Enhancing Seed Viability for Space Travel with Silk Protein Polymers

Dhiman, Gareema (School: Logan High School)
Jung , Yae-won (School: Logan High School)
Nguyen, Andre (School: Logan High School)

Our 2016-2017 research found negative effects to radish seeds from a low-orbit, 30-day space flight and verified those results with independent treatments of beta radiation and vibration. For 2017-2018, we sought to protect radish seeds from vibrations and beta radiation with use of spider silk, which has been found to withstand molecular degradation during X-Ray diffraction. Silk coatings on seeds did not prevent damage caused by beta radiation but did reduce effects of vibration by improving germination rates. Enhanced growth of seedling roots that emerged from silk-coated seeds compared to uncoated seeds was documented with photographs on a light microscope (100x magnification). Effect of silk proteins on seedling growth was then investigated with Raman spectroscopy by comparing molecular components in the soil surrounding the roots. Soil near silk-coated seeds had a greater number and diversity of components than uncoated seeds. Soil components near the roots could contain nitrogen since silk proteins are combined with Early Growth Response (EGR) enzymes, a nitrogen provider. Silk foam could replace other growth mediums used on the international space station. Silk foam allowed seeds to be protected, germinated, and “fed” with a water-wicking texture similar to “packaging peanuts.” Seeds in foam had little-to-no germination and were presumed inviable due to preparation methods; after 3 days in foam, 4 control seeds were added. Within 24 hours, seeds originally encased in foam began germinating. By 144 hours 50% had germinated. Control seeds provided growth enzymes, which had been denatured by UV light and temperature changes during preparation.