Meredith K. Huddleston
Environmental Science Lab 2
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Abstract

This experiment was undertaken to measure the relative levels of microbial activity in Overton Park and nearby fields. By running soil samples through a series of tests for ammonification and nitrification, we were able to determine that, as we hypothesized, there is a higher level of microbial activity in the forest than in surrounding non-wooded areas. This provides evidence for one of the important economic services provided by forests—reviving the nutrients in the soil and releasing nitrogen for further use.

Background

Forests should have more microbial activity than grassy areas because of the greater level of organic matter such as dead leaves that is available to be broken down for nitrogen. This organic matter can support high levels of bacteria which carry out these processes of ammonification and nitrification. which releases nitrogen for trees, etc.

Studies of the microbial activity in forests have become common, as this activity provides greater nutrients for plant growth as well as information about the ecosystems cycles in the surrounding areas (Verchot, 1999). We conducted an experiment of this kind in Overton Park, an urban forest located in Memphis, TN, to see if the contrast holds between forested and non-forested area activity in an urban setting. To provide a contrast to the forest sample, we took another sample from a grassy field across the street from the park. Through this experiment, we hope to capture one additional service provided by these trees which has perhaps been overlooked.

Methods and Materials

1. A Ziploc bag for each soil sample
2. Two sites for soil sampling, one forested and one non-forested
3. Tool for collecting dirt
4. Scale and containers for weighing dirt
5. Three test tubes for each soil sample
6. Three droppers, one for each chemical
7. Glass or plastic stirrers and spot plates
8. Nessler's solution, Trommsdorf's reagent, ¼ & full conc. sulfuric acid, diphenylamine

Each individual used a Ziploc bag and tool to collect their soil sample from one of the two sites, and at each site there were three groups of three individuals to provide many samples so as to avoid skewed results due to abnormal soil or human error. After gathering the samples, each individual returned to the lab and added .1 grams of their soil sample (measured on the scale) to three previously prepared reagents in test tubes: sterile 4% peptone broth, Nitrosomonas Medium and Nitrobacter Medium.

After 24 hours and again after 72 hours, we tested each reagent for microbial activity. For the peptone, we tested for ammonia by adding one drop of Nessler's solution to the spot-plate with the dropper, adding a drop of the peptone reagent with a stirrer, and looking for orange precipitate as an indication of ammonia presence. We tested for the nitrosomonas process by adding a drop of Nitrosomonas Medium to three drops of Trommsorf's and one drop of the acid—a blue-black color indicates the presence of nitrites. We also put the Nitrobacter Medium through the same process, looking for the disappearance of the blue-black color to indicate the conversion of nitrates, and tested further upon that disappearance for ~~nitrates~~ by adding one drop of the medium to one drop of diphenylamine and concentrated sulfuric acid and looked for a blue-black color.

Results

It is clear that the forest soil samples produce evidence of ammonification sooner than those from the non-forested area. After 24 hours. more than half of the first group had precipitate, while none of the second group did; after 72 hours, both sample groups showed precipitate (Chart 1).

If you examine the results of the nitrosomonas and nitrobacter tests, there is in general not a marked difference between the forested and non-forested samples. The only group to find significant presence of nitrification was the first group of six, which showed clear presence of nitrites due to the blue-black color present in each test, while the other forested and all the non-forested samples seem to have no such color reaction. The test of the nitrobacter medium showed that in this first group the nitrites had been transformed into another form, at which point the performance of the test for nitrates found a significant presence. In the other five groups, however, there was no disappearance of the blue-black color to indicate that the nitrites had been transformed into another form (Table 1).

In this case, there must be some explanation for the fact that only one-third of the forested samples exhibited the processes which according to the hypothesis should have been present when tested for. Perhaps the soil samples were taken in abnormal locations in the forest, or perhaps the differences in microbial activity were so small that they could not be detected by the human eye. There was some appearance of slight blue residue in most of the forested samples as opposed to the completely clear (no reaction) results in those non-forested samples in the test of the nitrosomonas medium, which seems to indicate a slightly higher level of microbial activity when compared to the non-forested samples (Chart 2, Table 2). Whatever the results, human error is also a possible factor, either from misunderstanding of the directions or unintended corruption of the soil and other inputs. The experiment should definitely be replicated before drawing further conclusions about microbial activity in Overton Park.

Conclusion

Overall, the class findings are somewhat consistent with the hypothesis that forested areas will contain more microbial activity than non-forested areas. The findings are inconsistent within the each site (containing three groups) and but consistent within each group (containing three samples). This indicates less of a likelihood of human error if each group member worked independently, which was the case in group 3, and more of a likelihood that there was some variation in the soil samples taken within the forested site. While one possible explanation for less than expected activity in forested areas could be the pollution associated with the urban location, studies have shown that pollution has little effect on microbial activity or nitrification (Wainwright, 1979). Therefore, there must be other factors that need consideration.

The class findings still show that to some extent there are more decomposing bacteria in the forested areas than in the non-forested areas. This is a result of the higher level of organic content in forests, which therefore provide matter for the bacteria which release more nitrogen for the plant life (since they cannot gather nitrogen from the atmosphere). This cycle perpetuates the ability of forests to sustain themselves and continue to flourish. This production of nitrogen does not directly produce any service that is economically valuable to humans, because the soil is not going to be used for agriculture and thus there is no direct need for the regeneration of nutrients in the soil.

However, this release of nitrogen for trees sustains the forest so that it can continue to provide other services such as carbon sequestration and water purification. √

Works Cited

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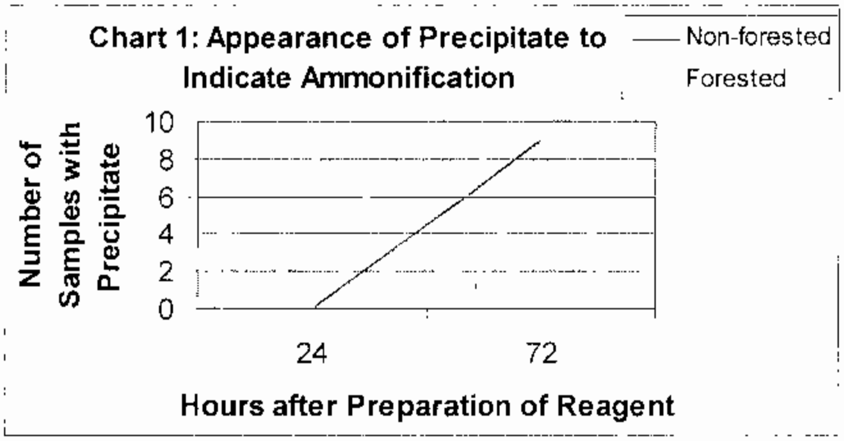

Table 1: Group Results by Color of Reaction, Site Location and Hours Elapsed

	Nitrate(yellow)	Nitrite(green)		Nitrate(yellow)	Nitrite(green)
Forest	24 Hours		72 Hours		
Lt yellow/Lt Precip	Lt. Blue	Dk. Blue	orange/heavy precip	1.Clear/2.Blk Blu	dark blue/blue
Lt. yellow/Lt Precip	Lt. Blue	Dk. Blue	orange/heavy precip	1.Clear/2 Blk Blu	dark blue/blue
Lt. yellow/No Precip	Lt. Blue	Dk. Blue	orange/heavy precip	1.Clear/2.Blk Blu	dark blue/blue
Forest	24 Hours		72 Hours		
Lt yellow	Dark Blue/ink	clear/ Lt. precip	Deep orange/Lt. Brown	Dark blue/black	light blue
Dk yellow/Lt. Precip	Black	clear-blue tint b/c of precip	Med. Orange/Lt. Brown	Dark blue/black	light blue
Lt. yellow	Black	clear/blue tint most precip	Lt Orange/Dk. Yellow	Dark blue/black	light blue
Forest	24 Hours		72 Hours		
Yellow/Slight precip	Blue	None	Yellow/More precip	Blue	Clear/blue tint
Pale yellow/precip	Deep Blue	Lightest Blue	Dark Yellow/Precip	Blue	Light Purple
None	Deep Blue	Blue residue	Precip	Blue	Clear
Non-Forest	24 Hours		72 Hours		
Lt yellow/No precip	Dark Blue	No reaction	Dk. Yellow/Heavy precip	Dark Blue	No reaction
Lt. yellow/No precip	Dark Blue	No reaction	Dk. Yellow/Heavy precip	Dark Blue	No reaction
Lt yellow/No precip	Dark Blue	No reaction	Dk. Yellow/Heavy precip	Dark Blue	No reaction
Non-Forest	24 Hours		72 Hours		
Lt. yellow/no precip	Dark Blue	No reaction	Orange/Heavy precip	Dark Blue	No reaction
Lt. yellow/no precip	Dark Blue	No reaction	Orange/Heavy precip	Dark Blue	No reaction
yellow/no precip	Dark Blue	No reaction	Orange/Heavy precip	Dark Blue	No reaction
Non-Forest	24 Hours		72 Hours		
Yellow/no precip	Blue	Clear	Dark Yellow/Precip	Blue	No change/clear
Lt. yellow/No Precip	Dark Blue	No change	Dark Yellow/Precip	Dark Blue	No change/clear
Pale yellow/no precip	Dark Blue	No change	Yellow/Precip	Dark Blue	No change/clear

Table 2: Nitrite Activity by Site	Forested	Non-Forested	Total
Clear	1	9	10
Light Blue	5	0	5
Dark Blue	3	0	3
Total	9	9	18

Chart 2: Appearance of Nitrite Activity in Samples