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COMPARISON OF PLANT GROWTH BETWEEN SELF-WATERING POTS WITH LUNAR REGOLITH SIMULANT AND HYDROPONIC SYSTEM.

Abstract

Green space gardens are crucial for enabling long term space missions on the Moon, Mars and other planets. The primary purpose is to provide fresh food that is rich in easily absorbed nutrients, vitamins, biomass, oxygen, and carbon dioxide, and also to reduce storage time for prepared food, which tends to deteriorate over time. However, there are several challenges associated with cultivating plants in space, as space radiation and limited access to water and nutrients. To address these challenges, hydroponic and regolith-based cultivation systems are the most promising options for future space missions. Based on past research, the current project aims to conduct a thorough analysis and comparison of the growth of various plant species simultaneously in hydroponic and regolith-based systems under diverse light and radiation conditions. The seeds have been exposed to intense high-energy radiation at Aerial Structure in Strasbourg to investigate the impact of cosmic radiation on plant growth under space-like conditions. This project employs an experimental approach to implement two types of agricultural systems in the Self-deployable Habitat for Extreme Environments (SHEE) at the International Space University (ISU) in Strasbourg, France. A quantitative approach is adopted, utilizing data gathered from an Ocean Optics USB-4000 spectrometer, thermometers, photometers, pH meter, humidity and CO2 probes. The sprouting, growth and adaptability have been for three different species: Iceberg Batavian Leafy Lettuce, Jardinier Lettuce and Roman Chamomile. We measured leaf size, crop height, root length, number of sprouted plants and of leaves per plant. The extent of chlorophyll production is monitored using in-situ spectroscopy. Six self-watering pots with regolith EAC-1A soil were connected using cotton ropes to a water container enriched with fertilizer. A second set of pots containing traditional soil has been irrigated with the same system but with a reservoir of water only. As for the hydroponic system, it is based on the Nutrient Film Technique. The first experimental round uses seeds irradiated at different levels: 0.1, 0.5, 1.0 and 2.0 Gy. The second round uses seeds not exposed to radiation. In all the experiments, the plants have been exposed to blue, red or a combination of both wavelengths (ranging from 380 to 800 nm). This project is under development with a goal to obtain results by the end of March 2023 and the outcomes of this investigation are expected to offer essential insights into the kinds of agricultural practices that could be employed for forthcoming planetary missions.