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THE APPLICATION OF RADIATION, MICROOXIC, AND COLD-DROUGHT CHALLENGES IN SIMULATED INORGANIC MARTIAN REGOLITH WITH CYANOBACTERIA FOR SELECTIVE BREEDING OF FOOD AND GRAIN CROP A. HYPOCHONDRICUS FOR INTERPLANETARY HUMAN EXPLORATION MISSIONS.

Abstract

The highest priority health risks for a human expedition to Mars include carcinogenesis, cardiovascular disease, and immune dysregulation induced by space radiation (1). These health risks can be mitigated to some extent with a properly adapted diet. Food crop growth and safety aboard the ISS have been studied extensively (3). In this project, we will test the hypothesis that selective breeding of Amaranthus hypochondricus in simulated Martian regolith previously inoculated with radiation-resistant, photoautotrophic, and diazotrophic cyanobacteria will result in a viable drought- and radiation-resistant primary producer of nutrient-rich vegetative and grain biomass. A. hypochondricus is a member of the Amaranthaceae and a valued source of food in many countries. Its leaves and seeds are a nutritious food source (1). If adapted to extraterrestrial conditions for growth, this plant could serve as a healthy food source during space travel and exploration of the Martian surface. Photosynthesis and nitrogen fixation are the two most vital metabolic activities that sustain life on Earth. Food crop adaptation to harsh and changing environments, including drought resilience and resistance to space radiation, will be necessary during human exploration of Mars. In order to properly simulate the regolith, food crops must adapt to for survival in relevant regolith. Creation of our own iron oxide and perchlorate regolith, sterilizing the inorganic matter and then inoculation with cyanobacteria followed by the above challenges will be used to produce a topsoil suitable for selective breeding of food crops with greater genomic plasticity than is present in crops currently used for large-scale monoculture to allow the development of adaptations to the new environment and resilience to harsher conditions during plant growth (3, 4).

It is important for students to understand the need to explore these dangers and to find possible solutions in an innovative way. Human Exploration of the Planet Mars can give students insight into efforts to correct the detrimental impact of past human activities. Illustrating how they have placed the ever-increasing human population at great risk for world-wide famine (2). Importantly, the concept of careful and strategic experimental activities under containment during human exploration of Mars illustrates to students not only the importance of investigative science, but also its applicability to urgent needs.