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PRACTICAL DESIGN OF A NOVEL TECHNIQUE FOR USING FOGPONICS IN EARTH-BOUND AND MICROGRAVITY ENVIRONMENTS

Abstract

With the rising worldwide interest in crewed deep space exploration, many small-scale in-situ food production solutions are being trialled. At the same time, a growing commercial Vertical Farming market is providing a vast proving ground for innovations, testing aspects of reliability, serviceability and efficiency at both small and large scales. Most irrigation solutions, especially in the commercial market, are focused around Hydroponic or Aeroponic technologies, which are often easier to use in an earth-bound environment, but become more difficult to adapt for use in a micro-gravity environment due to, among other factors, the large volumes of irrigation solution involved. There is a number of alternative irrigation technologies, including fogponics. In a space mission context, Vertical Farming designs also require a higher degree of reliability and serviceability, including the ability to be operated and maintained by non-expert personnel.

In this report, a fogponic irrigation design that can be applied to both Earth-based and space mission environments is presented. The design is based around a fog and liquid loop, including an array of ultrasonic atomisers and a condenser fan. The placement of the components is designed to provide slight negative pressure around the fixation locations of the plants, reducing the possibilities for leaks from the system. An overview of the basic functioning principles and a functional prototype of the system are described, as well as tests with various live plant species at different stages of maturity. Additionally, the results of a trial of the design in laboratory and non-laboratory commercial environments are provided. This includes a track record of failures, defects and other miscellaneous issues, an assessment of the general serviceability of the design, as well as an assessment of the ease of use by expert and non-expert users. Finally a future path to adapting the technology for use in microgravity is proposed.