

Abstract:

Long-duration missions to Mars will be required to sustainably produce food, reducing reliance on the pre-packaged, nutrient degrading supplies. This project presents a hybrid powered greenhouse for growing renewable food sources for astronauts while using the Martian environment. The greenhouse uses both solar and wind power to allow it to operate continuously despite Martian dust storms and low levels of sunlight. The research examines if a controlled greenhouse environment can increase caloric intake and diet variety when compared to existing spaceflight food systems. The greenhouse will incorporate hydroponic and soil based plant growth, water recycling technology and nutrient cycling using organic waste and insect larvae as supplements. In addition, the greenhouse will examine liquid nutrient delivery systems (as opposed to traditional vitamin pills) to increase nutrient absorption in space. The methodology will focus on the design and feasibility of the system and how it is impacted by the environmental constraints of radiation, temperature extremes and low atmospheric pressure. The main variables included in the methodology will include crop yield, energy efficiency and nutrient density. Although the full experimental data has not been collected, preliminary results indicate that the integration of renewable energy with controlled agriculture will greatly improve the health and mission sustainability of astronauts. This research will contribute to the development of closed-loop life support systems necessary for long-term human presence on Mars. This technology will also provide a basis for developing sustainable agricultural practices in extreme environments on Earth.