Biology 1H

Brock

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9th Grade Little Things

Organic vs. Inorganic

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There are many factors that affect what occurs in the soil. One of these many factors is whether plants are grown organically or are grown using artificial enhancements such as fertilizer. These two different methods can both significantly affect the bacteria that live inside the soil. Since soil bacteria help create the foundation of the food chain, any possible negative impacts that these two different methods for growing plants might have on the bacteria could potentially have a negative impact on the entire ecosystem.

Organic soil has been well documented to be beneficial (Hoorman, 2011). Organic soil is made up of organic matter that has been decomposed until it is resistant to further decomposition, provides essential nutrients, such as nitrogen, carbon, hydrogen, and oxygen, which are necessary for plants to utilize for their growth. Other benefits of organic soil include water- holding capacity, soil structure aggregation, and erosion prevention, all of which help plants grow much healthier (About Organics, n.d.).

Many people while gardening, do not always trust organic soil and add artificial chemicals to try to enhance plant growth. They do this in spite of the fact that soil that has had chemicals such as fertilizers and pesticides added to it does not always have the same benefits as organic soil does. Treated soil regularly contains many types of pesticides and fertilizer residues. These left over pesticides have been shown to decrease the general biodiversity in soil as well as making the soil more easily prone to droughts. The pesticides break down organic substances and harm microorganisms which are located in the soil, while making the soil unable to absorb organic acids due to the changes in pH that they cause in the soils. Artificially treated soil also can contain soil contaminants such as either solid or liquid hazardous substances that are mixed with the naturally occurring soil. These contaminants are physically or chemically attached to soil particles, and if they are not attached, they are trapped in the small spaces that are between the soil particles. The reason these contaminants are there is because they are either spilled or buried in the soil or they might have slowly migrated to the soil from a spill that might have occurred elsewhere. These chemicals for example can be present in ground paint or lawnmower gas and are known as xenobiotic, which is the title of the category which includes human made chemicals. These soil contaminants can have an impact for decades and affect soil conservation. (Mwangosi, M. 2008).

One organism impacted by whether soil is organic or inorganic are bacteria. These organisms play a very significant role in the nitrogen cycle where they produce nitrate and ammonia which plants need in order to survive. If the plants do not get the nitrate or ammonia, they will not be able to produce amino acids which will later result in death of the cells. Amino acids are fundamental because they first and most importantly produce enzymes, otherwise known as proteins, which start and stop chemical reactions. If this action does not take place chemical reactions will be unable to make and break chemical bonds using energy to make new substances, which will not allow the very important four tasks to take place. If the four tasks do not take place the cell will die. If the plants otherwise known as the producers die, the consumers will have nothing to eat, resulting in the death of animals or people. In summary, if the bacteria did not produce nitrate or ammonia the nitrogen cycle would be incomplete.

The increase of the nitrogen comes from using fertilizers that are laced with nitrogen. Inorganic treatment uses the type of fertilizer that disrupts the nitrogen cycle. These types of fertilizers are interfering with the typical order of the ecosystems. The fertilizers disrupt the nitrogen cycle because fertilizers do not contain nitrate, ammonia, ammonium, or urea. The use of fertilizers creates a negative effect on the nitrogen cycle which can cause many devastating and lasting effects on the ecosystem (Driscoll, C. 2003).

We decided to compare the density of bacteria in organic soil verses the density of bacteria in inorganic soil. We choose this because we wanted to figure out which soil is more sufficient and environmentally safe to use for gardening and planting. In order to test this experiment we decided to take samples of both inorganic and organic soil. After we took samples we completed the experiment by making dilutions and placing them on soil bacteria dilution sheets. The amount of red dots (bacteria) that showed up on the sheets was the amount of bacteria in either organic or inorganic soil. After we counted the amount of bacteria we recorded our results.

I. **Problem**

a. What difference is there in the population density of bacteria in soil that has been exposed to inorganic compounds compared to organic soil?

II. **Hypothesis**

a. The population density of bacteria will be higher in the organic soil.

III. **Procedure**

a. **Independent Variable**

i. organic soil verse soil heavily exposed to inorganic compounds

b. **Dependent Variable**

i. population density of soil bacteria

c. **Negative Control**

   i. not applicable

d. **Controlled Variables**

1. the time when soil samples are collected
2. age of plants and type of plants
3. type of water
4. time dilution is left in bacteria nutrient agar plate
5. type of nutrient agar plate
6. amount of soil tested in dilutions
7. size of serological pipettes
8. size of micro-pipette used for transferring dilution
9. size of culture tubes
10. number of trials per day
11. size of cc scoops
12. number of serological pipettes used
13. use of 100 µl soil samples from dilutions 10^{-2} and 10^{-3} on the nutrient agar plates
14. amount of sterile water added to culture tubes 10^{-1}, 10^{-2},10^{-3}
15. amount of sterile water added to culture 10^{0}
16. location of soil plots for soil exposed to inorganic compounds
17. location of soil plots for organic soil

a. **Step-by-Step**

1. Locate Plot O for organic soil at N- 39.35722^{0}, W- 76.63570^{0}, which is in the Roland Park Country School Learning Garden next to the Middle School

Playground near the entrance to Lower School Multi-Purpose Room and mark with a white flag that is labeled O for organic.

2. Locate Plot IO for with N-39.35692^0, W- 76.63480^0, which is in the courtyard near the Middle School playground, next to the cement outdoor stage-like area and mark with a yellow marker flag that is labeled IO for inorganic soil.
3. Each plot should be 15cm by 15cm in length and width, and in the very middle should be the white flag for organic soil or the yellow flag for inorganic.
4. Do steps 4-11 on the same day at the same time
5. Go to plot IO at the same time as the previous day with trial three plastics bags.
6. Push 48cm long soil extractor (with 2cm diameter) into the soil then twist clockwise. Then continue to push soil extractor into the soil until it reaches the first mark or 15cm.
7. Pull exactor upward and place soil into a plastic bag labeled “Inorganic Trial #1” and the date.
8. Repeat steps 6-7 twice and place first soil sample into a plastic bag labeled “Inorganic Trial #2” with the date and place the second soil sample into a plastic bag labeled “Inorganic Trial #3” with the date.
9. Go to plot O at the same time as the previous day with three plastic bags.
10. Do steps 11-27 on the same day at the same time
11. Repeat steps 6-7 three times, but place the first soil sample into a plastic bag labeled “Organic Trial #1” with the date, the second soil sample into a plastic labeled “Organic Trial #2” with the date, the third soil sample into a plastic bag labeled “Organic Trial #3” with the date.

12. Get 15 ml four culture test tubes. Label each culture tube with “Inorganic Trial 1” and one of the following labels “10^0, 10^{-1}, 10^{-2},10^{-3}” Use each label only once.

13. Use a clean new transfer pipette 10 ml of sterile water to the culture tube 10^0.

14. Use the same pipette to add 9 ml of sterile water to culture tubes 10^{-1}, 10^{-2}, and 10^{-3}.

15. Place 1 cc of the “inorganic Trial #1” soil sample into the "10^0 Inorganic Trial 1” culture tube.

16. Cap the tube and shake vigorously.

17. Using a new clean pipette, remove 1 ml of the soil/ water mixture from the "10^0" tube and place into the "10^{-1}" tube.

18. Cap and shake vigorously.

19. Using the same pipette in step 17, remove 1 ml of the soil/water mixture from the "10^{-1}" tube and place into the "10^{-2}" tube.

20. Cap and shake vigorously.

21. Using the same pipette in step 17, remove 1 ml of the soil/water mixture from the "10^{-2}" tube and place into the "10^{-3}" tube.

22. Cap and shake vigorously

23. Plate 100 µl samples from culture tubes 10^{-3} & 10^{-4} onto their own separate, labeled which type of soil, trial, and date on 3M Petrifilm™ Aerobic Count Plate.

24. Repeat steps 12-23 using each of the bags of soil previously extracted for a total of three trials of each soil type. There should be a total of 12 bacteria 3M Petrifilm™ Aerobic Count Plate plates used.

25. Allow to grow for 48 to 72 hours.

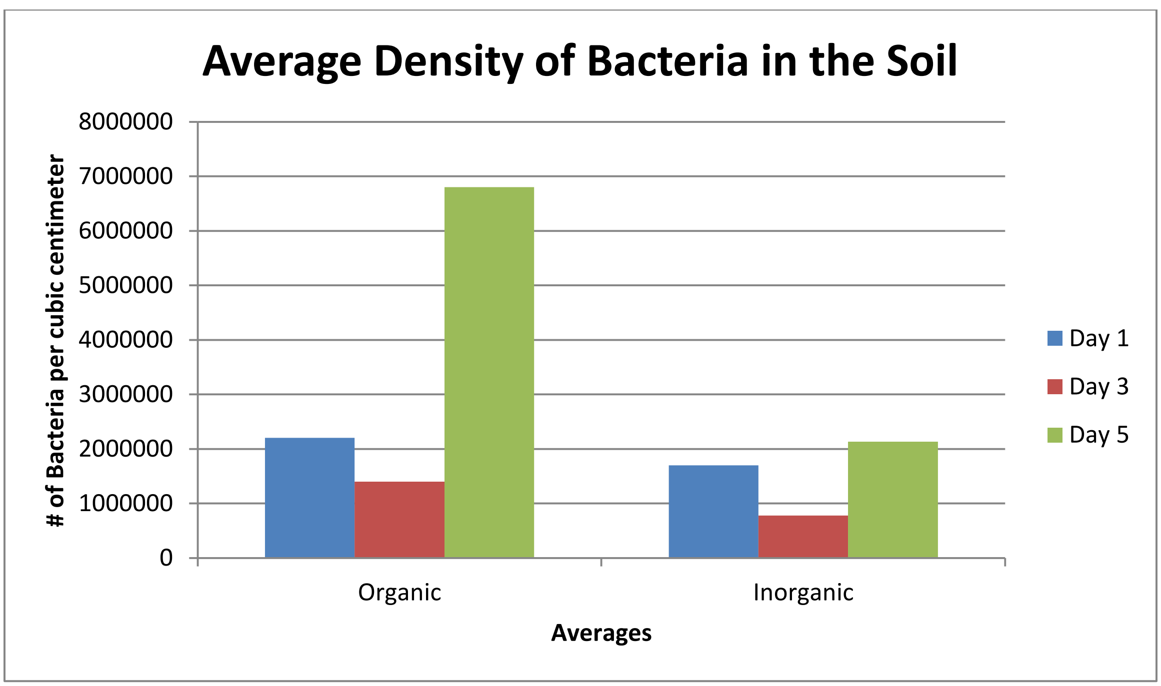
26. Examine each of the plates for individual bacteria colonies and choose the plate with the fewest colonies (but at least 5) and at the lowest dilution to make your estimates of the number of bacteria in the original 1 cc soil sample using the following formula.

27. # Microbes in 1 cc of soil = # Colonies on sheet x 10^2 x $10^{|\text{dilution \# at which these colonies were found}|}$

28. Then record number in a data table.

29. Repeat the steps 12-28 to complete two trials for two more days, going a day in between each set of trials.

Density of Bacteria in Different Types of Soil			
Day soil collected	Trials	Number of bacteria per cubic centimeter of soil	Average Bacteria/cc of soil
Day 1	Organic 1	4100000	**2200000**
	Organic 2	1900000	
	Organic 3	600000	
	Inorganic 1	2600000	1700000
	Inorganic 2	1200000	
	Inorganic 3	1300000	
Day 3	Organic 1	2500000	1400000
	Organic 2	700000	
	Organic 3	1000000	
	Inorganic 1	260000	776667
	Inorganic 2	670000	
	Inorganic 3	1400000	
Day 5	Organic 1	7300000	6800000
	Organic 2	4900000	
	Organic 3	8200000	
	Inorganic 1	1300000	2133334
	Inorganic 2	900000	
	Inorganic 3	4200000	



In our experiment we guessed that the population density of bacteria would be higher in organic soil than in inorganic soil. Our hypothesis was correct because after three days of testing the average population number of bacteria was larger in organic soil than inorganic. Specifically on each day, Day 1, Day 3, and Day 5, the average number was much higher than in the inorganic. For instance on Day 1, the organic average population of bacteria was 2200000, while the inorganic average population of bacteria was 1700000. On Day 3, the average population of bacteria for organic soil was 1400000, compared to 776667 which was the average population of bacteria in inorganic soil. Finally on Day 5 the average amount of bacteria populations were 6800000, while in inorganic the average was 2133334 populations of bacteria. In Conclusion our data proved to us that our hypothesis was correct showing that organic soil had a greater population of bacteria in it than inorganic soil did. If our experiment was continued we would test what type of bacteria is in the population density of organic soil. To test this we would collect organic soil samples and look at them under a microscope to examine the different bacteria colonies. Whichever type of bacteria was most commonly shown, we would study that type of bacteria and learn the benefit it gives to organic soil.

Reference

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