What does it take to make carbon stick around?

Introduction

Organic material in soil, a mixture of decomposed plant and animal matter, is a crucial source of carbon storage and plays a central role in the carbon cycle. This process is influenced by several factors, including climate, plant communities, and the chemical composition of the material. Climate change can alter temperature, humidity, and plant communities, all of which affect the decomposition rate of organic matter. Fungal necromass is rich in resistant compounds like chitin and glucan, which make it decompose more slowly than plant-based material. This slow decomposition plays a significant role in soil carbon storage.

Understanding how climate, plant communities, and the quality of organic material affect decomposition and carbon storage is essential for predicting and managing soil carbon reserves in the face of climate change

Method

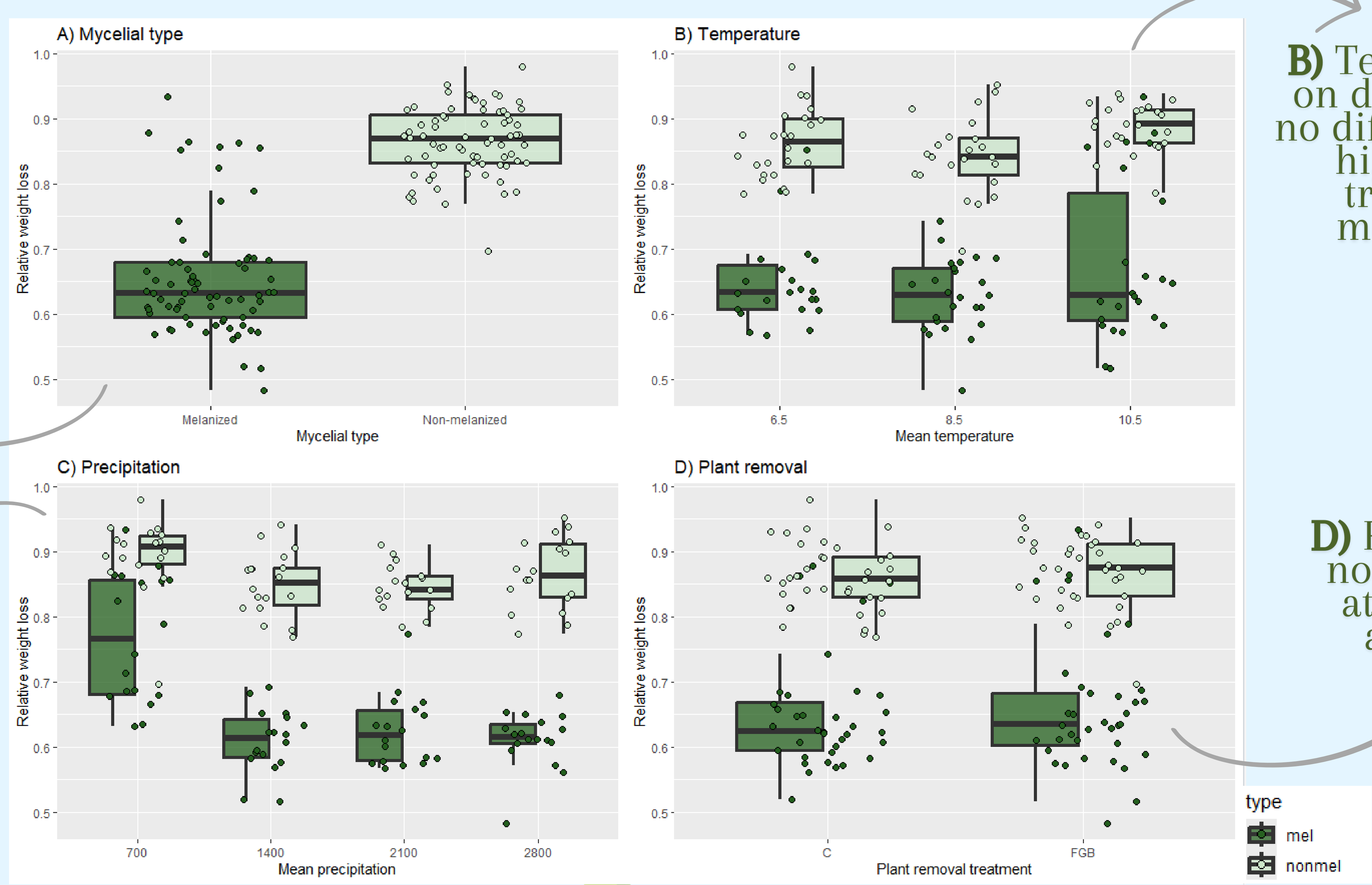
Field work) The study was conducted at 12 semi-natural grassland sites in Western Norway, representing three levels of mean annual summer temperature and four levels of mean annual precipitation. From 2015 to 2022, a plant removal experiment was carried out at these sites, where all vegetation (including forbs, graminoids, and bryophytes) was removed from the plots each year, with the removal repeated three times per site. In addition, mesh bags containing different types of organic matter (non-melanized mycelium or melanized mycelium) were buried in each plot in August 2021 and retrieved in August 2022 to measure decomposition by weight loss.

Lab work) First, I sterilized all the equipment to prevent contamination. I labeled and weighed Falcon tubes, then filled them with cleaned necromass. After recording the weights, I sealed the tubes, placed them in foam holders, and stored them in the freezer. The samples were freeze-dried for 48 hours, then I re-weighed them to determine their dry weight. Finally, I resealed the tubes and stored them for further analysis.

Results

A) Relative weight loss was significantly higher for non-melanized fungal necromass than for melanized necromass. Non-melanized necromass, with its open structure, facilitates faster decomposition, while melanin in melanized necromass requires more energy for maintenance, slowing decomposition

B) Temperature had little effect on decomposition, with almost no differences observed between high and low temperature treatments for both non-melanized and melanized necromass.



C) Lower precipitation resulted in higher weight loss, with melanized necromass showing a stronger response to reduced moisture. Non-melanized necromass was less affected by changes in precipitation

D) Removal of plants had little to no effect on the decomposition at all for both non-melanized and melanized necromass.

Conclusion

Our findings show that fungal necromass with high melanin content decomposes more slowly than melanin-free necromass, potentially contributing to enhanced carbon storage in soils. Melanin's protective properties likely reduce microbial decomposition rates, leading to slower breakdown of fungal biomass. This slower decomposition may result in more carbon being retained in the soil over time, as melanin-rich necromass resists microbial degradation more effectively than non-melanized necromass. Given the role of fungal necromass in soil carbon dynamics, these results highlight the importance of fungal melanin in regulating carbon cycling and storage.
As climate change impacts decomposition processes through shifts in temperature, humidity, and plant communities, understanding the chemical composition of organic matter—such as melanin content—can provide valuable insights into managing soil carbon reserves in a changing climate.

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