A COMPARISON OF HOW COFFEE GROUNDS AND BIOCHAR AFFECT SOIL FERTILITY FOR GROWING CHINESE CONVOLVULUS

RESEARCHERS: MISS CHALITA SUPANCHART, MISS CHANITSARA SINGHKRA, MISS EMILIE KANTICHA, MR. WONGSATHON CHAISAK, AND MISS CHUTIKARN WORRARATKUL
LEVELS: UPPER PRIMARY
ADVISORS: MISS RATTANAPORN WAENPHET, MISS KUNTALEE PANIN, MR. KANTAPAT THAPINTA, MR. SUPPASIT KIATPATTANANON
SCHOOL: VAREE CHIANGMAI SCHOOL, MUEANG, CHIANG MAI

Abstract

As the use of organic materials in agriculture to improve soil fertility can be beneficial, most farmers rely on biochar for soil improvement before planting. Due to high consumption of coffee in their school, the researchers were interested in studying and comparing the effects of different proportions of coffee grounds and biochar on soil fertility and the growth of *Chinese Convolvulus*. The study was conducted in seven experimental plots within the school premises which had different amount of biochar and coffee grounds. The soil structure in all plots was similar, characterized by dark brown, loamy soil with high crumbliness. Temperature and soil moisture were inversely related; higher temperatures corresponded to lower moisture levels and vice versa. Plots with coffee grounds and biochar retained moisture better than those without.

Chemically, the soil pH was lowest in the soil-only plot (pH 4), indicating higher acidity compared to plots with coffee grounds and biochar (pH 5). Nutrient analysis revealed low nitrogen (N) content in soil-only plots, moderate levels of phosphorus (P) and potassium (K). Plots with coffee grounds had low N but high P and moderate K levels. Biochar plots had low N, moderate P, and high K levels. These nutrient levels affected the growth of Chinese Convolvulus. During weeks 1-6, Chinese Convolvulus plants grown in plots with 10% biochar exhibited the highest growth. The soil-only plot demonstrated the lowest growth after 6 weeks of cultivation.

Upon measuring the fresh weight of Chinese Convolvulus plants, it was found that plots with 10% biochar and 5% coffee grounds had the highest weight (0.40 kilograms) with the soil-only plot had the lowest weight (0.32 kilograms). Overall, mixing coffee grounds and biochar in suitable proportions improved soil fertility, increased nutrient levels, and promoted plant growth.

Keywords : coffee grounds, biochar, Chinese Convolvulus, soil fertility , nutrients in soil, nitrogen (N), phosphorus (P), potassium (K)

Introduction

Soil is crucial for the growth of plants and agriculture. Plants rely on soil for root anchorage, water retention, air supply, and nutrients necessary for growth and productivity. If the soil is fertile, it positively impacts the growth of plants and increases yields for farmers. Currently, the soil in the local area exhibits physical and chemical properties that are not suitable or less suitable for cultivation, causing plants to grow and produce yields below normal levels. This is primarily due to naturally occurring soil types such as saline soil, excessively acidic soil, and soil deficient in organic matter. These conditions can severely impact the ecosystem and the environment. If these soils are to be used for crop cultivation, it is necessary to improve the soil before planting. The use of organic materials in agriculture to improve soil has physical and chemical implications for soil fertility. Plants can utilize these materials for growth. Typically, farmers use organic materials such as biochar to amend soil before planting. It is also often used as a planting medium mixed with soil for container gardening.

At V Café in Varee Chiangmai School, there is a large quantity of coffee grounds generated as waste from the coffee extraction process. Therefore, we were interested in utilizing coffee grounds as organic material in agriculture to improve soil before planting. We conducted a comparative study on the effects of different ratios of coffee grounds and biochar on soil fertility for the growth of *Chinese Convolvulus*. It was expected that the results would promote efficient and highly effective resource utilization.

Objectives

1.To study and compare the effects of different ratios of coffee grounds and biochar on soil fertility.
2.To study and compare the effects of different ratios of coffee grounds and biochar on the growth of Chinese Convolvulus.
3.To disseminate the comparative study findings as agricultural data for the school and community.

Question

Do different ratios of coffee grounds and biochar affect soil fertility and the growth of *Chinese Convolvulus*? If so, how?

Hypothesis

Different ratios of coffee grounds and biochar have varying effects on soil fertility and the growth of *Chinese Convolvulus*.

Acknowledgement

This Comparative Study of the Effects of Coffee Grounds and Biochar on Soil Fertility for the Growth of Chinese Convolvulus was successfully completed with generous support and convenient facilities provided throughout the research period by Mrs. Varee Patravanich, the Director of Varee Chiangmai School. Special thanks to Miss Rattanaporn Waenphet and Miss Kuntalee Panin, project advisors, for their valuable advice and guidance in successfully completing the research project. Much appreciation to Mr. Sanya Chaoonchom, Miss Sirinya Tualue, the technology teachers for their guidance in developing the equipment for measuring soil temperature and moisture. Gratitude to Miss Kritsiya Ukarin Morya, the science laboratory supervisor, for assisting in preparing materials and equipment for soil testing in the laboratory, and to the parents of the students for their support and encouragement, serving as a source of motivation throughout the excellent execution of the project.
On behalf of the research team, we would like to express our heartfelt gratitude to all authors of academic papers from books, journals, websites, as well as research data from everyone that the researchers have referenced in this study. We humbly extend our highest appreciation for the invaluable contributions made to our research.

Materials and Equipment

1. Chinese Convolvulus seeds
2. Seven experimental plots
3. Pointed trowel
4. Classification by Touch Field Guide/ Soil structure handbook
5. Soil color comparison book
6. In-house air temperature and soil moisture sensor
7. Measuring tools such as a ruler, vernier caliper, and weighing scale
8.Soil testing kit for pH, Nitrogen, Phosphorus, and Potassium values (Hanna HI 3895)

Methodologies

1. Prepare seven experimental plots measuring 0.5 meters x 1 meter
2. Prepare coffee grounds and biochar mixed into the soil for experimental plots 2-7 according to the specified ratios of 5%, 10%, and 15%, respectively.
3. Create equipment for measuring air temperature, air humidity, soil temperature, and soil moisture using ESP32 NodeMCU Devkit ESP32 DEVKIT WiFi and Bluetooth board and various sensors. Program the device to record data every 1 hour to collect information for analyzing the differences in temperature and soil moisture within the experimental plots.
4. Collect soil samples and measure the physical and chemical properties of the soil, such as soil pH values and the levels of nitrogen, phosphorus, and potassium, before planting.
5. Sow Chinese convolvulus seeds in the experimental plots, with each plot receiving 150 seeds. Record the growth of the Chinese convolvulus over 6 weeks, including height and stem circumference, using tools such as a vernier caliper.
6. Enter the collected data into the GLOBE Data Entry system and analyze and compare it with other data.
7. Collect biomass data by measuring the fresh weight of the plants. Analyze the data, summarize the findings, and provide discussions.

Findings

1.The soil structure was in the form of round clumps, dark brown in color, and loamy in texture across all 7 plots, showing no significant variation.
2.Using temperature sensor equipment, the lowest average air temperature recorded was 25 degrees Celsius, observed in the plot with 10% coffee grounds, while the highest average moisture content was 36 degrees Celsius, observed in the plot with 10% coffee grounds.
3.The pH level was acidic, with a pH of 4 in the soil plot and pH 5 in both the 10% coffee grounds plot and the biochar plot.
4.The quantities of nitrogen, phosphorus, and potassium in the soil were all low. In the coffee grounds plot, nitrogen was low, phosphorus was high, and potassium was moderate. In the biochar plot, nitrogen was low, phosphorus was moderate, and potassium was high.
5.The growth of Chinese convolvulus was measured in terms of height and stem circumference. The plot with 10% biochar exhibited the best growth.

Conclusion and Discussion

It was found that the optimal mixture of coffee grounds and biochar contributes to the chemical fertility of the soil, resulting in increased nutrient levels in the soil. Specifically, the soil mixed with coffee grounds showed higher phosphorus levels, while the soil mixed with biochar exhibited higher potassium levels. This has implications for plant growth. When measuring the fresh weight of Chinese convolvulus grown in different plots, it was observed that the plot with 10% biochar and the plot with 5% coffee grounds had the same fresh weight, which was 0.40 kilograms, the highest among all plots. Therefore, the appropriate ratio of coffee grounds and biochar may serve as an alternative organic material for farmers to amend and nourish the soil before planting, thereby promoting plant growth and increasing agricultural yields. From the study, we communicated agricultural knowledge within the school and community by creating brochures and summary videos of the research findings. These materials serve as guidelines for farmers to use in amending and nourishing the soil before planting, thereby promoting plant growth, increasing agricultural yields, and potentially reducing cultivation costs through the use of coffee grounds.

References

The World Education Fashion for Environmental Development, Institute for the Promotion of Teaching Science and Technology Education. (2019). Integrated Earth Science, Key Stage 2. (1st Edition). Intereducation Supplies.
Sutha Thongkaew. (2016). The effect of coffee grounds fermented with EM (Effective Microorganisms) on the growth of Chinese convolvulus. Northern Vocational Education Institute 1, Chiang Mai Agricultural and Technology College.