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STUDYING PLANT-MICROBE INTERACTIONS USING THE CYANOBACTERIA ARTHROSPIRA PLATENSIS: THE EFFECTS OF GROWTH IN SIMULATED LUNAR/MARTIAN REGOLITH AND HIGH CO2 CONCENTRATION ENVIRONMENTS.

Abstract

A key element for sustainable off-world habitation is the ability to grow food through in-situ resource utilization (ISRU). The space environment creates many unique challenges to plant growth which must be mitigated for space agriculture to succeed, including high CO2 environments, the use of available resources such as regolith, and non-terrestrial gravity. Growth substrates are required to promote healthy plant growth using in-situ regolith, which is not nutritive, in the high CO2 environments of confined space habitats and the low gravity of the Moon/Mars. Bio-regeneration using algae is a promising avenue for supporting plant growth with ISRU as it can potentially mitigate the lack of nutrients, alkalinity, heavy-metal contamination, poor water-carrying capacity, and presence of perchlorates in regolith as well as increase plant growth at high levels of atmospheric CO2. The blue-green cyanobacteria Arthrospira Platensis, or Hawaiian Spirulina® is an exceptional candidate for use in space environments due to its temperature and radiation resistance, nutritional properties, pharmaceutical applications, and ability to reclaim wastewater. It is a promising bio-fertilizer which has been shown to improve plant growth and nutritional levels even in heavy metal contaminated, highly alkaline terrestrial soils. Our research is a large-scale investigation of the efficacy of Hawaiian Spirulina® to enhance the growth of Raphanus sativus (Organic Daikon radish) microgreens using simulated Lunar and Martian regolith. We present preliminary results for a range of regolith-soil mixtures and Spirulina concentrations and evaluate growth in environments with increased levels of CO2 using both a laboratory setting and a terrestrial analog habitat which mimics the closed environments in space exploration, allowing evaluation of plant growth in an authentic, high CO2 environment. This research furthers the development of in-situ resource utilization in support of NASA's space exploration goals.