Synergistic garden ecosystems as climate stabilizers

a temperature analysis using the soil temperature Globe protocol

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Abstract

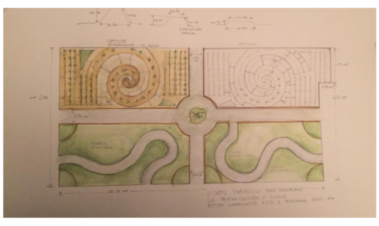
This study evaluates the SYNERGISTIC garden's role in climate resilience and soil biodiversity using the GLOBE Soil Temperature Protocol. By comparing findings with DIFFERENT SOILS, we explore its potential as a sustainable solution against climate change, focusing on temperature stability. Our research contributes valuable insights for resilient agriculture amid climate change, emphasizing careful site selection to address water accumulation issues. Preliminary observations highlight less variability at the 5 cm depth, affirming the synergistic garden's buffering function against temperature fluctuations. FUTURE PLANS include a summer season analysis to enhance understanding, aiming to bridge critical knowledge gaps and lay the foundation for sustainable agricultural practices in changing climates.

Research question

How does the temperature regulation of the synergistic garden compare to that of the surrounding school grounds, and what are the potential correlations between specific land uses and microclimate variations in an educational environment? Additionally, how does the design and composition of the synergistic garden contribute to temperature stability, and what broader implications does temperature regulation have for the overall biodiversity and ecological health of the synergistic garden?

Introduction

In recent years, a surge in extreme weather events has heightened concerns about their profound impacts on ecosystems. Research, such as that by Huang et al. (2023), underscores the pivotal role of plant diversity in mitigating climate change consequences by enhancing productivity and ecosystem stability. Despite recognizing soil temperature's importance in governing essential ecosystem processes, a critical gap exists in understanding whether plant diversity acts as a buffer against soil temperature fluctuations during long-term community development. Motivated by this gap, our research aims to investigate whether a similar cushioning effect is present in the synergistic garden ecosystem.



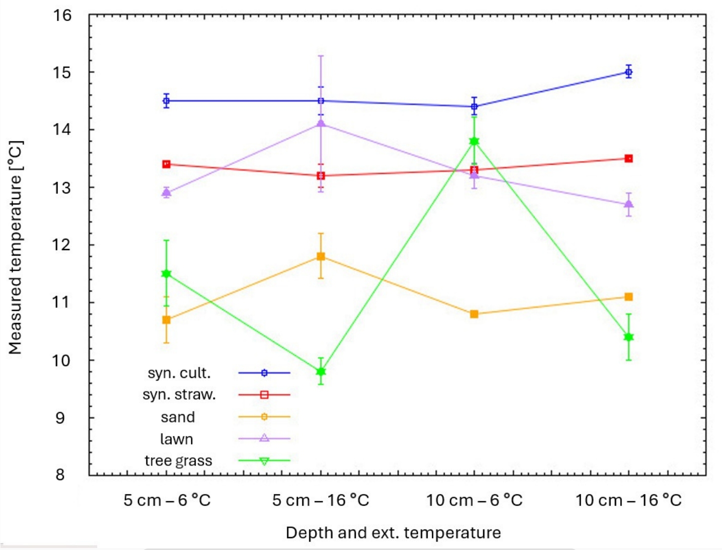
The synergistic garden's unique characteristics, marked by intentional plant diversity and diverse planting strategies, offer an intriguing setting to explore whether the observed diversity-induced stabilization of soil temperature could mitigate adverse impacts of extreme climatic events, such as soil carbon decomposition, thereby contributing to slowing down global warming. This study seeks to bridge existing knowledge gaps and unveil potential applications of plant diversity for climate resilience in agroecological systems, specifically within the synergistic garden framework. Building upon existing literature, our research extends insights into a new context, examining the long-term effects of plant diversity on soil temperature fluctuations. The synergistic garden, with its intentional mix of plant species, emerges as a potential model for enhancing climate resilience. By unraveling the mechanisms underlying plant diversity's impact on soil temperature stability, we aim to provide valuable contributions to agroecological practices. This exploration not only enriches our understanding of ecosystem dynamics but also holds promise for practical applications in sustainable agriculture, reinforcing the synergistic garden's role in climate change mitigation.

Research methods

To pursue our research, students initially selected soil temperature monitoring sites to compare temperature variations between the synergistic garden and other representative soil types in the vicinity of Assisi 3 Middle School, within the comprehensive institute. Following the Hobo data logger protocol for measurements at 5 cm and 10 cm depths, 15 measurements were taken at each site under cloudy weather conditions, ranging from 6°C to 16°C. The students recorded the data in a spreadsheet and subsequently processed the information. To compare the values obtained at the selected sites, average temperatures were used.

Results

	Result 5 cm T ext 6°C	Result 5 cm T ext 16°C	Result 10 cm T ext 6°C	Result 10 cm T ext 16°C
Syn cultivar	14,5	14,5	14,4	15
Syn strawberry	13,4	13,2	13,3	13,5
Sand	10,7	11,8	10,8	11,1
Lawn	12,9	14,1	13,2	12,7
Tree grass	11,5	9,8	13,8	10,4



Discussion

Our findings indicate that synergistic soil stabilizes temperature by reducing variability. Unexpectedly, the temperature at 10 cm depth increased for sand and grass, attributed to rainy winter months. Monitoring this trend with rising air temperatures may reveal insights into soil temperature fluctuations. However, a significant challenge in the synergistic garden is the soil's chemical composition, with an initial pH exceeding the optimal range. Reassessment is crucial for optimal growing conditions. Pest infestations pose health risks, requiring effective management. Future synergistic cultivation should implement measures to control and mitigate these risks, ensuring a sustainable and healthy environment for crops and humans.

Conclusion

In conclusion, our research on synergistic cultivation has provided valuable insights into the temperature maintenance capabilities of this soil type under various conditions. The data from our sampling clearly support the hypothesis that synergistic soil exhibits a remarkable ability to sustain temperature, showcasing the biodiversity within and contributing to reduced carbon degradation. The stability of subsurface temperatures in synergistic soil plays a crucial role in mitigating temperature-related carbon loss. While our synergistic garden demonstrates promising features such as temperature stability and biodiversity, addressing challenges like soil pH and pest control is crucial for the continued success of this innovative cultivation method. Our findings underscore the importance of ongoing monitoring and adaptation to ensure the long-term sustainability of synergistic farming practices.

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I **am a scientist**

The report incorporates a thorough examination of data collected and processed by students using spreadsheet software, aiming to determine the mean value and standard deviation. Additionally, students engage with data sourced from the Department of Civil and Environmental Engineering, Laboratory of Agricultural Chemistry, Biomass Chemistry for Agricultural use.

I **am an impact**

This project was carried out by students during both curricular and extracurricular hours, with the collaboration of multiple teachers. The synergistic garden was created with the assistance of local farmers and holds significance in the context of agriculture for the conversion of unused land in the area.

I **am a stem storyteller**