µG-LilyPond™: Preliminary Design of a Floating Plant Pond for Microgravity

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Versatile, reliable, and efficient space crop production systems can provide nutritional supplementation and a psychological benefit to the crew, while potentially reducing the mass of food provision for long duration space exploration missions. Aquatic plants have enormous potential to provide atmosphere regeneration, edible biomass production, biofuel generation, and even metabolic wastewater treatment, but been little studied as potential food crops for space applications. µG-LilyPond™ is an autonomous environmentally controlled floating plant cultivation system for use in microgravity. The system expands the types of crops able to grow in space to include aquatic floating plants. µG-LilyPond™ is designed to have low maintenance, increased reliability with passive water delivery, volume efficiency, full life cycle support via vegetative propagation, close canopy lighting, and crop versatility. Through a NASA STTR Phase I project, Space Lab and the University of Colorado at Boulder established feasibility of floating aquatic plant cultivation in microgravity and developed the growth chamber system concept. In Phase II, the project team is developing a fully functional engineering demonstration unit (EDU) that will be used to verify and validate the µG-LilyPond™ design. The EDU will demonstrate low-TRL technologies (water transport, nutrient medium recycling, harvesting, close canopy PAR delivery, and radiant heat dissipation), as well as extensibility to support higher rooted plants. Finally, the µG-LilyPond™ water transport and harvesting capabilities will be tested in a relevant microgravity environment via a Blue Origin suborbital flight. This paper reviews the µG-Lilypond™ growth chamber system concept, performance predictions, and prototype demonstrations to date.

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