An Effect of Different Types of Ground Cover Plants on Soil Temperature and Moisture

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Abstract

Continuous climate change over the years has impacted various aspects of the Earth, including soil quality, leading to its degradation. To address this issue, one widely adopted solution is the use of ground cover plants, which help preserve topsoil, retain moisture, and regulate soil temperature, preventing excessive heat. A survey of the school revealed that several types of ground cover plants were cultivated around large trees, prompting the researchers to study how different types of ground cover plants affect changes in soil temperature and moisture. The study aims to provide insights into selecting the most suitable ground cover plants for effective soil management.

A comparative study of four types of ground cover plants—Manila grass, Kyoto dwarf, Ceylon myrtle, and Spanish shawl—was conducted to assess their effects on changes in soil temperature and moisture during the day using custom-built equipment. The findings revealed that Spanish shawl was the most effective at maintaining stable soil temperature, followed by Ceylon myrtle, Kyoto dwarf, and Manila grass, respectively. Conversely, Manila grass was the best at retaining soil moisture, followed by Ceylon myrtle, Spanish shawl and Kyoto dwarf. Overall, Ceylon myrtle demonstrated the highest ability to maintain both soil temperature and moisture, followed by Spanish shawl, Manila grass, and Kyoto dwarf. These differences are likely influenced by factors such as stomatal structure and stomatal density. In conclusion, different ground cover plants have varying capacities to regulate soil temperature and moisture, depending on their leaf structures and plant characteristics. Selecting appropriate ground cover plants can significantly enhance soil preservation and management.

Keywords: ground cover plant, soil temperature, soil moisture, air temperature, air humidity

Introduction

It is well known that the ongoing climate change over the past several years has impacted various components of the Earth in multiple ways. For instance, average temperatures in different regions have risen, rainfall patterns and distribution have shifted, extreme weather events have become more frequent, and droughts have posed significant challenges to water management. Soil quality has also been directly affected. One key factor contributing to soil degradation is the widespread alteration of land cover, including urban expansion, deforestation for housing development, and the cultivation of cash crops. These activities have led to severe soil deterioration. Experts from the UN have warned that if soil degradation is not addressed, topsoil could be entirely depleted within 60 years. By 2050, usable soil is projected to decrease to only one-quarter of what was available in 1960 (Climate Change Adaptation Information Center of Thailand, 2022)

Soil quality improvement and maintenance can generally be achieved through various methods, with one of the most popular being the cultivation of ground cover plants. This method helps protect topsoil, retain soil moisture, and regulate soil temperature, preventing it from becoming excessively high. Additionally, many ground cover plants contribute to enriching the soil with nutrients. A survey of the school revealed that several types of ground cover plants are planted around large trees. This prompted the research group to study the effects of different ground cover plant species on soil temperature and moisture changes, aiming to provide guidelines for selecting suitable ground cover plants (Palintu Wutichatiwanich, 2015).

Hypothesis

The soil temperature and moisture under different types of ground cover plants will exhibit varying changes throughout the day

Objectives

1. To measure the changes in the air temperature and humidity, as well as soil temperature and moisture, over a 24-hour period.
2. To compare the effects of different types of ground cover plants on changes in soil temperature and moisture.

Equipment for Studying Leaf Structure

1. Microscope
2. Plastic Petri Dishes
3. Glass slides and cover slips
4. Forceps
5. Droppers
6. Measuring Cylinder
7. 200-ml Preserves Jar
8. Tissue Paper
9. Paintbrush
10. Distilled Water
11. 6% Sodium Hypochlorite Solution
12. Safranin O stain

Materials and Equipment

1. Arduino UNO R3 Board
2. Breadboard
3. Air Temperature and Humidity Sensor (DHT22 ASAIR AM2302)
4. Waterproof Soil Temperature Sensor (DS18B20)
5. Resistive Soil Moisture Sensor
6. Micro SD Card Module and Micro SD Card – For data storage and logging
7. Jumper Wires
8. Power Bank

Research Methodology

1. Identify four research sites under large trees with different ground cover plants, including two monocots (Manila grass and Kyoto dwarf) and two dicots (Spanish shawl and Ceylon myrtle)
2. Assemble equipment using the Arduino Uno R3 board and sensors to measure air temperature around leaves, as well as soil temperature and moisture. Program the devices to record data every 10 minutes and test the system before installation at the designated study sites.
3. Test the code before installing it to collect data at the designated study sites, ensuring that the device records data at each site continuously for at least 24 hours
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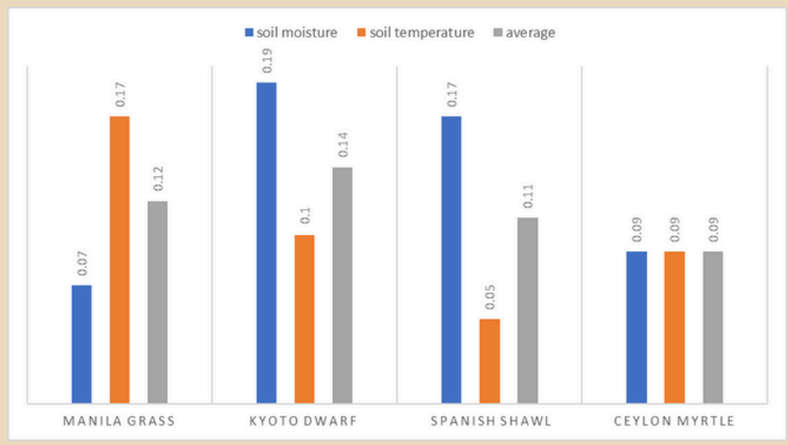
5. Examine the leaf structures of each type of ground cover plant under a light microscope. Use this information to analyze correlations with air temperature, soil temperature, and soil moisture data collected.
6. Analyze the data to compare the effects of each ground cover plant on changes in soil temperature and moisture, and the relationship between the leaf structure of each plant and the changes in soil temperature and moisture
7. Discussion and Conclusion

Conclusion and Discussion

The results from measuring changes in air temperature, soil temperature, and soil moisture using the custom-made Arduino board and various sensors at the research sites with four different ground cover plant species (two monocots and two dicots) are shown in the graph below. It was found that the temperature and humidity of the air fluctuate more easily throughout the day, while the temperature and humidity within the soil remain relatively stable. This can be observed in the graph showing the standard deviation data of temperature and humidity changes in the soil during the daytime period (6:00 AM - 6:00 PM), with the degree of variation increasing as follows.



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