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BIOSYSTEMS TO FEED ON MARS: CONSIDERATIONS ABOUT HIGH-PERFORMANCE SYSTEMS FOR OPTIMAL SPACE GREENHOUSE OPERATION

Abstract

Exploring the red planet will be a motivating factor to carry out off-planet food production with improved outcomes. At the same time that will be necessary to meet the food demand of the astronauts, an ecosystem with minimized losses and resource saving will give support for a sustainable long term human presence in space. While dealing with the challenge of growing crops in space, the combination of novel technological trends for agriculture can be an absolute game-changer throughout the human establishment process on Mars. Most of the experience generated by scientists and growers on Earth can impose certain requirements on technologies that will support plant growth, and will empower astronauts' wisdom on growing processes. By assuming a coherent deployment for plant biology with the integration of environmental monitoring, resource planning and operational capabilities for indoor crop cultivation, the greenhouse subsystems can follow the path to improve astronauts' labor performance. To sum up, adopting proper hardware and software innovative tools, such as: vertical farming; automated devices; Internet of Things (IoT) sensors; robotics; computer vision; Artificial Intelligence (AI) and Machine Learning (ML); astronauts will be capable to accurately monitor and control specific issues on agricultural activities. Said that, this paper focuses on analyse and discuss the integration of space-based solutions with the use of smart agriculture. Giving emphasis on current food experiments on Earth, future manned missions to Mars will be able to provide a remote farming control, improve task management, avoid organic wastes, reduce costs, increase crop yield, improve sustainability, boost food nutrition and ensure safe production inside of Bioregenerative Life Support Systems (BLSS). With that, focusing on life support routines will provide a better understanding of how to overcome the main issues on space farming and will drive value on crew workload. This will stimulate the development of solutions with optimal operation to achieve a feasible plant growth in space.