

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
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AGRIFUGE: AN EXPLORATION OF CONTROLLED IRRIGATION METHODS FOR A ROTATING
PLANT HABITAT**Abstract**

As humanity explores deeper into space, long duration missions will require horticulture activities to provide food, oxygen, and psychological benefit to astronauts. On-orbit horticulture allows for decreased launch mass as survival necessities are grown and produced during the mission as opposed to launching all required supplies. Additionally, tending to plants on-orbit can remind astronauts of Earth, relieving certain stresses of space isolation. This was seen during the previous VEGGIE experiments on the International Space Station (ISS). Even with the countless benefits of on-orbit horticulture, there are still many challenges that have to be solved before it can be integrated with confidence into missions. For example, the first VEGGIE experiments had trouble with their passive irrigation system. Our research explores a rotating horticulture enclosure that solves many of the issues encountered on previous experiments such as controlled irrigation and gravity directed growth. Rotation of the habitat provides artificial gravity within the environment. The artificial gravity can be used as an irrigation system that is tunable depending on rotation rate. Previous experiments have also used rotation as a method to remove water from roots to prevent mold. Lastly, plants such as vines, require a gravity vector to enable circumnutation in the cells, allowing them to climb. The rotating environment will allow future missions to expand their plant selection to items such as beans and pumpkins. Two version of our device were built, a manually rotated plant habitat and a automatically rotated plant habitat. These habitats were equipped with a water reservoir, irrigation channels, and a sensor suite that could detect water flow, soil humidity, and environment motion. These experiments were then flown on a Zero-G parabolic flight to test their performance in a microgravity environment. The manually rotated habitat tested the accuracy at which an astronaut could rotate the environment. This would determine how accurately irrigation rates could be controlled under fully manual actuation. The automatically rotated environment conducted a similar experiment to determine the accuracy with fully automated actuation. It also acts as a calibration to determine the flow versus spin rate of our system. Results conclude that both manually and automatically actuated rotation can achieve desired irrigation rates, with automatically actuated rotation providing more precision and accuracy.