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Ground-Based Preparatory Activities (11)
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Author: Mrs. Emma FORGUES–MAYET
France

Mr. Hugo CASTAING
France
Dr. IOANA-ROXANA PERRIER
Institute of Polytechnic Science and Aeronautics (IPSA), France
Prof. Bernard Foing
ILEWG "EuroMoonMars", The Netherlands
Dr. Agata Kolodziejczyk
Analog Astronaut Training Center, Poland
Mr. Quentin Gouault
France
Mr. Théo Podolsky
France

NON-CIRCULATIVE HYDROPONICS TO PRESERVE PLANT HEALTH DURING A LONG-TIME POWER FAILURE IN A SPACE COLONY

Abstract

Aquaponic systems could be the key to growing fresh food to sustain future lunar or Martian colonies. These systems are based on the following principle: growing vegetables in water, without the use of soil. An Aquaponic system uses fish's droppings to fertilize the plants thanks to nitrifying bacteria. On future long-duration missions on the moon, fresh-grown plants could be used to supplement meals thanks to these systems. An aquaponic system produces higher yields than soil-based agriculture while saving up to 90 % more water. While relatively low, power is needed to run these installations (pump to circulate the water and lights to illuminate plants). During the EMMPOL analogue astronaut mission with EuroMoonMars group, from October 15 to 30, 2020, we simulated an electrical generator long time failure. Should this situation occur in a space colony, astronauts would have to turn off non-vital life support equipment. Therefore, the aquaponic system's power supply would have to be turned off to reduce the electricity consumption in the base if deemed necessary. Hereby we describe a method to maintain plants in a sustainable state during the power failure. We transferred plants from the aquaponic system to a non-circulating hydroponic system (which does not require electrical supply) using a method described by B.A. Kratky from the Hawaii institute. The experiment was carried out with watercress considering the short duration of the mission compared to plant's growth time. The simulation's goal was to study the evolution of water's key parameters (pH, NO2, NO3). This would determine whether the plants can be put back in the aquaponic system without disrupting the balance of the system once electrical power is no longer limited. We measured the pH, nitrites (NO2) and nitrates (NO3) rates just after the transfer and six days after the transfer. We observed that the rates tend to remain stable, albeit with a slight decrease in the pH and the nitrites rates. However, 6 days after the transfer, these control parameters where still in the expected (if not optimal) range for an aquaponic system. Therefore, the plants and the water could be transferred back in the aquaponic system when electrical power is regained. With non-circulating hydroponic system, the astronauts could maintain the plants health and reduce the probability of crop failure.