Dr. James Girard Summer Undergraduate Research Program Faculty Mentor Project Application

Microbial Activity of Rhizosphere in Soils Amended with Biochar Produced from Different Species of Invasive Plants

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Abstract

 The program supported the mobility of students from Lewis University to travel to Colombia and learn from scientists and leaders in sustainable agricultural practices. In turn, students from the Universidad de La Salle in Bogota travelled to the United States and learned advanced techniques in microbiology to study soil microbes. The project shared in this proposal will use methods developed by this group to produce biochar and test its effects on the soil microbes of the rhizosphere. The rhizosphere plays a

The work proposed in this summer undergraduate research experience will examine the microbial activity of the rhizosphere supplemented with biochar, which will be produced by the method developed by this group, using leaves from different invasive plants as its feedstock. The chemical composition of leaves (total nitrogen and carbon, soluble and polymeric sugars, organic acids, and minerals) varies among different species of plants [11]. It has been determined that biochar produced from different feedstocks have different properties due to the differences in the chemical composition and physical structures of the plants [12]. Specifically, this project will examine if there are differences in the microbial activity of the rhizosphere when supplemented with biochar produced from different invasive plant species. Microbial

Approach/Methodology

Overview

Biochar will be produced using the leaves of invasive plants readily available in the area, such as Canadian thistle, Cirsium arvense, and the common reed, Phragmites sp., which differ in terms of chemical composition and physical structure. Laboratory experiments will be conducted where soil will be supplemented using the different biochar products. The soil from the rhizosphere will be collected from experimental and control pots. The DNA will be extracted from soil samples and the microbial communities profiled using ribosomal intergenic spacer analysis (RISA). Microbial metabolic activities will be examined by comparing carbon utilization of the soil communities using EcoPlate (Biolog, Inc.). Bacterial and fungal densities in the soil samples will be determined using standard microbiological techniques for estimating the number of microorganisms in a sample.

Biochar Production

Biochar will be produced using the method developed by the Lewis University-Universidad de La Salle research team in 2023. Plants will be collected, and the leaves will be cut into small pieces, which will then be dried. The dried leaves will be converted into biochar using a muffle furnace by subjecting the material to a temperature of 450°C for 25 minutes.

Experimental Setup

Soil will be collected from the native prairie plot next to the Science Center and sifted to remove plant debris and rocks. The soil will be supplemented with biochar produced from different invasive species. A treatment with no biochar supplements will serve as a control. Agricultural crops, such as lettuce, onion, soybean, and cilantro,

EcoPlate for analysis of community metabolism The utilization of carbon substrates by

Regarding the proposed research, the hypothesis is supported if we observe differences in the microbial activity of the rhizosphere based on the source of the biochar. The student is expected to present their findings at the Celebration of Scholarship in April 2025 and at a discipline specific scientific meeting during the 2024-2025 academic year.

References

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Description of other funding you will be using related to your proposed research (Doherty Grant, Lasallian Research Grant, External Research Grant, Caterpillar Grant, etc.) and how it will be used in this project, if applicable. Indicate which aspect(s) of the project will be completed with SURE funding.

Most of the lab supplies were already purchased for the program, Environment, and Food for Life.

Preferred coursework includes Genetics and General Microbiology with labs.

List of seminar topics you are willing to cover (Selecting from list below or suggesting your own):

- o Ethics in Research/Scholarship
- o Literature Search and Library Resources
- o Problem-