

New perspectives for watering substrate-based root modules in microgravity in the Advanced Plant Habitat (APH)

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The Advanced Plant Habitat (APH) was installed on the International Space Station (ISS) in October 2017. Following a successful EVT (Experiment Verification Test) study at Kennedy Space Center (KSC), using *Arabidopsis* lines with varying levels of lignin, two inaugural studies were carried out on ISS in 2018 under the same experimental design, with the corresponding ground controls at KSC.

The APH for this study deploys a substrate-based root module designed for plant growth in microgravity. Upon experiment initiation (such as for the EVT), the root module is primed (liquid imbibition) by flooding the root zone to initiate seed germination and to remove air from the porous tubing and particulate media. In the APH ISS inaugural study, the speed of supplying water to initially dry media was found to adversely affect the overall moisture distribution within the root module in microgravity (but not at 1g). Non-destructive estimations of *Arabidopsis* plant growth were carried out by monitoring changes in rosette leaf area on a daily basis. These data indicated that the original priming procedure caused patchy moisture distribution that affected plant growth and survival.

An improved methodology for priming the second root module of PH-01 was devised and implemented in the second experiment. Leaf area and color estimates suggested that the modified priming scheme improved moisture distribution and plant growth. These data, when compared with the EVT study, suggest that nondestructive measurements of plant growth can aid towards optimization of plant growth conditions in microgravity.