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EFFECTS OF LOW-EARTH ORBIT ON GROWTH OF A PHOTOSYNTHETIC MICROORGANISM

Abstract

The University of Manitoba Space Applications and Technology Society (UMSATS) is preparing a nanosatellite that will carry a biological payload consisting of the cyanobacterium, Anabaena cylindrica and materials necessary to sustain its growth in low-earth orbit (LEO). Previous evidence demonstrates that A. cylindrica can tolerate certain extreme conditions which suggests that it could be utilized as a model organism for experiments in LEO. Current studies are harnessing the carbohydrate producing capabilities of Anabaena species (sp.) and past studies have explored the possibilities of employing the oxygen producing capabilities of cyanobacteria such as Anabaena in bioreactor systems for future uses in human-sustaining life support systems. Experiments have shown that the resting cell state of A. cylindrica (Its akinete form.) can be regenerated on earth upon returning from exposure to the solar radiation and microgravity in LEO. This experiment aims to evaluate the growth capabilities of A. cylindrica while still in exposure to the conditions of LEO. Necessary apparatus will provide required nutrients, growth conditions, and mechanisms for re-germination as well as varying degrees of shielding from solar radiation. The payload module will carry an array of identical growth chambers. Following various durations of exposure to solar radiation and microgravity, akinetes will be provided growth-stimulating conditions. Such conditions include selective stimulation of randomly defined BG-11 and akinete containing compartments with light and heat. Growth of A. cylindrica will be assessed with photodiodes detecting the absorbance of light supplied by LEDs. The photodiodes will be used to monitor levels of chlorophyll autofluorescence within each chamber as an approximation of growth. In addition, cell quality will be assessed by measuring the absorption of wavelengths known to correspond to the health of microbes. Results will be made by comparing an enclosure containing growth-stimulated A. cylindrica to a negative control. This experiment will provide an opportunity to investigate the details of re-germination and growth of A. cylindrica in the environment of LEO. A better understanding of A. cylindrica growth capabilities in LEO can be utilized for more complex studies of multi-trophic level interactions involving bacterial producers and other model organisms for space experimentation such as tardigrades. The conclusions will be the groundwork for future experiments utilizing A. cylindrica as a component of a larger ecosystem.