Turning the Red Planet Green: Study of Cyanobacteria/Algae Growth Kinetics Coupled with Hydroponics Applications for Terraforming and Settling on Mars

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This project examined how cyanobacteria/algae might exist under Martian simulated conditions, helping convert Mars' most abundant gas CO_2 into oxygen; thus paving the way for possible settlement in the future. Furthermore, this project involved the innovative incorporation of the lysed cyanobacteria/algae nutrients into hydroponics to sustain future colonies on Mars by evaluating the growth of basil plants as potential food source. Decline in cell viability with increasing UV exposures was observed with 10.3% reduction occurring in as short as 10 minutes. Regression equation showed excellent fit with extrapolation to complete cell deaths occurring at 2.9 days of exposure. Thin film of Martian regolith provided protection with a 171% increase in cell counts over a day. Additionally, the cyanobacteria/algae were lysed and nutrients incorporated in homemade hydroponic systems. Hypothesis was partially supported in that although hydroponic fertilizer was found to promote best growth, basil plant growth was unexpectedly sustained utilizing just lysed Scenedesmus (72% vs. optimal) and lysed Spirulina (31% vs. optimal). Pressure-induced lysing produced 61% better plant growth statistically ($p<0.05$) than freeze-thaw lysing. Different hydroponic systems were tested with Deep-Water-Cultures growing 340% better than Thin-Film-Nutrients. Statistical differences were not seen ($p=0.699$) between plants grown in excessive CO_2 versus typical levels. Initial growth were observed on Martian soil, but not sustained. No studies have been found that have utilized lysed cyanobacteria biomass into hydroponic systems as nutrients to grow food crops. Hopefully, results/ideas tested in this project will expand the knowledge/options to fulfill the vision for sustained human presence on Mars.

Awards Won:

Third Award of $1,000