Microorganisms' climate adaptation can slow down global warming

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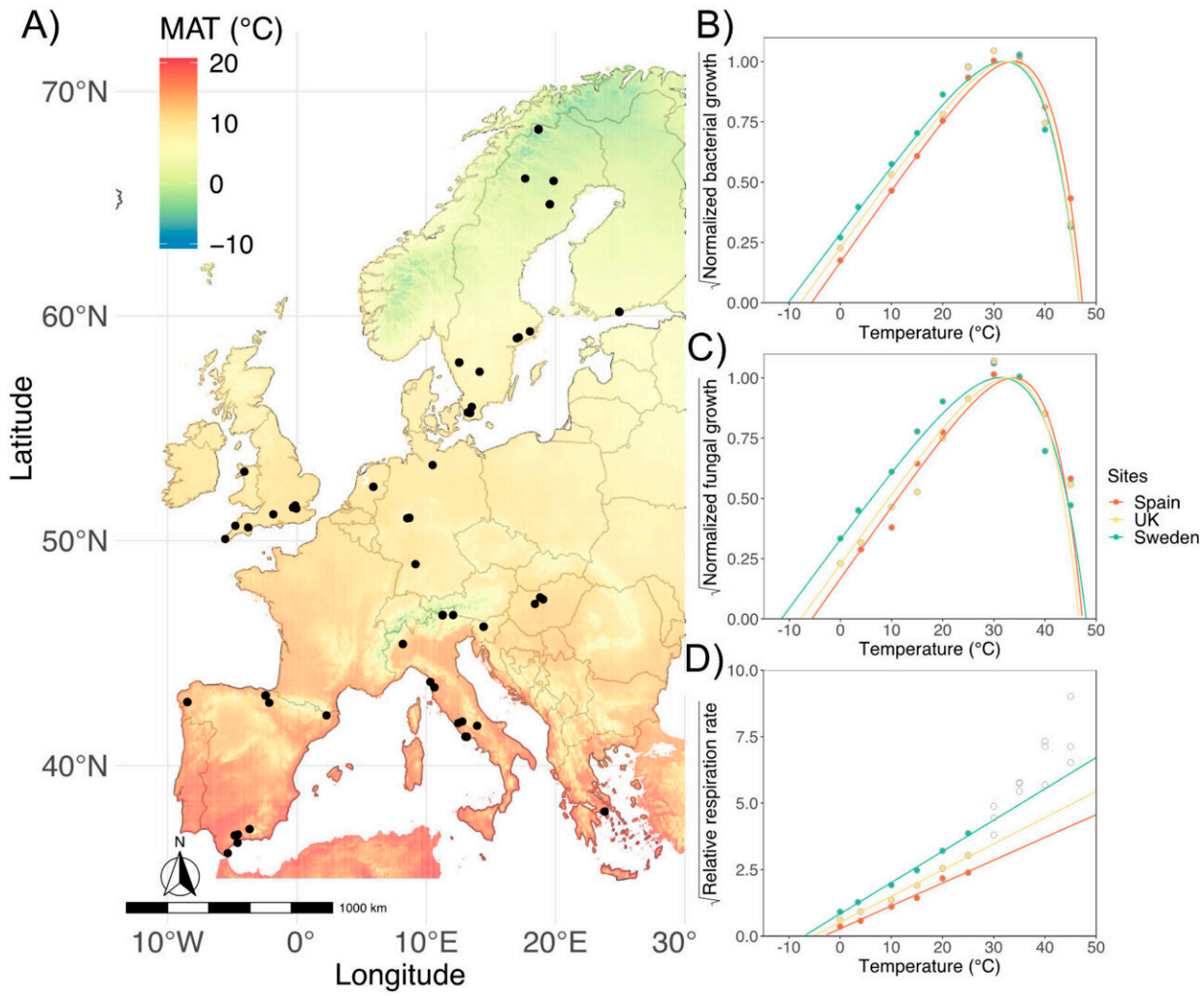

(A) Soil sampling points across a European gradient. Colors represent the historical mean annual temperatures (MAT) between 1970 and 2000. More information on the sampling sites is presented in Table S1. (B to D) Temperature relationships for square root transformed rates of (B) bacterial growth, (C)

fungal growth, and (D) respiration rate in a comparison of three selected contrasting sites from the 72 collected across Europe. The orange site is in Spain with a MAT of 17.4°C, the yellow site is in the United Kingdom (UK) with a MAT of 10.3°C, and the green site is in Sweden with a MAT of 6.5°C. Bacterial and fungal growth rates are normalized to the optimum temperature (T_{opt}) for growth. Due to normalization, the microbial growth is unit-less. Fitted curves are based on the Ratkowsky model. Below the T_{opt}, square root transformed rates showed a linear response to the screening temperature. Unlike bacterial and fungal growth, the respiration rate did not reach a temperature optimum or maximum in the studied incubation temperature interval. Therefore, the simplified square root relationship was used. The open circles in panel D indicate the excluded data points for the linear fitting. Credit: *Applied and Environmental Microbiology* (2023). DOI: 10.1128/aem.02090-22

A new study from Lund University in Sweden shows that the ability of microorganisms to adapt to climate warming will slow down global warming by storing carbon in soil.

In the study, researchers collected soil samples from across Europe in a wide range of temperatures, from minus 3.1°C to 18.3°C. The samples revealed that microorganisms in soils—such as bacteria and fungi—are strongly adapted to their local climate when it comes to growth and respiration. However, the researchers surprisingly demonstrated that microorganisms can adapt to temperature changes. The organisms can even benefit from these changes.

"Despite decades of scientific pondering, researchers have not been able to determine whether microorganisms can adapt to warming, and if they do. We can now confirm that this is the case, and that the organisms can actually mitigate climate warming," says Carla Cruz Paredes, a biology researcher at Lund University.

The new study, published in the journal *Applied and Environmental Microbiology*, also reveals that groups of microorganisms react differently to warming. Bacteria and fungi differ in their sensitivity to temperature changes, with bacteria being more sensitive than fungi. Moreover, microbial growth is more sensitive to temperature changes than respiration. These differences in temperature sensitivity have important implications for predictions of future carbon losses and storage, as well as how the soil is affected by climate warming.

"The outcome of these varying sensitivities to growth and respiration at different temperatures, and between bacteria and fungi, will impact the carbon balance between the soil and the atmosphere, and thus the soil's feedback on climate warming," says Carla Cruz Paredes.

The study highlights the importance of accurately representing microbial responses to climate warming in models of soil carbon content. The research also shows that ecological responses from the Earth's microorganisms will play a key role in regulating the planet's climate.

"Climate warming is one of the biggest threats to our environment. To mitigate global warming, it is necessary to enhance the soil's ability to store or sequester carbon and reduce carbon emissions into the atmosphere. This study is a step forward in providing better predictions for the assessments of the UN's climate panel," says Carla Cruz Paredes.

More information: Carla Cruz-Paredes et al, Variation in Temperature Dependences across Europe Reveals the Climate Sensitivity of Soil Microbial Decomposers, *Applied and Environmental Microbiology* (2023). DOI: 10.1128/aem.02090-22

Provided by Lund University

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