How does the Application of Biochar vs. Artificial Fertilizer Affect Soil Health?

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Background/Motivation

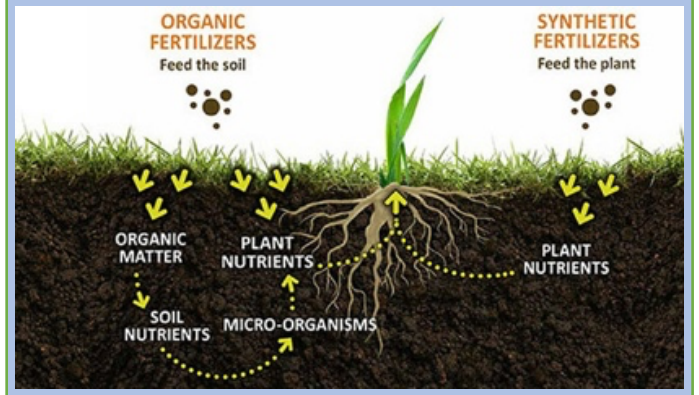
- Soil health is a crucial aspect to consider when growing plants. Produce such as vegetables or perennial and annual crops all heavily depend on soil amendments to grow when the soil is depleted of nutrients. One means to enhance soil health is through fertilizers; fertilizers can be either organic, such as biochar, or artificial. Fertilizers aid in adding nutrients to the soil, as well as affecting the levels of soil organic matter and microbial life, and soil acidity (Singh).
- Biochar is a form of charcoal which is produced through exposing organic matter to heat in an environment with low levels of oxygen and is an organic soil amendment which aids in carbon sequestration; this carbon-fix substance also has the properties of the organic matter burned, such as nitrogen and phosphorus (Rawat).
- Artificial fertilizers also improve soil health by adding nutrients with synthesized chemicals of nitrogen, phosphorus, and potassium. However, the long-term application of nitrogen-rich fertilizer can lead to a loss of soil organic matter through mineralization, as well as a damage to the soil's microbial life (Singh), (Figure 1).
- This study looks at the differences between biochar and an artificial fertilizer source and the effect they have on the soil where they are applied.

Hypothesis

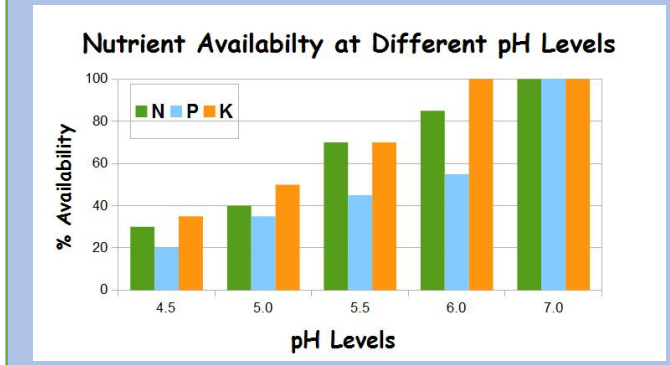
- I hypothesize that there a positive relationship between the application of biochar and the artificial fertilizer and soil health. I hypothesize the fertilizers will benefit the soil where they are applied, and that the site with biochar will have better soil health than the purely synthetic fertilizer site. There will be differences between the two sites, such as the amount of nutrients in the soil, as well as the effect on soil microbial life and the levels of organic matter. If too much of either fertilizer is applied, there will be negative results on the soil and ecosystem health for both locations.

Peaceful Valley Holdings, Inc., 2020.

Zero Waste Family, 2014.



(Figure 1). Fertilizer Production Line, 2020.



(Figure 2). Allotment & Garden, 2020.

Study Design

- I will conduct a field experiment at two different sites at the dimensions of 25 ft^2; this size will make the experiment manageable and not too large or too small in scale. For both plots, I will use loam-based soil, which is the most common and ideal type of soil for a variety growing plants; having the same soil type is important to make sure the basis of the study is consistent, although it reduces randomization. Each site represents the dependent variable and will be given the independent variable of biochar or artificial fertilizer as a soil supplement. I will also have a control plot where no fertilizer is added. The goal of this study is to see how the soil compositions change with the addition of different fertilizers. An example is the soil pH, which can be affected by nutrient-based fertilizers like most artificial ones; the soil pH changes the availability of other soil nutrients like phosphorus and potassium (Figure 2).

Intended Analysis

- The data types I will be measuring are continuous; things like the levels of chemicals/nutrients in the soil, the soil acidity, and microbe levels will be measured and compared to the control plot.
- Because I am measuring two categories, the application of organic biochar and the artificial fertilizer, I will use a T-Test to measure the differences between the fertilizers and see if the results are statistically significant with the solved p-value.

Literature Cited: *Biochar effects on soil biota – A review, Soil Biology and Biochemistry, https://doi.org/10.1016/j.soilbio.2011.04.022. El-Naggar, A., El-Naggar, A. H., Shaheen, S. M., Sarkar, B., Chang, S. X., Tsang, D. C. W., Rinklebe, J., & Ok, Y. S. (2019). Biochar composition-dependent impacts on soil nutrient release, carbon mineralization, and potential environmental risk: A review. Journal of Environmental Management, 458–467. https://doi.org/10.1016/j.jenvman.2019.02.044. Glaser, B., Wiedner, K., Seelig, S., Schmidt, H.-P., & Gerber, H. (2015). Biochar organic fertilizers from natural resources as substitute for mineral fertilizers. Agronomy for Sustainable Development, 667–678. https://doi.org/10.1007/s13593-014-0251-4. Rawat, J., Saxena, J., & Sanwal, P. (2019). Biochar: A Sustainable Approach for Improving Plant Growth and Soil Properties. https://doi.org/10.5772/intechopen.82151. Singh, B. (2018). Are Nitrogen Fertilizers Deleterious to Soil Health? Agronomy, 8(4), 48. https://doi.org/10.3390/agronomy8040048*