To determine nutrient holding capacity/pH, a Rapitest Soil Test Kit will be used to look at the pH and NPK. The preparation that is required for the samples use the Rapitest Soil Kit is a container filled with ⅕ soil and ⅘ distilled water. It can be seen in all of the Figures that there is a lot of overlap in all of these graphs for all of the values tested meaning there wasn't much variation in the results. Unfortunately, all the values show that none of them are below 0.05 meaning none of the data is statistically significant. These results prove the null hypothesis to be correct that there is no difference in the health quality of the two types of soil.

Keywords: Soil, Forest, Lawn, Health, and pH

Comparison Between the Health of Forest Soil and Lawn Soil

The earth is full of life from animals big and small, trees that tower far above the land they come from. While water and air are usually thought of as the most important things to help keep organisms alive, soil is usually left as an afterthought. When looking at a picture of the forest, the ground can usually be seen, but it never draws any attention compared to the trees, sky, or the sun. While soil seems simple on the surface, taking a shovel and digging a few inches down can really open up the expansive world of soil, as it can get more complicated from there. Soil is composed of organic matter, air, water, and minerals with sand, silt, and clay making different percentages of the soil contributing to different attributes (Ocean County Soil Conservation District). The soil is the lifeblood of any ecosystem as it stores and cycles nutrients, allowing certain organisms to form populations and communities around it.

On top of supporting the growth and diversity of organisms, soil regulates the drainage of water and filters or slows down any toxic compounds from getting into the water (Soil Quality National Technology Development Team with contributions from North Dakota NRCS, 2010; Ocean County Soil Conservation District). The soil is seen as an environment on its own and just like an environment it needs to remain healthy in order to properly function. Unfortunately, human activities are the major cause of soil health deterioration. This can be done by us spraying fertilizers and insecticides, getting rid of organisms entirely from the soil that we deem as pests, or by replacing the beautiful land with huge buildings, houses, or artificial landscapes (Li et al., 2023; Soil Quality National Technology Development Team with contributions from North Dakota NRCS, 2010). This not only dampens the functions that were previously talked about, but also affects the world as a whole. The soil is a huge carbon sink as its pool is about 3.3 times

bigger than the atmospheric pool and 4.5 times bigger than the terrestrial biological pool of carbon (Li et al., 2023).

The quality of the soil is extremely important on only for us, but for the entire world. So in order to examine the health of the soil, it can be broken down into three different properties: chemical, biological, and physical (Minaoui et al., 2021). The chemical properties are the nutrient holding ability, presence of nitrogen, phosphorus, and potassium (NPK), and pH of the soil. The biological properties are the organic matter, color, roots, soil life, and growth. Then finally, the physical properties which are compaction, structure, friability, soil tilth, erosion, and drainage (Ocean County Soil Conservation District). This brings up a question of how the soil has changed when it's in a landscaped area and a forest. The objective of this study is to examine the difference between lawn soil and forest soil health. The hypothesis is that the soil in the forest will have better pH, NPK, and overall health compared to lawn soil. The null hypothesis of this experiment is that there is no difference in the pH, NPK and overall health quality of lawn soil and forest soil.

Methods

Three holes will be randomly dug with a shovel in two different locations, measuring 12 inches down from the surface with a tape measure, and placed into a ziplock bag with a trowel. In order to determine the health of the lawn soil (LS) and forest soil (FS), the New Jersey Soil Health Assessment Guide developed by the Ocean County Soil Conservation District will be used. While digging the holes, the guide will look at the compaction, soil tilth, erosion, drainage, organic matter, soil life, plant growth, and nutrient holding capacity/pH of the soil. While a majority of those categories are visually determined, compaction and nutrient holding

capacity/pH will require extra material. For compaction, a flag will be stuck into the ground and measured how deep it goes down. To determine nutrient holding capacity/pH, a Rapitest Soil Test Kit will be used to look at the pH and NPK. The preparation that is required for the samples use the Rapitest Soil Kit is a container filled with ⅕ soil and ⅘ distilled water. The Rapitest Soil Test Kit has attribute values of depleted (0), deficient (1), adequate (2), sufficient (3), and surplus (4). The NJ Health Assessment will use the attribute values of good (5 points), fair (3 points), and poor (1 point) depending on the condition of each soil sample within the category then they will be added to see the final condition of the soil. The final result scores are Excellent (40 points), Good (38-25 points), Poor to Fair (24-10 points), and Poor (8 points). After looking at the health of the soil, the texture type of each soil sample will be examined using the Jar test method and the soil texture triangle. Each jar will have about 130 grams of soil and measured with a ruler and converted to millimeters.

Sites

The first location is the front and backyard of a home in Ocean Acres, Manahawkin, and the second location is in the woods off of Lakeview Drive in Barnegat. These sites were chosen due to the easy accessibility and the premise that Manahawkin and Barnegat are towns that reside in the Pine Barrens meaning that taking a drive down one road and there is a forest that surrounds them compared to a lawn that has little to no trees growing in it. The first site is the lawn, a clear area with barely any grass in the back with pitch pine (*Pinus rigida*) needles scattered across the ground. The front yard has nice green grass in the front with one white oak (*Quercus alba*) and along the right side of the house has a cluster of *Bryophyta* sp.. The second site is along Lakeview Drive in Barnegat which is an oak-dominated upland. The left side of the road was filled with white oak (*Quercus alba*), pitch pines (*Pinus rigida*), black huckleberry

(*Gaylussacia baccata*), and leaf litter scattered across the floor. The right side had some scarlet oak (*Quercus coccinea*), mountain laurel (*Kalmia latifolia*), and a few pitch pine (*Pinus rigida*), but had a lot more smaller plants inhabiting the ground like wintergreen (*Gaultheria procumbens*) and black huckleberry (*Gaylussacia baccata*) with the leaf litter. Using the Web Soil Survey, it shows that site one has the series Downer and site two has the series Atsion with Downer being under the Order Ultisols and Atsion being under the Order Spodosols(NRCS & USDA, n.d.).

Results

Sample	Sand Amount	Silt Amount	Clay Amount	Total	Sand Percent	Silt Percent	Clay Percent	Texture Type
Lawn #1	17mm	2mm	2mm	21mm	81%	9.5%	9.5%	Loamy Sand
Lawn #2	12.5mm	2.5mm	2mm	17mm	73.5%	14.7%	11.8%	Sandy Loam
Lawn #3	16mm	4mm	5mm	25mm	64%	16%	20%	Sandy Loam
Forest #1	15mm	2mm	2mm	19mm	80%	10%	10%	Loamy Sand
Forest #2	12mm	2mm	1mm	15mm	80%	13%	7%	Sandy Loam
Forest #3	13mm	0.5mm	0.5mm	14mm	92%	4%	4%	Sand

Figure 1. The type of texture of the soil samples is broken down by the percentage of soil type present in the soil.

Date	Location	Compaction	Soil Tilth	Erosion	Drainage	Organic Matter	Soil Life	Plant Growth	Nutrient Holding Capacity/pH	Total
3/30/2025	Lawn Sample #1	8 ⅛” (Fair)	Good	Fair	Good	Good	Fair	Fair	Fair	30
3/30/2025	Lawn Sample #2	8 ½” (Fair)	Good	Good	Good	Poor	Fair	Poor	Fair	26
3/30/2025	Lawn Sample #3	6 ⅞” (Fair)	Good	Good	Good	Fair	Poor	Fair	Good	30
3/30/2025	Forest Sample #1	12 ½” (Good)	Good	Fair	Fair	Fair	Good	Fair	Fair	30
3/30/2025	Forest Sample #2	7 ⅞” (Fair)	Good	Good	Fair	Good	Good	Good	Good	36
3/30/2025	Forest Sample #3	10 ½” (Fair)	Fair	Good	Fair	Fair	Good	Good	Fair	30

Figure 2. The New Jersey Health Assessment sheet filled out with the two types of samples, Lawn and Forest.

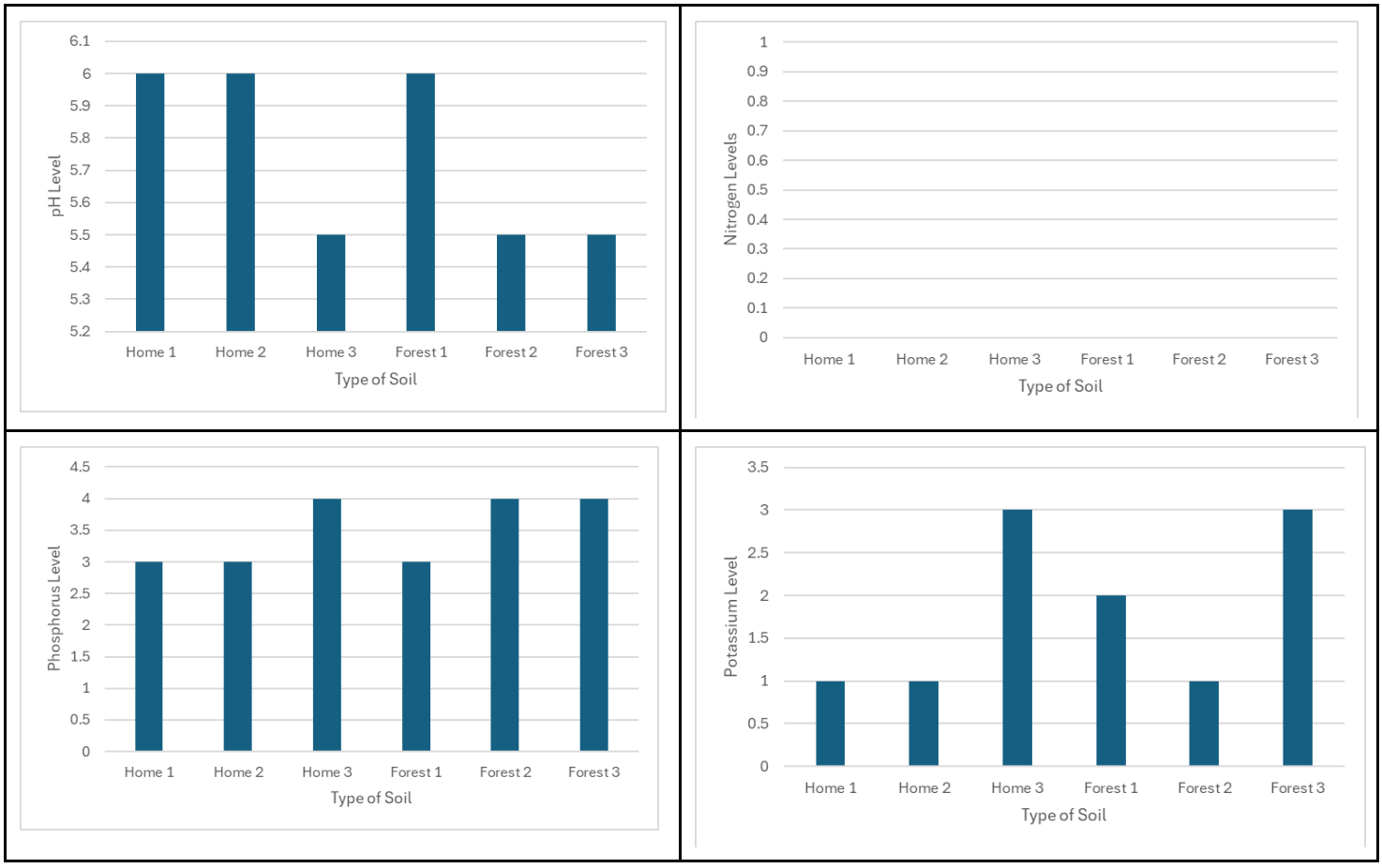

Figure 3. This shows the individual values of pH, nitrogen levels, phosphorus levels, and potassium levels of each sample from the two types of soil.

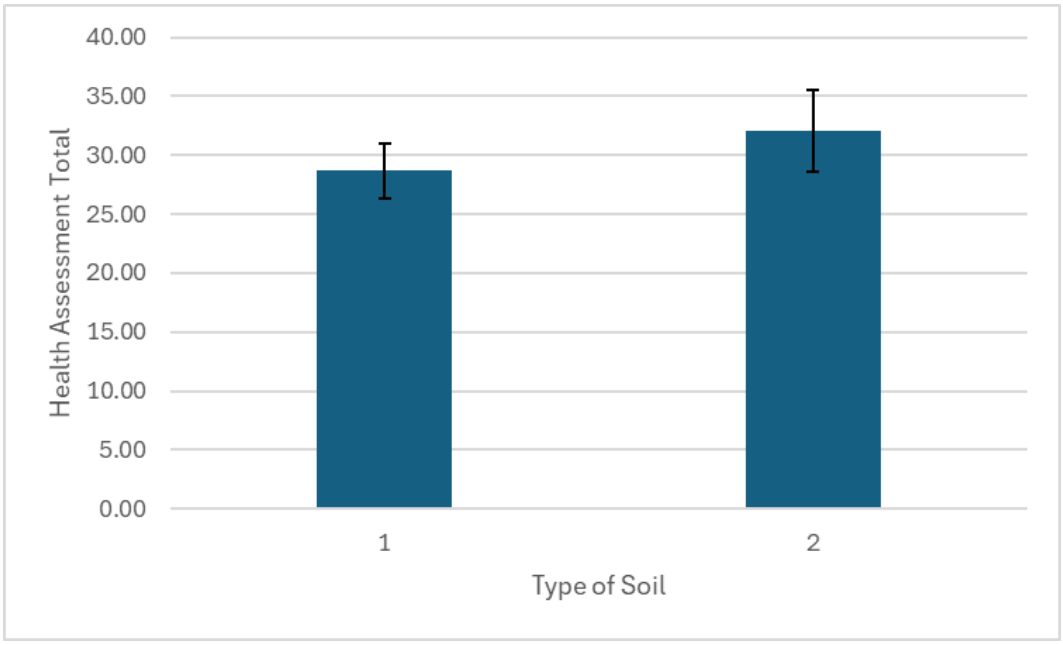

Figure 4. This graph shows the average Health Assessment value of the soil from the lawn soil samples (1) and the forest soil samples (2).

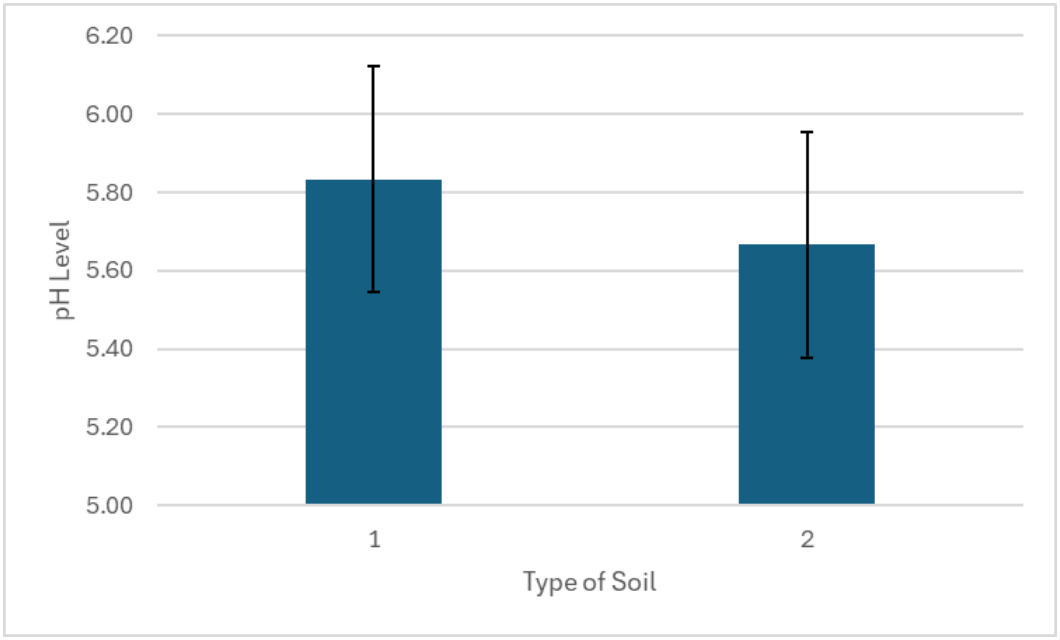

Figure 5. This graph shows the average pH of the soil from the lawn soil samples (1) and the forest soil samples (2).

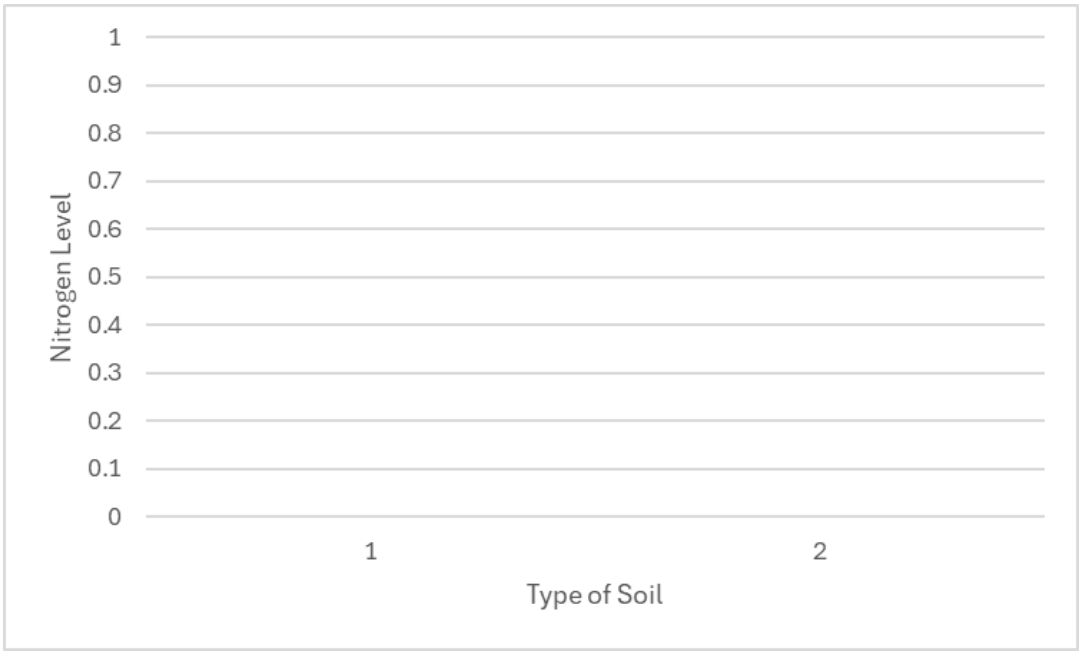

Figure 6. This graph shows the average nitrogen levels of the soil from the lawn soil samples (1) and the forest soil samples (2).

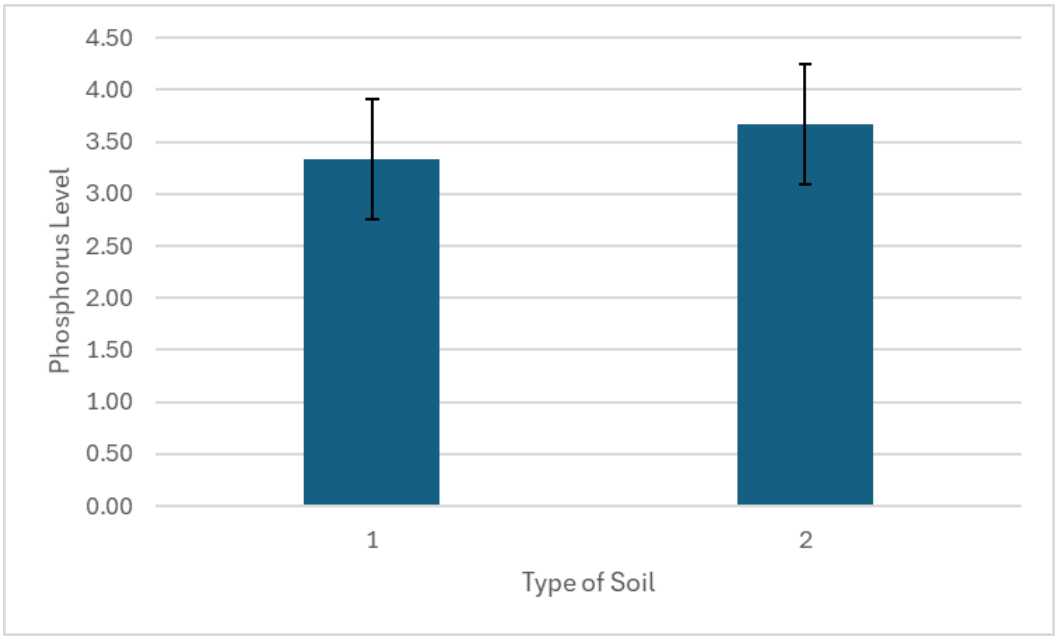

Figure 7. This graph shows the average phosphorus levels of the soil from the lawn soil samples (1) and the forest soil samples (2).

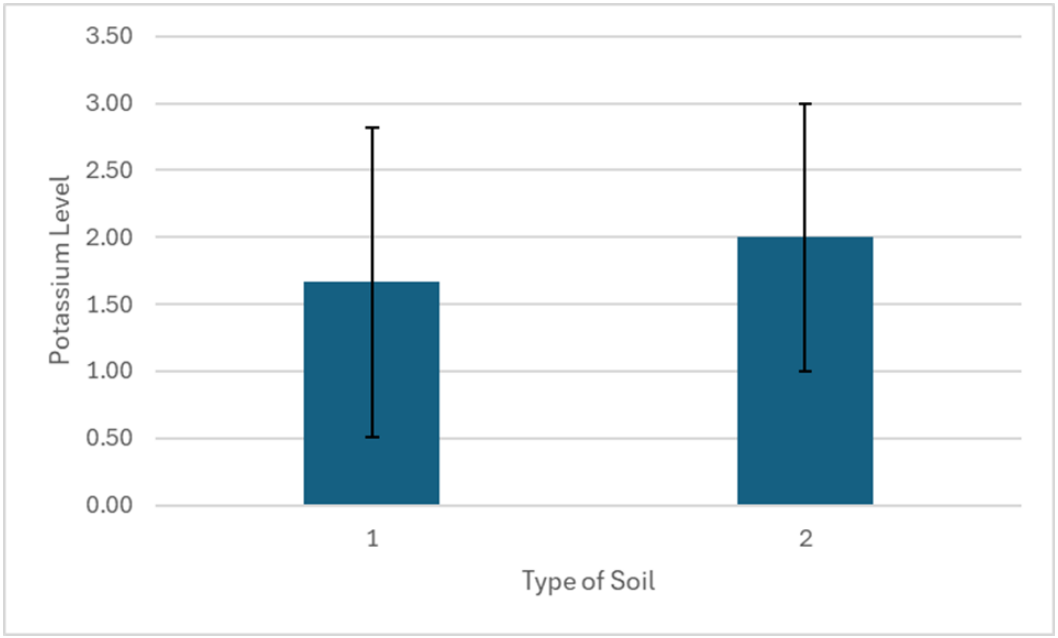

Figure 8. This graph shows the average potassium levels of the soil from the lawn soil samples (1) and the forest soil samples (2).

Results

In order to see the health of the soil, we have to look at four things: the NJ Health Assessment, pH, nitrogen levels, phosphorus levels, and potassium levels. First looking at Figure 2 it shows that Lawn Sample 1 (LS1) had value of good (30), Lawn Sample 2 (LS2) had a value of good (26), Lawn Sample 3 (LS3) had a value of good (30), Forest Sample 1(FS1) had a value of good (30), Forest Sample 2 (FS2) had a value of good (36), and Forest Sample 3 (FS3) had a value of good (30). Figure 4 shows the averages of those values with LS with an average of 28.67 and a standard deviation of 2.309, and FS is an average of 32 with a standard deviation of

3.646. Examining Figure 5, it can be shown that the average pH of the LS is 5.83 with a standard deviation of 0.2887, and the FS's pH is 5.67 with a standard deviation of 0.2887. Figure 6, shows the nitrogen levels in the two types of soil which are 0.00 for LS with a standard deviation of 0.00 and FS has an average value of 0.00 with a standard deviation of 0.00. Figure 7 shows the phosphorus levels for LS which are 3.33 with a standard deviation of 0.5774 and Forest soil with a value of 3.67 and a standard deviation of 0.5774. The final Figure 8 shows the potassium levels of LS which is 1.67 with a standard deviation of 1.155, and FS has an average level of 2.00 with a standard deviation of 1.000.

Statistical Analysis

Looking at the NJ Health Assessment and the total score values that each sample came back can be shown in Figure 2 that all of the samples for LS and FS had a value of good meaning that the soil isn't in need for improvement. This also isn't helped by their standard deviations with values of 2.309 (LS) and 3.646 (FS) showing a huge amount of overlap making it seem like there is no difference between each other. In Figure 3 it shows that the pH of all the samples are acidic with only a slight variation between the two types, being LS with 5.83 and FS with 5.67 pH. Looking over not only Figure 6 but Figure 3 as well it can be seen that there are no nitrogen levels present in any of the soil samples. Figure 7 also shows the same situation as Figure 3 with the FS being slightly different with FS2 & FS3 surplus of phosphorus (4) and FS1 having sufficient levels (3). While LS1 & LS2 have sufficient levels of phosphorus (3) and LS3 has a surplus. The final graph is Figure 8 and looking at Figure 3 they show a wide array of values with LS1 has a value of deficient (1), LS2 has a value of deficient (1), LS3 with a value of sufficient (3). FS1 showed a value of adequate (2), FS2 with a value of deficient (1) , and FS3

with a value of sufficient (3). It can be seen in all of the Figures that there is a lot of overlap in all of these graphs for all of the values tested meaning there wasn't much variation in the results. To make sure that these differences hold any value a t-test must be performed. Performing a t-test on all of these values results in a 0.2378 for the Health Assessment, 0.5185 for pH, 0.5185 for phosphorus levels, and 0.7247 for potassium levels. Due to nitrogen being 0's across the board, a t-test was unable to be performed. Unfortunately, all the values show that none of them are below 0.05 meaning none of the data is statistically significant.

Discussion

The objective of this study was to look at and compare the health differences between soil from a lawn or landscaped area and soil from the woods. One area was filled to the brim with trees and plants while the other site had virtually no plants besides grass and the remnants of plants. As explained before the values of the NJ health Assessment, pH, nitrogen levels, phosphorus levels, and potassium levels are extremely similar. Even performing a t-test on the differing values showed that they aren't significantly different or hold any value in those differences. These results prove the null hypothesis to be correct that there is no difference in the pH, NPK and overall health quality of the two types of soil.

Looking at the things I could have done better the number one thing that could have been done better was instead of the Jar test a soil sieve was done to get a more accurate texture type. The second thing that could have limited the study was not going too far into the forest as site two kept getting more and more dense the farther in as well as the fear of something happening to the experimenter's vehicle. Another thing that could have swayed the study for the NPK and pH test is the collection of the samples as the top of the holes were a lot larger than bottom after

digging the foot down. This made it kinda hard not to scoop previous layers into the sample bags especially at site two where there were tons of roots present. The NJ Health Assessment is based on visual judgement and handling of the soil so I could have messed up on assigning a value to each category. This does beg the question: Would the results be different if the soil samples were the same series?

If there is any advice to give from this research it would be to go further and try to find a more in-depth look at the health of soil. I honestly learned so many different things during this project like what classification is looked at when it comes to determining if soil is healthy. I never knew a lot of it would be based on visual observation rather than scientific testing as pH and NPK is only one part of the Health Assessment Guide. The biggest thing I learned is how much more complex soil is than I ever would have guessed. I believe that everyone should learn more about soil and understand more than what meets the eye.

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