Paper ID: 89167
oral

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Biology in Space (8)

Author: Dr. Borja Barbero Barcenilla
Texas A&M University, United States

GROWING BEYOND EARTH: TELOMERE TALES OF ARABIDOPSIS THALIANA IN LUNAR REGOLITH SIMULANT AND ON THE INTERNATIONAL SPACE STATION

Abstract

NASA envisions sustainable colonies on the moon and on Mars by 2050, and plants will play pivotal roles in these endeavors. Here we investigate how the telomeres and telomerase of Arabidopsis thaliana are impacted by space flight and growth on extraterrestrial soil simulants. We report that telomere length is steady in plants grown on the International Space Station (ISS), although telomerase enzyme activity is strongly induced, increasing by up to 150-fold in roots. Ground-based studies affirmed telomerase activity is elevated in Arabidopsis by diverse environmental stressors, and this induction is independent of telomere length changes. There was a strong inverse correlation between genome oxidation and telomerase activity levels, suggesting plant telomerase may harbor a redox protective role that can help to facilitate survival in harsh environments. Recent studies show that A. thaliana can be successfully cultivated in lunar regolith, but arrests at a terminal vegetative state and activates multiple stress responses. We found that pre-washing the simulant with an antioxidant cocktail facilitated seed setting and viable second-generation plants, but plants grown in lunar regolith simulant displayed increased genome oxidation and reduced biomass compared to Earth soil cultivation. Moreover, growth in lunar regolith simulant resulted in progressive telomere shortening and reduced telomerase enzyme activity for a variety of different A. thaliana accessions and in a variety of different regolith simulants. These findings highlight both the promise and the challenges of ensuring genome integrity for successful plant growth in extraterrestrial environments.