Report

Template

Title of Project:

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Table of Contents

List the sections of your paper and the page numbers where they begin. This is the only thing that should go on page 2 of your research paper.

Abstract

Write a brief description of the report (maximum 250 words) that summarizes the project's purpose, hypothesis, procedures, principal results, and conclusions.

This report and research was performed to discover the relationship between the temperatures of soil and air and how they affect each other. Throughout our experiments, we noticed very few discrepancies. The

air directly affected the soil temperature as its own temperature fell throughout the season. During the founding of our first ideas, we had believed that the air temperature would critically affect the soil temperature. We followed strict and precise procedures to collect our data, surveying similar spots in the ground each time we collected the soil temperature. Our results did indeed confirm said hypothesis. The results stated that the air temperature affected the soil temperature directly. This allowed us to draw conclusions that as the air temperature raised or lowered, the soil temperature would follow similar trends of changing temperatures.

Introduction

On some clear sunny days, the ground temperature will be much warmer than the air temperature. On the contrary, clear days during the winter can result in ground temperature being much less than the air temperature (Cliff Mass Weather Blog). The conditions of the weather can greatly effect how the temperatures of soil and air change with each other. We made sure to measure the differences in soil and air temperature. Before our tests, we made sure to question how the two temperatures might affect each other; How does air temperature affect soil temperature over time? After doing some research, we found that many studies came to the same conclusion, that air temperature correlates well with soil temperature (University of Montana).

During our temperature tests, we formed the hypothesis that the soil temperature will increase in direct proportion to air temperature, with higher air temperatures leading to higher soil temperatures. We believed this as we saw a quote by a Purdue University Extension corn specialist Bob Nielson “It’s all about the sun hitting the soil surface” (Farm Progress). We also read about how heat conduction is the reason air temperature is related to soil temperature. We read that heat conduction, in this case the transfer of heat from the air to the soil and vice versa, is dependent on air–soil temperature gradients (Science Direct). Another interesting fact we found from the New Jersey Agricultural Society is that soil does a much better job of storing heat than air does. The heat is trapped by many different variables like vegetation, snow, and the top of the soil. This insulation also increases as the depth of the measurements increase. This is actually how most creatures tend to survive during the cold winters; The heat trapped by all of the variables keeps the organisms warm (New Jersey Agricultural Society).

We performed this experiment through a procedure we followed, using the same measurement tools every time. We found the air temperature from the same source each day, and recorded it. We also used a soil temperature probe, roughly six inches long, to measure the temperature of the soil. We measured five different places each day, recording the maximum temperature as well as the minimum temperature. Then we compared the results.

After much researching and testing, we learned many new intriguing ideas about the ways that air and soil temperature affect each other. We believed that while air temperature does affect the soil temperature, it does not affect it fast, the soil would change very slowly from the air. Another conclusion that we thought of was that most of the soil measurements could be very precise and close to each other. Meaning, much of the ground tested had relatively the same temperatures that were being affected by the air. Overall, this

experiment was very educational and allowed us to use our knowledge and skills to come to a scientific conclusion.

Methods and Materials

Materials:

You will need a thermometer that will measure soil temperature, a thermometer to measure air temperature,

and a recording sheet for the data

Procedure:

1. Check the air temperature on the thermometer or any device that the temperature is displayed on

2. Record the data in the day 1 box

3. Repeat for however many days you are composing this experiment

4. Grab a Lavatools Javelin® PRO Duo Ultra-Fast 1-Second Professional Digital Instant Read Thermometer and locate a general area of soil to measure

5. Stick the thermometer into the chosen area and let it sit for a few seconds

6. Once the thermometer has measured a stable temperature after sitting, record the measurement into the table

7. After the first measurement is recorded, locate a new spot in the general area of the first measurement and repeat steps 5 and 6

8. Repeat the soil temperature measurement steps until the desired amount of measurements have been made and recorded

9. Use this same procedure the next day measurements are taken and recorded, putting the data into the correct day box

Be sure to identify any potential risks and safety precautions needed.

State any statistical tests you will use to analyze your data. Describe the number of trials you ran and the sample size. Always state the number of trials as (N = number).

Presentation of Data and Results

Multi-Day Min/Max **Air** Temperature

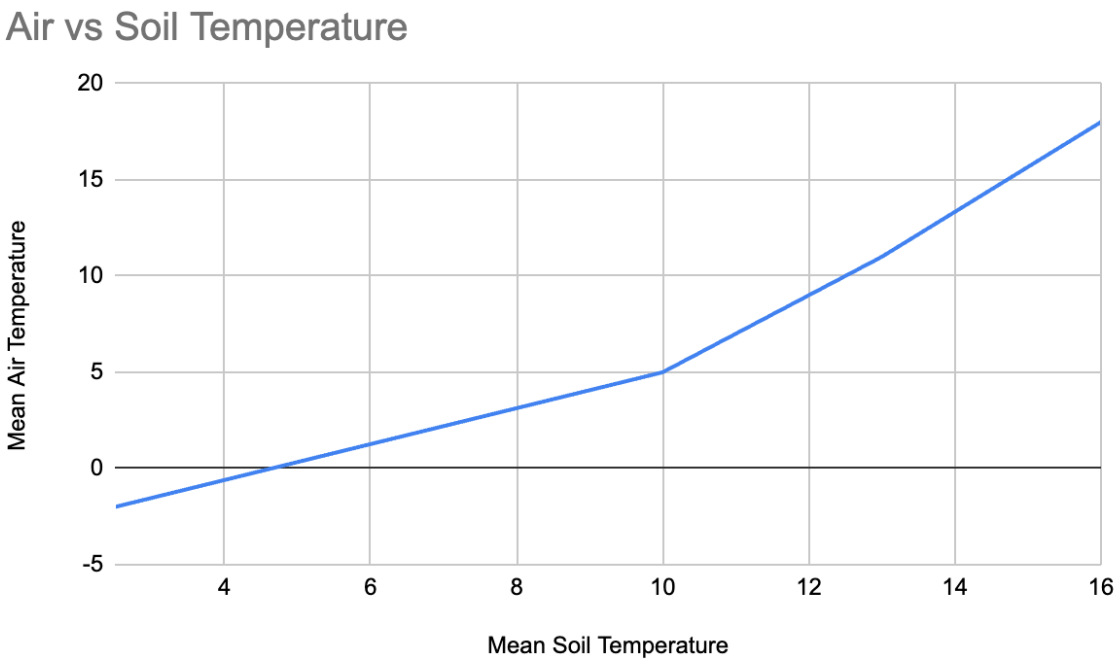
Label on Thermometer Display	Corresponding Date	Minimum Temperature (oC)	Maximum Temperature (oC)
N1	11/7/24	18	18

N2	11/13/24	11	11
N3	11/26/24	5	5
N4	12/6/24	-2	-2

Multi-Day Min/Max **Soil** Temperature

Label on Thermometer Display	Corresponding Date	Minimum Temperature (oC)	Maximum Temperature (oC)
N1	11/7/24	15	17
N2	11/13/24	11	15
N3	11/26/24	8	12
N4	12/6/24	1	4

Comparing the air and soil temperatures on their corresponding dates, an observer would find some interesting occurrences. On the warmer days, it seemed like the soil temperature was closer to the air temperature, while on the colder days, it seemed like the air temperature was closer to the soil temperature. This could make sense as the soil would take longer to change temperature the colder it was. Also, the ranges were commonly in only 2 - 4 oC difference, which we found surprising. These observations were interesting, but can be explained by our research.



Analysis and Results

A common way to start the Discussion is "My findings suggest…"; "This study demonstrates…"; "These results suggest…"; etc. In the discussion you will interpret your results in detail.

Include statistical analysis of the data. Explain any mathematics and equations that were used in the analysis.

Then, connect your interpretation of your results with your hypothesis. Restate your hypothesis. Compare your results with results from other studies. Explain if your results supported or did not support your hypothesis (are the results what you thought they would be or not?)

Provide a scientific analysis of why you think you obtained these results. (Use information from your background research to support your reasoning).

Discuss experimental errors and offer ideas for improvements. Be sure to account for and discuss the uncertainties in the data set.

Connect the results back to your hypothesis. (Did your experiment accurately test your hypothesis?)

Conclusion

After our research, we came to the conclusion that as air temperature decreases, the soil temperature does the same along with it. We noticed that the air temperature would be significantly cooler than other days and when it was, the soil would show a drop in temperature in our measurements. Even while measurements in different regions of our area, the trend of the two temperatures still continued.

Discussion

Some improvements that could be made for this project if repeated in the future could be using a more accurate measuring tool. With the research of this project, it could be impact the area by showing whether or not it would be a great time or place to build a structure or plant something to help nature.

Acknowledgements

Credit those who assisted in the research, including individuals, businesses, and educational or research institutions

- Dr. Kreischer Gajewicz - Our teacher who helped us and explained the way we should do our project. She also provided us with the materials needed to collect our data.

References

Bechman, T. J. (Ed.). (2017, May 31). *7 facts you didn't know about soil temperature*. Farm Progress. Retrieved January 31, 2025, from https://www.farmprogress.com/crops/7-facts-you-didn-t-know-about-soil-temperature

Bramer, I., & Gillingham, P. K. (2008). *Conductive heat transfer*. Science Direct. Retrieved January 31, 2025, from https://www.sciencedirect.com/topics/earth-and-planetary-sciences/conductive-heat-transfer

New Jersey Agricultural Society. (n.d.). *Comparing soil and air temperature*. New Jersey Agricultural Society Learning Through Gardening Program. Retrieved January 31, 2025, from https://www.njagsociety.org/uploads/1/7/0/5/17057112/comparing_soil_and_air_temperature_lesson_plan_ls_wb.pdf

Soil temperatures and gardening. (2012, May 6). Cliff Mass Weather Blog. Retrieved January 31, 2025, from https://cliffmass.blogspot.com/2012/05/soil-temperatures-and-gardening.html#:~:text=During%20sunny%20days%2C%20ground%20temperatures,8F%20cooler%20than%20air%20temperature.

Zheng, D., Hunt, R., Jr., & Running, S. W. (1993, July). *A daily soil temperature model based on air temperature and precipitation for continental applications*. ScholarWorks at University of Montana. Retrieved January 31, 2025, from http://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1329&context=ntsg_pubs#:~:text=Air%20temperature%20correlates%20well%20with,is%20less%20for%20cloudy%20days.