An alternative to adapt, migrate or die: insights into microbial enhanced plants resilience to warming

[1]David J. Weston, [1]Alyssa A. Carrell, [2]Richard J. Norby, [3,4]Jeremy Schmutz , [5]Jonathan Shaw, [2]Paul Hanson

[1]Biosciences Division and Climate Change Science Institute, Oak Ridge National Laboratory, [2]Environmental Sciences Division and Climate Change Science Institute, Oak Ridge National Laboratory, [3]HudsonAlpha Institute for Biotechnology, Huntsville, AL 35806, USA; [4]Department of Energy Joint Genome Institute, Lawrence Berkeley National Lab, Berkeley, CA, USA, [5] Duke University, Durham, NC 27708, USA

Contact: (westondj@ornl.gov)
Project Lead Principal Investigator (PI): Paul J. Hanson
BER Program: ESS
Project: ORNL Terrestrial Ecosystem Science SFA
Project Website: https://mnspruce.ornl.gov/

The onset of changing climatic conditions is eliciting research in the resilience of ecosystems to challenging environmental conditions. Initial results from such studies have led to the generalization that many plant species will have to either adapt or migrate in order to avoid extinction. However, species interactions, such as those mediated by microbes may provide an alternative approach. Here, we use a microbiome transfer approach to test if microbiome thermal origin influences host plant thermotolerance. We leveraged an experimental whole-ecosystem warming study to collect field grown *Sphagnum*, mechanically separate the associated microbiome and then transfer onto germ-free laboratory *Sphagnum* for temperature experiments. Host and microbiome dynamics were assessed with growth analysis, chlorophyll-*a* fluorescence imaging, metagenomics, metatranscriptomics, and 16S rDNA profiling. Microbiomes originating from warming field conditions imparted enhanced thermotolerance and growth recovery at elevated temperatures. Metagenome and metatranscriptome analyses revealed that warming altered microbial community structure in a manner that induced the plant heat shock response, especially the Hsp70 family and jasmonic acid production. The heat shock response was induced even without warming treatment in the laboratory, suggesting that the warm-microbiome isolated from the field provided the host plant with thermal preconditioning. Our results demonstrate that microbes, which respond rapidly to temperature alterations, can play key roles in host plant growth response to rapidly changing environments.