Utilizing ARC EMCS Seedling Cassettes as Highly Versatile Miniature Growth Chambers for Model Organism Experiments

J.L. Freeman[1], M. Steele[2], G-S. Sun[2], D. Heathcote[2], S. Reinsch[3], J. DeSimone[4], Z. Myers[4]

[1] Intrinsyx Technologies Corporation, Space BioSciences Division NASA-Ames Research Center. Moffett Field, CA 94035 john.l.freeman@nasa.gov
[2] Lockheed Martin, Space BioSciences Division NASA-Ames Research Center. Moffett Field, CA 94035 marianne.k.steele@nasa.gov david.g.heathcote@nasa.gov gwo-shing.sun-1@nasa.gov
[3] Space Biosciences Division, NASA-Ames Research Center. Moffett Field, CA 94035 Sigrid.Reinsch@nasa.gov
[4] Universities Space Research Association (USRA) Space Biosciences Division, NASA-Ames Research Center. Moffett Field, CA 94035 zachary.a.myers@nasa.gov
[4] Universities Space Research Association (USRA), Space Biosciences Division, NASA-Ames Research Center. Moffett Field, CA 94035 julia.c.desimone@nasa.gov

The aim of our ground testing was to demonstrate the capability of safely putting specific model organisms into dehydrated stasis, and to later rehydrate and successfully grow them inside flight proven ARC EMCS seedling cassettes. The ARC EMCS seedling cassettes were originally developed to support seedling growth during space flight. The seeds are attached to a solid substrate, launched dry, and then rehydrated in a small volume of media on orbit to initiate the experiment. We hypothesized that the same seedling cassettes should be capable of acting as culture chambers for a wide range of organisms with minimal or no modification. The ability to safely preserve live organisms in a dehydrated state allows for on orbit experiments to be conducted at the best time for crew operations and more importantly provides a tightly controlled physiologically relevant growth experiment with specific environmental parameters. Thus, we performed a series of ground tests that involved growing the organisms, preparing them for dehydration on gridded Polyether Sulfone (PES) membranes, dry storage at ambient temperatures for varying periods of time, followed by rehydration. Inside the culture cassettes, the PES membranes were mounted above blotters containing dehydrated growth media. These were mounted on stainless steel bases and sealed with plastic covers that have permeable membrane covered ports for gas exchange. The results showed we were able to demonstrate acceptable normal growth of *C.elegans* (nematodes), *E.coli* (bacteria), *S.cerevisiae* (yeast), *Polytrichum* (moss) spores and protonemata, *C.thalictroides* (fern), *D.discoideum* (amoeba), and *H.dujardini* (tardigrades). All organisms showed acceptable growth and rehydration in both petri dishes and culture cassettes initially, and after various time lengths of dehydration. At the end of on orbit ISS European Modular Cultivation System experiments the cassettes could be frozen at ultra-low temperatures, refrigerated, or chemically preserved before being returned to Earth for analyses. Our results suggest that with protocol modifications and future verification testing we can utilize the versatile EMCS to conduct tightly controlled experiments inside our culture cassettes for a wide variety of organisms. These physiological experiments would be designed to answer questions at the molecular level about the specific stress responses of space flight.

Supported by: Directed Funding From NASA Space Biology Program