CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
31081

Project Title
Biochar and Acid Rain

Abstract

Objectives/Goals
Biochar is the porous carbon residue left over from burning biomass by pyrolysis, a low oxygen, high temperature process. When added to the soil, biochar helps retain nutrients and enhances plant growth. Acid rain, or acidic precipitation, leeches nutrients out of the soil and decreases plant growth. My objective was to learn if biochar mitigates the harmful effects of acid rain.

Methods/Materials
I used hydrochloric acid and sodium acetate to make my acidic solution. For my biochar, I crushed charcoal made by pyrolysis. I set up an experiment with four different treatments: potting soil watered with H2O, potting soil watered with my acidic solution (pH 4.3), biochar with H2O, and biochar with the acidic solution. I grew plants in these treatments for approximately one month. I also took the nutrient and pH levels at the beginning and end of the experiment.

Results
I discovered that the acid treatment had a negative effect and reduced the final biomass and the pH of the potting soil. The biochar (no acid) treatment had a positive effect and increased both the pH of the soil and the plant biomass. The acid plus biochar treatment did not have as reduced biomass as caused by the acid alone.

Conclusions/Discussion
Overall, biochar alone had a positive effect and, as expected, enhanced plant growth. My results also indicate that biochar did slightly mitigate the effects of acid on plant growth. The biochar plus acid treatment also retained a lot of nutrients, but curiously, lowered soil pH more than acid alone. I also found that the root weight was the exact opposite of the results for plant biomass, with potting soil and acid having the largest roots and biochar with H2O having the smallest. I concluded that this was because the roots had to go deeper into the soil to access the nutrients the acid was leeching out.

The pyrolysis process is carbon negative, meaning that the biomass that is burned retains the carbon that it collected while the plant was alive, instead of releasing it back into the atmosphere. Biochar is an excellent way to sequester carbon dioxide in the ground, and, if it is made on an industrial scale, biochar could help fight climate change. Biochar, as shown in this experiment may also help mitigate the effects of acid rain.

Summary Statement
I conducted an experiment to examine whether biochar could mitigate the effects of acid rain on plant growth.

Help Received
To conduct this experiment, I used Professor Grant Pogson's lab at UC Santa Cruz. He helped me with making my acidic solution and let me use his pH meter and scale.