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EFFECTS OF MICROGRAVITY AND SOLAR RADIATION 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 determine the re-germination, growth and oxygen producing capabilities of A. cylindrica during 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 provide both shielded and unshielded growth chambers, and following various durations of exposure to solar radiation and microgravity akinetes will be provided growth-stimulating conditions. Such conditions include selective re-hydration of pre-defined compartments with BG-11 nutrient containing media and a continuing supply of oxygen, nitrogen, and carbon dioxide gases. Growth and oxygen producing capabilities of A. cylindrica will be assessed with a fluorometer and imaging techniques, respectively. A fluorometer will monitor levels of chlorophyll autofluorescence while imaging techniques will monitor the rate of iron filing oxidation within each growth chamber. Comparisons will be made between an enclosure containing growth-stimulated A cylindrica relative to a baseline control. This experiment will provide an opportunity to assess the overall ability to re-germinate and monitor the growth levels 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.